Volume 16, Number 3

Print ISSN: 1533-3604
Online ISSN: 1533-3590

JOURNAL OF ECONOMICS AND ECONOMIC EDUCATION RESEARCH

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TABLE OF CONTENT

A DICHOTOMY: WHAT THE STATE OF LOUISIANA STATES IT IS DOING ABOUT ECONOMIC DEVELOPMENT AND WHAT IS ACTUALLY HAPPENING AT THE PARISH (COUNTY) LEVEL

Biruk Alemayehu, Southern University at New Orleans
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ABSTRACT

The top goal of economic development is to improve the economic wellbeing of a community and its residents. The main factors for economic development are viable community, business and local governments. Local governments are the catalyst and responsible for creating opportunities to enhance economic development and businesses are a backbone of Economic Development. In terms of business tax competitiveness, Louisiana currently ranks number two in the United States for new firms and number ten in the United States for mature firms, which has improved significantly over the past few years. Louisiana ranked No. 8 in the country in overall economic performance with strong job and income growth.However, there is a dichotomy with the data shown in the United States Census Data; the average median income in Orleans Parish is $36,681 and in the State of Louisiana the median income is $44,673. Coupled with this data is the poverty level in Orleans Parish which is 27.2% and in the State of Louisiana it is 18.7%. Whereas, in the United States the average median income is $51,371 with Maryland having the highest median income of $71,122 and Mississippi having the lowest at $37,095.

The above data reveals a disparity between the claims of the Louisiana Economic Development Agency and the actual numbers presented in the U.S. Census Data. Thus, this begs the question, the effectiveness of the state economic development program and its impact on the well-being of the citizens of the State of Louisiana, as well as, the local government agencies.

The purpose of this paper is first, to explore the local government economic development initiative to enhance economic development in the State of Louisiana for their specific areas. Second, to identify the coordination effort between local, regional and state economic development program. Third, to explore the types of programs offered by local governments.

INTRODUCTION

The top goal of economic development is to improve the economic wellbeing of a community and its residents. (lannone, 2007) The main factors for economic development are viable community, business and local governments. Local governments are the catalyst and responsible for creating opportunities to enhance economic development and businesses are a backbone of Economic Development. In terms of business tax competitiveness, Louisiana currently ranks number two in the United States for new firms and number ten in the United States for mature firms, which has improved significantly over the past few years (Louisiana Economic Development, 2012). Louisiana ranked No. 8 in the country in overall economic

performance with strong job and income growth. (Chambers of Commerce Foundation, 2013) However, there is a dichotomy with the data shown in the United States Census Data; the average median income in Orleans Parish is $36,681 and in the State of Louisiana the median income is $44,673. Coupled with this data is the poverty level in Orleans Parish which is 27.2% States the average median income is $51,371 with Maryland having the highest median income of $71,122 and Mississippi having the lowest at $37,095 (Noss, 2013).and in the State of Louisiana it is 18.7%. (U.S. Census Bureau, 2014) Whereas, in the United

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The purpose of this paper is first, to explore the local government economic development initiative to enhance economic development in the State of Louisiana for their specific areas. Second, to identify the coordination effort between local, regional and state economic development program. Third, to explore the types of programs offered by local governments.

The Louisiana Economic Development Agency has developed a 5-Year Strategic Plan beginning in 2014 to 2019 indicating their priorities are to:

1) Improve Louisiana's economic competitiveness;
2) Enhance community competitiveness;
3) Cultivate top regional economic development assets;
4) Focus on business retention and expansion;
5) Develop national caliber business recruitment capacity;
6) Cultivate small business, innovation, and entrepreneurship;
7) Develop robust workforce solutions; and
8) Aggressively tell our story. (Louisiana Economic Development, n.d)

The above is what the Louisiana Economic Development Agency states but what is actually happening in the various parishes is different when dealing with economic development.

RESEARCH QUESTIONS

To explore what each parish or groups of parishes are doing to enhance economic development for their specific areas, a list of questions were developed:

- Does the parish have an economic development office?
- What services does the parish use from the state economic development program?
- Does the economic development office have its own office either in parish government or in an outside venue (such as, a chamber of commerce)?
- How long has the parish economic development program been operating?
- Does the economic development office have a specific strategic plan?
- Does the economic development office have a person in charge (for example, a manager, director, etc.)?

- Does the economic development office offer incentives to a prospective business willing to locate in the parish?
- Does the parish economic development office offer incentives to prospective businesses?
- Does the parish economic development office have a formal economic development program for local, regional, national, and international businesses?
- Does the parish economic development office have an incubator to help small businesses?
- The demographics of the parish economic development office.
- Business opportunities produced in 2013 by the parish economic development office.
- Is there a plan to expand the parish's economic development program?

DATA COLLECTION

In the State of Louisiana there are sixty-four parishes, however, due to economic development clustering for the smaller population parishes there are fifty-four parishes with economic development agencies. Therefore, all fifty-four parishes, with existing economic development office agencies were interviewed.

In the first phase, the survey questionnaire was sent by email via Survey Monkey to all parish economic development offices, followed by a telephone interview for those who did not respond to the email. The telephone interviewer contacted the director and/or manager of the economic development parish office to respond.

Advanced Southern University at New Orleans business administration graduate students were used to conduct the survey supervised by the senior professor in business. Survey Monkey was used to collect the data.

RESEARCH RESULTS

Question 1: Does the parish have an economic development office?

Ninety-eight percent or fifty-three parishes indicated that they have an economic development office, whereas, only one parish indicated it uses the State of Louisiana Office of Economic Development.

Question 2: What services does the parish use from the state economic development program?

It is very interesting to report that only five parishes are using the services of the Louisiana Economic Development program:

- A program for tax incentives – 2 parishes
- An industrial park – 2 parishes
- Location and/or land incentives – 1 parish.

Thus, only nine percent of the Louisiana parish economic development agencies are utilizing the resources of the state agency.

Question 3: does the economic development office have its own office either in parish government or in an outside venue (such as, a chamber of commerce)?

Sixty-six percent of the Louisiana Economic Development Offices have their office located in parish government. Nineteen percent have their offices located in their local parish chamber of commerce and fifteen percent have offices elsewhere. (See Table 3)

Table 1
THE TYPE OF ECONOMIC DEVELOPMENT OFFICE IN THE PARISH

Type of Office	Percent	Number
Economic Development Office in Parish Government	66	35
Chamber of Commerce	19	10
Other	15	8
Total		53

Question 4: How long has the parish economic development program been operating?

The results of the study reveal that the parishes in the State of Louisiana have a very young economic development program. As shown in Table 2, only nine percent of the economic develop offices have been open over ten years and only fifteen percent of the office have been open six to ten years. Over seventy-four percent of the offices have been opened one to five years and one parish just opened an office.

Table 2
THE LENGTH OF PARISH ECONOMIC DEVELOPMENT PROGRAM

Length	**Percent**	**Number of years**
Less than a year	2	1
1 to 5 years	74	39
6 to 10 years	15	8
Over 10 years	9	5
Total		**53**

Question 5: Does the parish economic development office have a specific strategic plan for economic development?

Over ninety-eight percent of the parishes' surveyed indicated they do have a specific strategic plan for economic development.

Question 6: Does the economic development office have a person in charge (for example, a manager, director, etc.)?

Again, ninety-eight percent of the parishes have a person in charge of their economic development office.

Question 7: Does the economic development office offer incentives to a prospective business willing to locate in the parish?

Only one parish interviewed in the State of Louisiana does not offer incentives to a prospective business willing to locate in the parish, however, fifty-two parishes do offer incentives. One parish abstained from answering this question.

The results of the research study revealed that seventy-two percent of the parishes offer training programs, such as, developing business plans. Ten percent of the parishes offer some form of incentive to prospective businesses desiring to locate in the parish and twenty- two percent of the parish offices offer special programs for small business. (See Table 3)

All parish economic offices claim that they offer advocacy and promotion for business development.

Table 3
THE ECONOMIC DEVELOPMENT PROGRAMS

Programs	**Percent**	**Number**
Training Programs - (such as, business plan development, how to obtain a DBE, etc.)	72	37
Incentives	10	5
Special Programs for Minorities	0	0
Special Programs for Women	2	1
Special Programs for Handicapped	6	3
Special Programs for Veterans	0	0
Special Programs for Small Business	22	11
Other:	2	1
Total		**51**

In addition, forty parishes (seventy-seven percent) offer an industrial park incentive, please see Table 4. Fourteen parishes offer a tax incentive program for prospective businesses. Only two parishes offer location and/or land incentives and no parish offer a monetary incentive. (See Table 4)

Table 4
THE ECONOMIC DEVELOPMENT PARISH INCENTIVE PROGRAMS

Incentives	**Percent**	**Number**
A program for tax incentives	27	14
A program for monetary incentives	0.	0
An industrial park	77	40
Location and/or land incentives	4	2
Total		**52**

Question 8. Does the parish economic development office have a formal economic development program for local, regional, national, and international businesses?

As shown in Table 5, the vast majority of the parish economic development offices have a formal economic development program for national businesses, whereas, only a few parish economic development offices offer local, regional, and international programs.

Table 5
PARISH ECONOMIC DEVELOPMENT PROGRAMS

Economic Programs	Percent	Number
Local	12	6
Regional	12	6
National	79	41
International	6	3
Total		**52**

Question 9. Does the parish economic development office have an incubator to help small businesses?

Eighty-three percent of the Louisiana parishes offer an incubator program to help small businesses. The study showed that over thirty percent of the parishes have indicated that the economic development office has over five incubator offices in the parish. It is interesting to note, one hundred percent of the Louisiana parishes that answered this question, offer incubator services for a business office and no parish provides an incubator for manufacturing facility.

Question 10. The demographics of the parish economic development office.

Per Table 6, thirty-one parish offices have seven or over employees; sixteen parishes have between four and six employees; and six parishes have three or fewer employees.

Table 6
NUMBER OF EMPLOYEES IN PARISH ECONOMIC DEVELOPMENT OFFICE

Employees	Percent	Number
1 Person	4	2
2 People	6	3
3 People	2	1
4-6 People	30	16
7-10 People	30	16
Other:	28	15
Total		**53**

Twenty-eight parishes (fifty-three percent) have an economic development budget of less than $100,000. (See Table 7) Only one parish has an economic development budget of $500,000 and above.

Table 7 THE BUDGET OF PARISH ECONOMIC DEVELOPMENT OFFICE		
Budget	**Percent**	**Number**
Less than $100,000	53	28
$100,000 to $199,999	17	9
$200,000 to $299,999	17	9
$300,000 to $399,999	11	6
$400,000 to $499,999	0	0
$500,000 and above	2	1
Total		**53**

Question 11. Business opportunities produced in 2013 by the parish economic development office.

Table 8 indicates that parishes provided training sessions forty-two times in 2013; seven parishes distributed grants, three parishes increased their industrial park occupancy rate, two parishes provided tax incentives and one parish increased their incubator occupancy rate.

Table 8 BUSINESS OPPORTUNITIES PRODUCED IN 2013 BY PARISH ECONOMIC DEVELOPMENT OFFICE		
Business Opportunities	**Percent**	**Number**
Incubator Occupancy: (percentage rate, e.g., 90% full)	2.	1
Industrial Park Occupancy Rate: (percentage rate, e.g., 90% full)	6	3
Tax Incentives Provided: (Number of companies receiving Tax Incentives)	4	2
Training Sessions Provided: (Number of training sessions)	82	42
Grants distributed:(Amount of Grants)$	14	7
Total		**55**

Question 12. Is there a plan to expand the parish's economic development program?

One hundred percent of the parishes plan to expand their economic development program in the future.

DISCUSSION OF FINDINGS

It is fascinating to reveal that over ninety-eight percent of the parishes have an economic develop office, however, only nine percent of the offices have been open over ten years. The Louisiana Economic Development Commission brags in its Mission Statement how they support local and regional communities in their efforts to improve their economic competitiveness. (Louisiana Economic Development, n.d) However, the research study reveals that the State of Louisiana is certainly behind-the-times and is currently playing catch-up.

Coupled with the relatively short-term existence of the local economic development offices, this research study reveals that only five parishes are using the services of the Louisiana Economic Development program. Only two parishes use state tax incentives; two parishes have

an industrial park, and one parish offers from the state location and/or land incentives. Thus, the local development programs are not taking advantage of the state economic develop incentives.

The Louisiana Economic Development Commission has stated in their goals that they are cultivating Louisiana's top regional economic development assets. (Louisiana Economic Development, n.d) This research study shows that there is a disparity between what is asserted in the goals to actual performance at the parish level. Again, the parish economic development offices have just begun their efforts to obtain business; a dearth of coordination between the state and local parishes; and there is a lack of infrastructure from the Louisiana Economic Development Commission (LED) to the parish level.

Another goal for the LED is to reposition Louisiana as one of the best places in the country in which to start and grow a small business, and operating climate, thereby increasing the state's economic competitiveness. (LED, n.d.) This is going to require a quantum leap from the present status of Louisiana Economic Development to what is desired. For example, in Orleans Parish there is a poverty rate of 27.2% (United State Census bureau, 2014**),** and in the state a poverty rate of 18.7%. Coupled with this is the low median household income of $36,681 (Orleans Parish) and the state with a median income of $44,673. (United State Census bureau, 2014) In addition, the low higher education rate of 33% and 21.4%, New Orleans and Louisiana, respectively. (United State Census bureau, 2014) In Orleans Parish there are 60% African Americans residing in the parish, whereas, the percentage of African Americans owning a business is 28.9%. (United State Census bureau, 2014) Therefore, there is a 52% difference between African American population and businesses owned by them. Home ownership in Orleans Parish compared to the state is only 47.6% versus state ownership of 67.4% (United Sates Census Bureau, 2014), which hurts the public school system because of low property tax which in-turn causes new businesses to think twice before moving to the parish due to quality of life and the high cost of sending children to private schools. So, it is questionable as to why a business would vote with their feet and locate to Louisiana - when there are states with better public services and infrastructure. Thus, the LED must coordinate their efforts not only with the parishes but with other state departments to improve the quality of education, reduce high property taxes, and support the majority of the population to build businesses. There are some existing state and parish small business and disadvantage support programs such as, statewide network of programs that certify minority-owned and/or women-owned businesses and provide training, assistance and support for starting a small or home-based business (LED, n.d). The state, as well as, the individual parish needs to create strategy to enhance effectiveness of these programs to increase the participation of the disadvantage groups, which is currently underrepresented.

SUMMARY AND CONCLUSIONS

The study results reveal that there is certainly a dichotomy between the State of Louisiana's Economic Development Commission and the various parish economic development organizations. Frankly, the State Commission talks a good game but it is obviously lacking at the parish (county) level.

It would be recommended that the State Economic Development Commission work hand-in-hand with the local institutions. In particular, the State Commission should develop a communication/training program to make sure the parishes are knowledgeable about the state's ongoing economic development programs. A state certification program might be developed to enhance the capacity of the local government's economic development program. Also, the parishes should be able to voice their economic development needs to the state yearly. Not only should the state aggressively tell their story as stated in their strategic plan, but also create a mechanism to better coordinate the effort between state and local economic development programs.

It is certainly recommended that research should continue to look at the various aspects of economic development programs in the State of Louisiana at both the state and local level.

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APPENDIX

Economic Development Survey

This survey is designed to learn about Louisiana Economic Development programs and incentives in different parishes. The professors of Southern University at New Orleans, College of Business and Public Administration will use this survey to compare the existing programs and incentives in Louisiana Parishes. Your answers will assist us in teaching students about economic development in the State of Louisiana. The professors would appreciate greatly if the director or someone in authority answers the survey.

Thank you for your assistance!

Name of Parish:

1. Does the parish have an economic development office?
   Yes (IF YES, please go to question 5) No (IF NO, please go to question 2)
2. If not, does the parish use any economic development office: **(check all that applies)**
   - State office of economic development Inter-parish economic development office Chamber of Commerce
   - Private firms dealing with economic development
3. Instead of having a parish economic development office, does the parish use the state economic development programs:
   - Yes (**IF YES, please go to question 4)**
   - No **(IF NO, please go to question 21)**
4. What services does your parish use from the state economic development programs: **(check all that applies)**
   - A program for tax incentives
   - A program for monetary incentives
   - An industrial park
   - Location and/or land incentives
5. If yes, does the economic development office have its own office either in parish government or in an outside venue (such as, chamber of commerce)?
   - Economic Development Office in Parish Government
   - Chamber of Commerce
   - Other: _____
6. How long has the parish economic development program been operating?
   - Less than a year
   - 1 to 5 years
   - 6 to 10 years
   - Over 10 years
7. Does the economic development office have a specific strategic plan?
   - Yes
   - No
8. Does the economic development office have a person in charge (for example, a manager, director, etc.).
   - Yes
   - No
9. Does the economic development office offer incentives to a prospective business willing to locate in your parish?
   - Yes (**IF YES, please go to question 10)**
   - No **(IF NO, please go to question11)**
10. Does the economic development office offer: **(check all that applies)**
    - Training Programs - (such as, business plan development, how to obtain a DBE, etc.)

Incentives
Special Programs for:
Minorities
Women
Handicapped
Veterans
Small Business
Other: _____

11. Does the economic development office provide advocacy and promotion for business development?
Yes
No

12. Does the economic development office have a formal economic development program for: **(check all that applies)**
Local Regional
National
International

13. Does the economic development office have an incubator to help small businesses?
Yes
No

14. If so, how many incubator offices are in you parish?
0
1
2
3
4
5
Over 5 (place number here): _____

15. Is the incubator just for business offices or for manufacturing? **(check all that applies)**
Business Office
Manufacturing

16. Does the incubator have specialty facilities for small business: **(check all that applies)**
Scientific/Research Facility Heavy
Manufacturing Facility Entertainment Facility
(film, music, etc.) Retailing
Other: _____

17. Does the economic development parish office offer: **(check all that applies)**
A program for tax incentives
A program for monetary incentives
An industrial park
Location and/or land incentives

18. How many employees does the parish economic development office have?
1 Person
2 People
3 People
4-6 People
7-10 People
Other: _____

19. How much is the economic development office budget?
Less than $100,000
$100,000 to $199,999
$200,000 to $299,999
$300,000 to $399,999
$400,000 to $499,999
$500,000 and above

20. How many business opportunities has the office of economic development produced in 2013? **(Check all that applies)**

    Incubator Occupancy: (percentage rate, e.g., 90% full) _____
    Industrial Park Occupancy Rate: (percentage rate, e.g., 90% full) _____
    Tax Incentives Provided: (Number of companies receiving Tax Incentives) _____
    Training Sessions Provided: (Number of training sessions) Grants distributed:(Amount of Grants)$ _____

21. In the future, is there a plan to expand the parish's economic development program?

    Yes
    No

EVALUATING THE "UNDERSERVED STUDENT" SUCCESS IN ECONOMICS PRINCIPLES COURSES

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ABSTRACT

Math, reading and critical thinking skills are foundational tools among many college-level courses. However, many students from "underserved backgrounds" lack the exposure to rigorous pre college quantitative and qualitative programs. These same "underserved" students are afforded significantly less resources in relation to their peers, thus they tend to be exposed to a higher risk of lower academic achievement. Without a grasp of these foundational tools, a student's performance in collegiate-level courses may be severely handicapped. This paper serves to analyze the pertinence of reading and critical thinking skill-sets along with math course intervention tools in enhancing the performance of students who are largely from "underserved communities" in Principles of Economics courses.

The authors examine the relationship of student's pre and post math, reading motivation and critical thinking skills on the students' overall performance in Principles of Economics courses at a Historically Black College and University. Among the preliminary findings, the math pre-test results were significantly poor thus the authors knew it was compelling that most students work on math intervention skills within the study period. The students consequently used Smart Thinking online tutorial service, which is a virtual tutoring service, to help improve their math skills concurrently with their principles of economics courses. Other interventions strategies included redesigning the course to include more student participation individually and in-groups. This entailed replacing one class meeting a week with activities such as relevant videos and games, in-class small group problem solving, and debates as well as individual online assignments. An Undergraduate Learning Assistant was also placed in an experimental redesign course to serve as additional assistance for the students.

For this paper, an empirical regression based on data from three sections of the principles of macroeconomics course was used to test the effects of reading motivation, math and critical thinking skills on student performance in the course. The dependent variable for the regression involved a difference in the pre and post scores on a comprehensive economics test. The utilization of pre and post economics test scores were taken into account for fixed effect changes in student characteristics. The findings reveal that while math plays a significant role in increasing Principles of Economics students' scores, students' motivation to read is a greater predictor of performance in the principles courses. The study also finds significant gain in knowledge of the principles of economics for students who combine good math skills and a strong motivation to read. The redesign hybrid variable showed a strong statistical relationship with the performance of students in the course compared to the redesign face-to-face class. This can possibly be explained by the consideration that students in the hybrid class spent time in the non-face to face periods to seek more tutoring. Other variables such as student's gender, year of study, transfer versus non-transfer

students, and full time versus part time were found to be insignificant. It is indicative from the study that interventions to build students' skills in math and reading as well as critical thinking would benefit principles of economics students in general and those from "underserved backgrounds" in particular. The implications of the findings of this study, stress the importance of developing math and reading intervention tools within the economics principles courses.

1. INTRODUCTION

Principles of Economics courses universally have a reputation for being challenging with concepts that may seem foreign to lower-level undergraduate students. In addition to the lack of prior knowledge of the concepts of economics, many first generation students from "underserved communities" lack the exposure to rigorous pre-college quantitative and qualitative tools needed to successfully complete an economics principles course (Rumberger, 2007 and Walker, 2007). Without a strong grasp of these foundational tools, such as math, reading and critical thinking, a student's performance in collegiate-level courses may be severely handicapped. So is there a solution that will help students from "underserved communities" understand the tools needed to successfully complete a rigorous course, such as Principles of Economics? This paper serves to analyze such a question, by measuring the effectiveness of a student's prior skill-set and course intervention tools in Principles of Economics courses at an institution that services students from underserved backgrounds. We seek to explore if classroom intervention strategies to enhance students' math skills and prior critical thinking and reading will consequently influence students' performance in principles of economics courses.

Defining an "Underserved Background"

Students from an "underserved background" span throughout many categories of students who historically were not provided the opportunity to meet the mark in the educational system. One could define a student from an underserved background as a student who was not given adequate resources compared to their counterparts, which in-turn creates a greater risk of lower level academic achievement. One group that is referenced by researchers, as an underserved is one made up of first generation college students (Thayer, 2000, Rumberger, 2007 and Walker, 2007). First-generation students are likely to enter college with less academic preparation, and possess limited access to information about the college experience, either firsthand or from relatives (Thayer, 2000). Thayer (2000) highlighted that students whose parents did not go to college are more likely than their non-first-generation fellow students to be at a disadvantage academically and not prepared for college. Students were also found to have less knowledge of how to apply for college and for financial assistance, and to have more difficulty in acclimating themselves to college once they enroll (Vargas, 2004).

Low-income, minority, and first-generation students are especially likely to lack specific types of "college knowledge" (Choy, 2001). Students from this underserved background often do not understand how to make the connection between career goals and educational requirements (Vargas, 2004). The first generation, and/or African-American students also tend to lack the exposure to rigorous pre college quantitative and qualitative programs needed to succeed in college (Rumberger, 2007 and Walker, 2007). Vargas (2004) found in his research that first generation college students that excelled academically in high school enter college without exposure to higher-level course offerings such as advanced placement and honors high school courses.

Underserved students are also more at risk of not completing a degree because they are more likely to: delay enrollment after high school; enroll in postsecondary education part-time; and to work full-time while enrolled. Researchers have found that targeted intervention efforts that reach out to first-generation students both before and during college can help lessen the differences between first-generation and non-first-generation students (Vargas, 2004). The University in which this study was undertaken encompassed students from an underserved background, also known as first generation college students. As of 2012, approximately 68 percent of the students attending this University were first generation college students (OPAA, 2015).

2. LITERATURE REVIEW

Math, reading and critical thinking are skill-sets that greatly affect students' performance in the principles of economics courses. The challenge for every economics department in the country is that some students, especially underserved students lack the required skill-sets to succeed in these courses. A body of literature has examined the sets of skills that a student requires to succeed in undergraduate college level economics courses. Barrett (2005) argues that many economics courses are designed with an understanding that students possess prior knowledge of math and other important skill sets to succeed in the course. Consequently, researchers have discovered that many students lack prior knowledge and responsiveness to the skills needed to understand economic fundamentals (Allwine and Foster, 2013; Ballard and Johnson, 2004 and Arnold and Straten, 2012). Among these important skill-sets, decision-making and reasoning skills play an integral part in student success. Thus, strong critical thinking skills help students to prepare for more complex and vigorous decision-making in courses such as economics (Heijltjes et al., 2014). Maudsley and Strivens (2000) discovered that employers ask questions that require potential employees to be critical thinkers rather than possess the ability of memorization. Overall, critical thinkers have been seen to perform better in school compared to other students. Dykstra (1996) attributes this to a student's ability to breakdown a problem and derive a solution through several analytical techniques. He adds that a student that is a critical thinker solves the problem in a sequential manner and knows how to explain their thoughts in a clear and concise manner (Dykstra, 1996). Graham and Harris (2000) discussed that a student can acquire the ability to think critically by evaluating data and analyzing complex situations. Many of the skill sets discussed by Graham and Harris (2000) are fundamental skill sets needed to succeed in many economics courses.

In the economics principles literature there exist robust findings on importance of math skills as an essential tool for success in introductory economics courses (Allwine and Foster, 2013; Ballard and Johnson, 2004; Arnold and Straten, 2012 and Swope and Schmitt, 2006). Anderson, Benjamin, and Fuss (1994) discovered strong math skills in areas such as calculus were major indicators for student success in introductory economics courses. Ballard and Johnson (2004) also stress the need to strong math skills in economics courses. They go on to suggest that improved mastery of algebra is essential to success in certain economics courses (Ballard and Johnson, 2004). Such discoveries regarding the importance of math skills have led to course experiments and testing of various technological methods in order to correct these inadequacies. For example, Allwine and Foster (2013) developed a model that identified students weak and unskilled in the math. They utilized ALEKS math adaptive learning system as an intervention to solve student math deficiencies. Students were identified in order to alert students of their inefficiencies and provide corrective means. If students passed the Algebra 1 assessment, technological resources were not mandatory.

Use of technology in collegiate level classes has increased in the past years. Researchers have dedicated much time to analyzing different aspects of modern technology and how it is implemented and integrated in courses. It has been seen to engage students, encourage them to be active learners and strengthen their community amongst each other (Green, 2013). Textbook publishers are one of the many web based learning providers (Galizzi, 1987). Such websites facilitate faculty and student interaction and aim at providing better communication and feedback in regards to performance and interventions (Galizzi, 1987). There is much speculation as to whether online based resources actually help to improve students' comprehensiveness. According to Olczak (2013), online based resources help to provide students with study plans, practice questions, immediate and detailed responses and feedback, as well as other complements to the textbook. As online resources are continually incorporated into courses, it is imperative to measure the effectiveness of such technology.

The method with which effectiveness is measured varies from researcher to researcher. There is a considerable amount of literature on how to adequately measure students' performance and the effect technology has on such performance. Coates and Humphreys (2000) suggest, effectiveness is measured by the students' willingness and ability to use technological resources; if unused, resources are ineffective at enhancing comprehension. Self (2013), provides a pedagogical experiment that utilizes students' online homework assignments as a basis for measurement. Homework assignments are seen as mandatory effort, while additional problems are viewed as voluntary effort. Test grades are used as the dependent variable. In a sample size of 129 students, this experiment concluded that overall exam scores were not significantly impacted by students' grades on mandatory online homework; however, students who voluntarily accessed the extra practice problems did better than those who declined opportunities for extra practice. Like Coates and Humphreys (2000), Self (2013) agrees that student efforts are directly linked to better test scores and outcomes. Arnold and Straten (2012) also found that student math skills and motivation plays an integral part in economics course success. Arnold and Straten (2012) found that gathering information of student motivation allows institutions to better assist in student success.

Within the arena of effort, researchers have found that reading motivation is a key driver to overall student success (Schafer, 1999 and Schraw and Lehman, 2001). Retlsdorf et al (2011) uses Guthrie and Wigfiled's (2000) definition to describe reading motivation. They describe reading motivation as "the individual's personal goals, values and beliefs with regard to the topics, processes and outcomes of reading" (p55). Researchers have discovered that reading motivation increases student performance and ability to comprehend (Retlsdorf et al, 2011 and Taboda et al., 2009). Denton et al. (2012) stressed that reading motivation along with comprehension fosters a student's ability to solve problems, decipher information and develop one's vocabulary. Carnegie Corp (2010) further highlighted that high school students lack proper reading comprehension and literacy skills, which will impede their performances upon entering college. Retlsdorf et al (2011) found that parental education qualifications contributed to students' reading motivation and performance. This paper will explore whether the skill set of reading motivation is a predictor of student success in an economics principle course.

3. DATA AND METHOD

The data for this paper come from three sections (a total of 173 students observed) of ECON 211, principles of macroeconomics course, taught by three different instructors at Bowie State University during the spring of 2014 academic semester. This course fulfills a general education requirement for all professional studies students and is required of all business majors. Thirty-eight

percent of the students were business majors. The study used a pre-test/post-test design, which is commonly used in the literature to measure student learning in undergraduate principles of macroeconomics course. The key variable used to capture knowledge gained by the students during the 16 weeks semester was a pre-test/post-test comprehensive economics exam. The pre-test was given to the students at the beginning of the semester and a post-test at the end of the semester to measure the extent of the knowledge gain in the course during the semester. Both tests contained 30 multiple choice questions, which were designed to test various skills: computational and math skills, and critical thinking skills which also measure students' ability to understand and interpret basic economics models and graphs. A number of intervention tools, which are discussed in the next sub-sections, were used during the semester to enhance students' performance in the principles of economics courses.

3.1 Math Intervention tool - Smarthinking Virtual Math Tutoring

Students in the Principles of Economics courses were also required to take a pre-test in basic math skills at the beginning of the semester and a post-test at the end of the semester that assessed students' aptitude in key math concepts used in the course. It was immediately obvious after the pre-test that with an average score of 23 percent, most students needed extra help. The redesign team decided to use Smarthinking Online Tutorial services as the intervention tool. Smarthinking is a virtual tutoring service, used at the university, which is available through Blackboard, its learning management system. The students can use it at no extra charge to them.

Smarthinking allows students to drop-in and receive tutoring in basic math and economics almost every day in the week following a published schedule. The redesign faculty created assignments in math involving economics concepts, which they encouraged students to complete with the help of Smarthinking tutoring. The students could earn a maximum of 5 percent of their final grade in the course by successfully completing these assignments using this tutoring service. Apart from the assigned exercises, students were encouraged to seek help with any other problems they were experiencing in the course. The math post-test showed some improvement in the average score even though overall the performance was poor.

3.2 Traditional versus Redesign Courses

Two of the three sections of the economics principles courses were considered redesigned courses, while one section was organized as a traditional economics course. Table 1 outlines the core differences within each section. All sections participated in the Smart thinking online tutorial exercises for math as well as utilized the online textbook supplements. The redesign model courses utilized some form of the National Center for Academic Transformation's Replacement model in which we substituted one class meeting per week with supplemental online math and economics course videos, online individual assignments, study plans, low stake quizzes, and small in-class group exercises using classroom debates, and the classroom clicker system. The utilization of the replacement model decreased faculty classroom time and increased face-to-face subject matter feedback. Redesign course #1 also offered an Undergraduate Learning Assistant (ULA) that was an upper level undergraduate student who had successfully that successfully completed the principles courses in the past. The purpose of the ULA was to assist the instructor in transforming the pedagogy delivery for the course, assisting students that struggled in the course and acting as a liaison between the course instructor and students in the course.

The Redesign course #2 was a hybrid course that met once every other week for two and half hours. During the non-face to face weeks, students were required to seek Smarthinking tutorial help in both math and economics. This course did not have a ULA present in the course, however the students were given the opportunity to receive text message notifications of any assignments that were soon to be due in the courses' various online environments. Lastly, there was no difference in selection bias with the redesign hybrid, because the students did not know upon registering for the course that it was a hybrid model set up.

Table 1
TRADITIONAL VERSUS REDESIGN COURSES

Traditional	Redesign #1	Redesign #2- Hybrid Course
60 Students per section	60 Students per section	60 Students per section
3 Lecture ~~s~~essions	2 Lecture sessions and 1 Lab	Hybrid with Online Smarthinking Economics
Smarthinking Online Math Tutoring	Smarthinking Online Math Tutoring	Assignment
No ULA	Peer Mentor-Undergraduate Learning Assistant (ULA)	Smarthinking Online Math and Economics Tutoring
NA	Met With Students who scored low on Pre-Econ Test	Met with Students who scored low on Pre-Econ Test
No Debates	Classroom Debates	Classroom Debates

3.3 Key student Skill-Sets and Descriptive Statistics

Table 2 displays the descriptive statistics for the principles courses broken down by student skill sets. The first skill set observed is the student's desire to read frequently. According to the literature, reading motivation is a key driver to overall student success (Schafer, 1999 and Schraw and Lehman, 2001). Therefore, during the first week of class, we administered a survey. The students' survey captured the student's GPA, major, classification, reading motivation and other variables utilized for the model. To gauge reading motivation, we asked students in the survey to list the five top things that they do within a day. From this survey we created a proxy variable labeled *Read*. This dichotomous variable offered a one to students that mentioned that they read daily and a zero otherwise.The second skill set observed was through the administration of an essay question to students in which the faculty utilized a critical thinking rubric to assess student success. The results below are solely based on students that achieved an above average (score of 3.0) or exemplary (score of 4.0) on the critical thinking rubric. Lastly, column 4 of descriptive statistics displaying math scores of students achieving an 80 percent or higher on their post-test exam.

Table 2
DESCRIPTIVE STATISTICS

Variable	Students that Read Frequently	Critical Thinking Rubric Score of 3.0 or Higher	Math Post Test Score of 80 or Higher
Number of Cases	53	17	9
Pretest Math Score	29	41	43
Post Math Score	40	59	84
Pretest Economics Score	36	44	43
Posttest Economics Score	73	70	85
GPA	2.5	1.9	2.0

Working	74%	1.9	2.0
Male	32%	47%	22%
Female	68%	53%	78%
Transfer Student	38%	53%	22%
Freshman	6%	12%	0%
Sophmore	38%	41%	56%
Junior	30%	41%	22%
Senior	26%	6%	22%

The pre-test and post-test scores for math and economics were out of a 100-point scale. Overall, students that achieved high math scores were more likely to receive higher post-test economics scores. This statistical finding is in-line with the literature that states that math skills and knowledge is an important indicator for success in a principles of economics course (Allwine and Foster, 2013; Ballard and Johnson, 2004; Arnold and Straten, 2012; and Swope and Schmitt, 2006). While math displayed strong post-test scores, the students' motivation to read found in column two displayed a GPA average of 2.5, which was higher than all other skill-sets reported. Females offered stronger skill-sets in all three categories over males. Sophomores offered the largest group with the strongest skill-set. This course is usually offered during a student's sophomore year; therefore this may explain the high frequency of above level skill-sets in the descriptive statistic findings.

3.4 Method

For the method, we utilized the difference in the pre and post economics exam scores to account for fixed effect changes in student characteristics. We adopted the methods of Green (2014) and Valletta, Hoff and Lopus (2012) in which students were given a pre-test during the first day of class and the same post-test during the week of finals. This method was utilized by Green (2014) and the results were robust and reliable. Since we are utilizing pre and post-test scores we were able to control for many external factors that students might have experienced before entering the course. The model is as follows:

$$Y_{post-}Y_{pre} = \beta_1 + \beta_2 S + \beta_3 T + \beta_4 CT + \beta_5 Read + \beta_6 (M_{post}\text{-}M_{pre}) + \varepsilon$$

where the variable S represents a vector of various student characteristics such as major, GPA, student employment status, and classification. The variable T represents whether the section was a redesign or traditional economics course. As mentioned in the above descriptive data section, the key variables utilized to evaluate student skill- sets and intervention techniques were as follows: The variable CT is a dichotomous variable representing students that score above average (score of 3.0) or exemplary (score of 4.0) on their critical thinking essay rubric assignment. The "Read" variable is a variable that captures the students reading motivation. The M_{post}-M_{pre} captures the pre and post math test results of students in the principles of economics course. ε is the stochastic error term.The purpose of offering pre and post math test results is to capture the impact of the intervention of Smarthinking online math tutoring. ε is the random error term.

4. ESTIMATED RESULTS

This study uses data from three sections of principles of macroeconomics at the college of Business, Bowie State University during spring 2014 to test the effects of reading motivation, math

and critical thinking skills on student performance in the course. Table 4 reports the estimated results of the empirical regression of the response variable-ECONPREPOSTPCT2 (in the method section described as "($Y_{post} - Y_{pre}$") on a set of covariates that affect the performance of students in the principles of economics courses. We tested the estimated model for evidence of serial correlation among the errors as reported in Table 3 using the Breusch-Godfrey serial correlation LM test. The LM test statistic for the null of no serial correlation in the errors is labeled as Obs*R-squared. The test results suggest the absence of serial correlation. We further tested for the presence of heteroskedasticity and the results found no evidence of heteroskedasticity suggesting that we cannot reject the null hypothesis that the errors are homocesdastic implying that the response variable exhibit similar variance across the explanatory variables.

Table 3
DIAGNOSTIC TESTS

1. Breusch-Godfrey Serila Correlation LM Test			
F-Statistic	1.557581	Prob. F(2,31)	0.2267
Obs*R-squared	4.200405	Prob. Chi-square(2)	0.1224
2. Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	1.936263	Prob. F(12,33)	0.0661
Obs*R-squared	19.00621	Prob. Chi-square(12)	0.0884
Scaled explained ss	14.54646	Prob. Chi-square(12)	0.2672

With a p-value of 0.0050, the estimated results show evidence of a positive and robust relationship between math skills and performance in principles of economics course. Also, we found that students who chose the traditional approach of teaching the course were also likely to succeed in the course although the relationship between preferences for the traditional approach was weaker with a p-value of 0.0898. Students' perception of reading as the key motivation for success was also controlled in the regression. The results indicated a positive and significant relationship between performance in the economics course and reading. We discovered that reading embodies a very important motivation for success in the principles of economics.

TABLE 4
DEPENDENT VARIABLE: ECONPREPOSTPCT2 ("$Y_{POST} - Y_{PRE}$")

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
GPA	0.674017	4.319614	0.156036	0.8770
WORKINGFT	1.291570	7.304435	0.176820	0.8607
FEMALE	6.285650	7.166093	0.877138	0.3868
JUNIOR	0.008318	8.231794	0.001011	0.9992
MATHPREPOSTPCT2 " M_{post}-M_{pre}"	0.374828	0.124740	3.004872	0.0050***
TRADITIONAL *"T"*	17.86614	10.22371	1.747520	0.0898*
TRANSFER	1.061396	6.929556	0.153169	0.8792
REPEAT	9.644297	7.152620	1.348359	0.1867
READ	12.49436	7.294395	1.712872	0.0961*
REDESIGNHYB	17.58083	7.945798	2.212595	0.0340***
SOPHMORE	6.050171	9.418913	0.642343	0.5251
HIPRECT *"CT"*	4.250088	7.536994	0.563897	0.5766

C	-3.830870	15.89172	-0.241061	0.8110
R-squared	0.435809	Mean dependent var		28.02174
Adjusted R-squared	0.230648	S.D. dependent var		21.49262
S.E. of regression	18.85176	Akaike info criterion		8.944173
Sum squared resid	11727.83	Schwarz criterion		9.460963
Log likelihood	-192.7160	Hannan-Quinn criter.		9.137766
F-statistic	2.124232	Durbin-Watson stat		0.966642
Prob(F-statistic)	0.043195			

Statistically significant levels are shown as follows: *=10 percent, **=5 percent, ***=1 percent

Dependent Variable: ECONPREPOSTPCT2	

The concepts of economics are new to many students that are entering this course for the first time, therefore reading, studying and preparing outside of the course is essential for success in the course. The results also show that the redesign hybrid variable was significant in explaining changes in the response variable at one percent level. The results from the study did not matter whether a student was a female or male, junior, senior, sophomore or transfer, and whether a student was working full time or not. The overall model was significant indicating that the independent variables jointly explain the variability of the response variable.

5. DISCUSSION

The results from this study find significant gain in knowledge when a student had adequate math skills along with strong reading motivation skills. This suggests that knowledge of math and reading motivation were a key determinant of students' success in the course. Students that possess math skills did comparatively better than the rest as revealed by post-test scores. Post-test scores were also influenced by the variable "read", which was used to test if performance in the course could be improved if students devoted time to reading. The estimated coefficient of the "read" variable was significant and had the expected sign indicating that students who devoted time to reading tended to acquire more skills and this result is supported by the literature (Schafer 1999; Taboda et al., 2009; Retlsdorf et al. 2011; Denton et al., 2015). In our study, we also examined the effect of pedagogical best practices by adopting teaching strategies different from the traditional face-to-face class lectures within the perspective of economics principles redesign project which incorporated innovative pedagogical methods to the instruction environment which tended to raise students' skill sets. In our approach, students were divided into groups to debate on topics and issues, which help them to improve their critical thinking skills. The use of classroom clickers, and group assignments greatly improved learning outcomes.

The redesign utilized a replacement model whereby faculties were assisted by ULAs who tended to identify problems faced by their student peers in a timely manner. The redesign hybrid variable was also found to have a strong statistical relationship with students' learning outcomes and this relationship tends to be robust as confirmed by the p-value in the estimated model. The redesigned hybrid model was different from the redesigned model in that the latter utilized ULAs while the former did not. The strong significance of this variable might be explained by the fact that students spent the time during the non-face to face weeks to seek help using smarthinking tutorials in math and economics which both enhanced students' skills and knowledge of the course. While this study is the first as we implement the economics principles redesign project, the project has enabled

the faculty involved to modify the course design especially to address problems encountered during the implementation of the project which started in fall 2013.

6. CONCLUSION

In conclusion, math plays a significant role in increasing Principles of Economics students' scores. Particularly important is the fact that students gain math skills using Smarthinking tutorials and in-class group discussions to acquire skills that enhance their understanding of the principles courses. Group discussions and debates also enabled students to think critically. However among student skill-sets studied in this paper, a student's motivation to read was found to be a greater predictor of performance in the principles courses. Students who indicated that reading was the key motivation for success also performed better. The study has also found that pedagogy intervention strategies such as required Smarthinking tutorials in math and economics helped to enhance learning outcomes for the courses.

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TUITION SENSITIVITY IN ONLINE EDUCATION

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ABSTRACT

The paper presents a price discrimination model of a university operating in two markets, traditional and online education, and attempting to maximize revenue under a minimum profit constraint. Optimality conditions, based on demand elasticities are derived. Using a dataset of 398 southeastern public two and four year higher education institutions we estimate the price elasticity of demand for both online and traditional education. Utilizing a panel framework, we find that online education (e-learning) is highly price elastic and traditional education is price inelastic.Comparison of the empirical elasticities with the model predictions indicates that universities do not behave optimally. Reduction of online tuition and increases in traditional tuition are required to move universities towards the goal of revenue maximization.

*We would like to thank two anonymous referees for their valuable comments.

INTRODUCTION

Postsecondary education in the US has seen remarkable growth in distance learning in the past decade. In 2000, an estimated 2,320 two and four year institutions participated in some form of distance learning [Waits *et al*. (2003).] By 2006, an estimated 2,746 US two and four year institutions were participating in distance learning [Parsad and Lewis (2008).] At the same time, enrollment in online education grew faster than traditional enrollment. In 2002, 16.6 million students enrolled in postsecondary education. By 2009, approximately 19 million students were enrolled in postsecondary institutions, a growth rate of 14%. At the same time, approximately 1.6 million students partook in at least one online course in 2002. In 2009, 5.6 million students took at least one online course, creating a growth rate of nearly 250% in online education [Allen and Seaman (2010).This trend is likely explained by the growing demand for higher education, widespread use of the internet, the declining cost of instructional delivery, and changing business models of postsecondary institutions (Hanna 1998; Hanna 2003; Byrd and Mixon 2012).

As enrollments for both traditional and nontraditional methods of instruction increase, a key issue that public higher education institutions face is the decline in state appropriations in contrast to the growing demand for their programs. Increasing tuition and fees has been a method that many institutions have employed to offset these funding windfalls [Potter (2003).] Yet, the changing culture of students, both demographically and technologically, has led many institutions to turn to online learning as an additional method to offset funding shortfalls.

Distance education programs allow the university to move beyond its traditional brick and mortar structure and become a global presence. Prior to the widespread adoption of

computers and the internet, traditional distance education modes of delivery were two-way audio/video classes and correspondences courses. As the cost of technology decreased, so did the dissemination of distance education via online programs. Given the widespread adoption of online programs, we focus on one aspect of distance learning, e-learning.

A model of a university operating in two distinct markets, the traditional education and the online education, is presented. Postulating that the goal of the university is to maximize revenue, under a minimum profit condition, we derive that the optimal policy is to price discriminate and set prices based upon the price elasticity of demand in each market. We proceed to examine tuition sensitivity and student response for both the traditional as well as the alternative and emerging method of instruction in e-learning. We use the estimated elasticities to make inferences about whether universities achieve revenue maximization and, if not, to suggest changes in pricing policies that will help universities move toward their revenue maximization goal. Furthermore, we expand upon the extant literature of tuition sensitivity of traditional higher education, by supplementing it with elasticity estimates for e-learning in higher education.We do this by specifying a demand model for e-learning using undergraduate credit hours and pricing per credit hour in two- and four-year public colleges in the southeastern United States. The data used are from 2004-2009 and encompass a time of growing enrollments and tuition.

In the next section, we summarize the literature on tuition sensitivity and student choice. Following, we present a model of the modern university in revenue maximization with a minimal profit framework. A presentation of data that highlights the importance of e-learning in higher education follows. Finally, we consider the role that pricing plays in demand for two- and four-year colleges.

TUITION SENSITIVITY, STUDENT CHOICE AND ONLINE PROGRAMS

The prior literature on tuition price sensitivity is extensive in that it covers long time series (Chang and Hsing 1996) at the national level, panel data (Wetzel et al., 1998; Zhang 2007; Hemelt and Marcotte, 2011) and is divided among private and public schools (Parker and Summers 1993; Shin and Milton 2006) at the regional level, single universities (Curs and Singell 2002; Curs and Singell 2010), demographics (Wetzel *et al*. 1998) and by major (Shin and Milton 2008) to name but a few. Elasticity estimates are typically varied for public and private universities (*e.g*. see Gallet 2007 and the references therein) and the level of analysis: credit hours, total enrollment, and in-state compared to out-of-state students. Gallet's analysis does conclude that tuition is more inelastic in the short run and less so in the long run.

Compared to many of the previous studies on tuition sensitivity, Hemelt and Marcotte (2011) provide estimates from 1991 – 2006 and conclude that the tuition elasticity has changed very little since the studies conducted in the 1980s and 1990s. There have been suggestions Savoca (1990) that price elasticities could be underestimated by not taking into account the various effects of the application and enrollment process. Indeed, it may be the case that the increase in availability of education through greater channels of funding has prompted a greater range of student choice.

Student choice also plays an important role in determining the tuition response in the economics literature. Some (Shin and Milton 2007) have suggested that different majors should be charged different tuition rates through a cost-related tuition policy. Seneca and Taussig (1987) study student choice for a large public institution with at least one alternate and conclude that students select their best available academic choice. However, they note changes in the relative

tuition price have only a small impact on enrollment yields. Moreover, the current body of literature has not addressed the elasticity of online learning. This area of research has theoretical justification; however, little empirical research has been conducted.

Online programs offer students greater flexibility and greater student choice not only in where they can attend but when they can attend. The economic downturn was instrumental in many students' choice to increase their demand by 74.5% for online programs (Allen and Seaman 2010). As demand for online programs increased, a key issue that institutions face besides meeting demand is providing quality online programs that meet institutional goals. Young and Norgard (2006) survey student perception of quality of online courses at a small upper level university and find that most needs regarding quality measures were met with few exceptions regarding course content. Similarly, Yang and Cornelius (2005) surveyed students at two four-year colleges and one community college and found that technological accessibility and efficacy promoted a higher quality learning environment. Whereas, limited access to instructors and technological problems detracted from the overall quality of a course. In a broader analysis of 29 Austrian universities, Paechter and Maier (2010) promote a blended approach (face-to-face and online elements combined) to enhance the overall quality of a course. This stems from the nature of the course material, ease of material dissemination, and the desire (or lack thereof) to engage in discourse with the instructor. In contrast, one-third of the academic leaders surveyed by the Sloan Consortium continue to believe that the quality of addressing learning outcomes for online courses are inferior to those of face-to-face courses (Allen and Seaman 2010), though this number has been slowly decreasing since 2003. While these studies have varied viewpoints among students and administrators of online education, they are settling on a greater degree of quality online programs. An increase in the quality of online programs can then potentially lead to a higher price.

A MODEL OF THE MODERN UNIVERSITY

We hypothesize that the modern not-for-profit public university operates closer to the revenue maximization model, under a minimum profit constraint, rather than a straight profit maximization model. The university finances its capital improvement projects with bond issues. These construction bonds are usually rated by rating agencies in order to expand their customer appeal. The rating agencies look at a number of factors, but ability to repay is likely the most important. A University's ability to repay is usually associated with increasing (or, at least, non-decreasing) enrollments and the presence of a healthy reserve account that will guarantee repayment in the short-run. Thus a university that wants to minimize their borrowing costs, *i.e.* maintain or improve their credit ratings, should try to increase their revenue and achieve an adequate profit to add to their reserve account.

In addition to financial concerns, increased enrollments have multiplier like effects by providing for services (like athletics, specialized dorms and cafeterias, gym facilities, entertainment events, lecture series *etc*.) that make the university more attractive to some categories of students and may result to further increases in future enrollments and revenue.

It should be noted that in actuality the mission of universities is rather complex and multidimensional. It also differs from university to university, *e.g*. it is different for state flagship universities, for land-grant institutions, for regional state universities, and for community colleges. Our argument is that in a period of diminishing shares of state appropriations, university administrators will be paying significantly more attention to revenue increases,

whatever their officially stated goals are. Furthermore, state authorities may not have a strong argument against revenue increasing changes in the pricing structure. Such changes may be a trade off the universities can try to negotiate. Thus, we consider a revenue maximization model more appropriate than a profit maximization model or an enrollment maximization model or some other alternative.

Economic analysis of a sales revenue maximizing organization originates with Baumol (1959) and its main result is that it will produce a quantity larger than the profit maximizing organization. If the minimum profit constraint is non-binding, the produced quantity will be determined by equating marginal revenue to zero. If the profit constraint is binding, the solution is the largest quantity that produces the minimum profit.

The analysis of a modern university behavior is complicated by its expansion to the online education market. As is argued elsewhere in this paper, the online market eliminates physical classroom boundaries and effectively allows the university to compete with every other institution worldwide. Hence, it can be argued that each university participating in the online market is a monopolistic competitor in a very large market. As monopolistic competition requires, the university offers a product (education) that is slightly differentiated than that of its competitors, but is highly substitutable. The implication is that universities face a highly elastic demand for their online education offerings.

The traditional segment of the public university's offerings is best modeled as a local monopoly. While the university is most likely an oligopoly for entering students (it should be noted that the majority of students enroll in in-state universities and, hence, state public universities enroll mostly in-state students), after the initial enrollment, students stay with the university giving it a monopoly status. Furthermore, universities many times have no other public university competitors in close geographical proximity, which further enforces their local monopoly status. The implication is that the traditional on-campus students represent a relatively small market with a relatively inelastic demand.

Economic theory suggests that if an organization operates in two separate markets with differing sizes and differing price elasticities of demand, then optimization cannot be achieved by charging a common price. In other words, optimization requires price discrimination. The data collected here indicate that universities do charge approximately the same price for both traditional in-state students and online students (and, sometimes, online students are charged small premium over the in-state price.)

In what follows a constrained sales maximization model with price discrimination is presented. Let market 1 represent the smaller, less elastic residential market, with q_1 as the number of students (or credit hours) in that market. Market 2 is the larger, more elastic online market, with q_2 representing its quantity. If ϵ represents the absolute value of the price elasticity of demand, then by assumption:

$$q_2 > q_1 \text{ and } \epsilon_2 > \epsilon_1 > 0 \quad (1)$$

The organization's objective is to maximize its total revenue, given by:

$$R = p_1(q_1)\, q_1 + p_2(q_2)\, q_2 \quad (2)$$

Subject to a minimum profit condition[1]:

$$\pi_0 = p_1(q_1)\, q_1 + p_2(q_2)\, q_2 - c(q_1 + q_2) \quad (3)$$

where p represents price and $c(\cdot)$ is the cost function.
The Langrangean of the problem is:

$$L = p_1(q_1)\, q_1 + p_2(q_2)\, q_2 - \lambda\, [\pi_0 - p_1(q_1)\, q_1 - p_2(q_2)\, q_2 + c(q_1 + q_2)] \quad (4)$$

Where the multiplier λ represents the addition to revenue when the profit constraint is relaxed by one unit.

The Kuhn-Tucker conditions of the problem are:

$$\frac{\partial L}{\partial q_1} = (1+\lambda)[p_1(q_1) + p_1'(q_1)q_1] - \lambda c'(q_1 + q_2) = 0 \quad (5)$$

$$\frac{\partial L}{\partial q_2} = (1+\lambda)[p_2(q_2) + p_2'(q_2)q_2] - \lambda c'(q_1 + q_2) = 0 \quad (6)$$

$$\frac{\partial L}{\partial \lambda} = \pi_0 - p_1(q_1)q_1 - p_2(q_2)q_2 + c(q_1 + q_2) \geq 0, \quad \lambda \geq 0, \quad \lambda \frac{\partial L}{\partial \lambda} = 0 \quad (7)$$

If the profit constraint is non-binding, *i.e.* $\lambda = 0$, then the well-known condition of $MR_1 = MR_2 = 0$ gives the optimal solution (in terms of elasticity, the solution is $\epsilon_2 = \epsilon_1 = 1$). Thus, the organization should set the price that corresponds to zero marginal revenue in each market. Since market 1 has a more inelastic demand, it will reach zero marginal revenue at a higher price than market 2, *i.e.* p_1 should be higher than p_2.

If the profit constraint is binding, *i.e.* $\lambda > 0$, then taking the ratio of the first two conditions yields:

$$\frac{p_1(q_1) + p_1'(q_1)q_1}{p_2(q_2) + p_2'(q_2)q_2} = 1 \; or \; \frac{p_1(q_1)[1-\frac{1}{\epsilon_1}]}{p_2(q_2)[1-\frac{1}{\epsilon_2}]} = 1 \; or \; \frac{p_1(q_1)}{p_2(q_2)} = \frac{\epsilon_1\epsilon_2 - \epsilon_1}{\epsilon_1\epsilon_2 - \epsilon_2} \quad (8)$$

Condition (8) indicates that the optimal solution will be characterized by equality of marginal revenues of online and traditional credit hours. The actual value of the marginal revenue will be determined by (7), *i.e.* the minimum profit condition. Here again, if the price elasticity in market 2 is larger than that of market 1, it immediately follows that the price in market 2 should be lower than the price in market 1.

In both cases, the revenue maximizing condition implies that the organization should set a higher price in the smaller, more inelastic market and a lower price in the larger more elastic market.

A potential complication is that on campus residential students cannot be prevented from signing up for online classes. If online classes are cheaper, a potential problem may arise. In what follows we examine this "slippage" problem.

Suppose that students can switch markets easily, *i.e.* residential students can sign up for online classes and online students can register and attend face-to-face classes. In such a case, the revenue function becomes:

$$R = p_1(q_1, q_2)\, q_1 + p_2(q_1, q_2)\, q_2 \quad (9)$$

And the problem's Langrangean becomes:

$$L = p_1(q_1, q_2)q_1 + p_2(q_1, q_2)q_2 - \lambda\, [\pi_0 - p_1(q_1, q_2)q_1 - p_2(q_1, q_2)q_2 + c(q_1 + q_2)] \quad (10)$$

The first order Kuhn –Tucker conditions are:

$$\frac{\partial L}{\partial q_1} = (1+\lambda)\left[p_1(q_1, q_2) + \frac{\partial p_1(q_1,q_2)}{\partial q_1} q_1 + \frac{\partial p_2(q_1,q_2)}{\partial q_1} q_2\right] - \lambda c'(q_1 + q_2) = 0 \quad (11)$$

$$\frac{\partial L}{\partial q_2} = (1+\lambda)\left[p_2(q_1, q_2) + \frac{\partial p_2(q_1,q_2)}{\partial q_2} q_2 + \frac{\partial p_1(q_1,q_2)}{\partial q_2} q_1\right] - \lambda c'(q_1 + q_2) = 0 \quad (12)$$

$$\frac{\partial L}{\partial \lambda} = \pi_0 - p_1(q_1, q_2)q_1 - p_2(q_1, q_2)q_2 + c(q_1 + q_2) \geq 0, \quad \lambda \geq 0, \quad \lambda \frac{\partial L}{\partial \lambda} = 0 \quad (13)$$

If the profit constraint is non-binding, *i.e.* $\lambda = 0$, then the first two conditions become:

$$p_1(q_1, q_2) + \frac{\partial p_1(q_1,q_2)}{\partial q_1} q_1 = -\frac{\partial p_2(q_1,q_2)}{\partial q_1} q_2 \quad (14)$$

$$p_2(q_1, q_2) + \frac{\partial p_2(q_1,q_2)}{\partial q_2} q_2 = -\frac{\partial p_1(q_1,q_2)}{\partial q_2} q_1 \quad (15)$$

The left hand side of each equation represents the respective marginal revenue function. If we recognize that it is extremely rare to have online students show up on campus to take face-to-face classes, then expression (15) will have zero on the right hand side[2]. This means that the revenue maximizing price of the online student market will be determined by setting marginal revenue to zero. This is very reasonable, since in general it is not expected to observe customers from the low price market to switch to the higher price market.

If, on the other side, the profit constraint is binding, *i.e.* $\lambda > 0$, then from the ratio of the first two conditions:

$$\frac{p_1(q_1,q_2)+\frac{\partial p_1(q_1,q_2)}{\partial q_1}q_1+\frac{\partial p_2(q_1,q_2)}{\partial q_1}q_2}{p_2(q_1,q_2)+\frac{\partial p_2(q_1,q_2)}{\partial q_2}q_2+\frac{\partial p_1(q_1,q_2)}{\partial q_2}q_1} = 1 \quad (16)$$

$$or \quad p_1(q_1, q_2)\left[1 - \frac{1}{\epsilon_1}\right] + \frac{\partial p_2(q_1, q_2)}{\partial q_1} q_2 = p_2(q_1, q_2)[1 - \frac{1}{\epsilon_2}]$$

where use of the fact that online students do not take face-to-face classes is made. This expression implies that the price in the less elastic residential market will be such that its marginal revenue plus the "slippage" effect will be equal to the more elastic online market marginal revenue. The equation can be rewritten as:

$$p_1(q_1, q_2)\left[1 - \frac{1}{\epsilon_1}\right] + \epsilon_{12}\frac{p_2 q_2}{q_1} = p_2(q_1, q_2)[1 - \frac{1}{\epsilon_2}] \quad (16')$$

Where ϵ_{12} is the cross price elasticity and the term next to it represents e-learning revenue per traditional credit hour. The sign of the cross price elasticity is positive if traditional and online credits are substitutes and negative if they are complements. While common sense would suggest that the two are substitutes, it would not be very surprising if they turn out to be complements. It is possible for universities to cancel low enrollment traditional classes and steer students to the corresponding online classes.

If the cross price elasticity is negative, then it is immediately obvious that the traditional marginal revenue should be higher than the e-learning marginal revenue and so does the corresponding price. If, on the other side, the cross price elasticity is positive, then no *a priory* claim about the relationship between the two prices can be made.

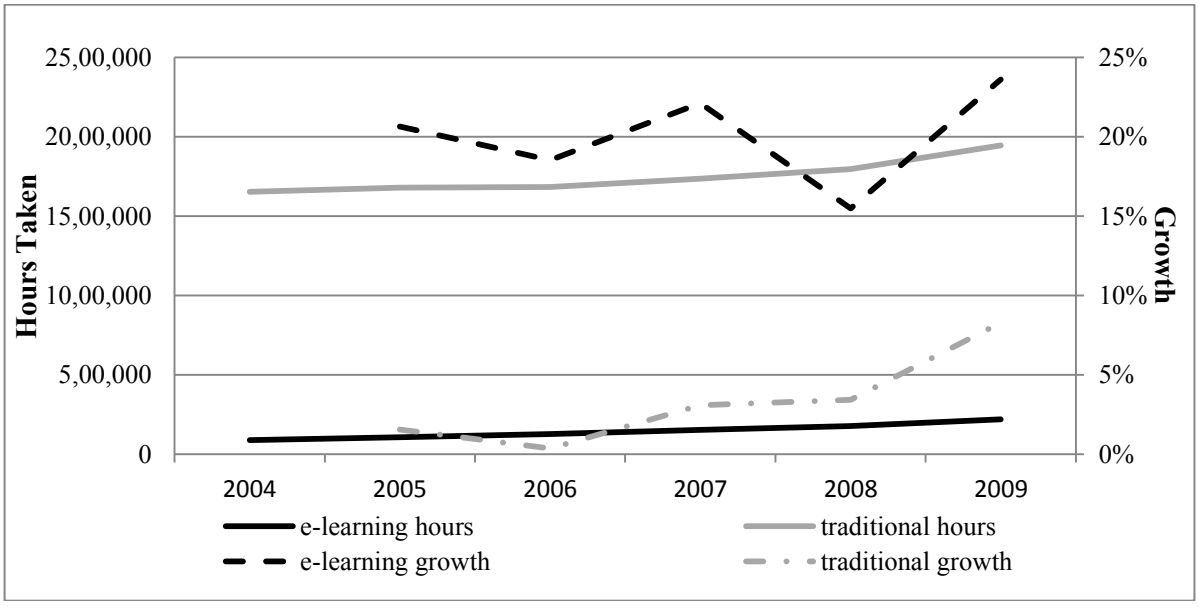
The analysis demonstrated that charging the same price for both residential and online students is not optimal when revenue maximization under a minimum profit constraint is assumed (and is definitely non optimal under profit maximization).Just as under profit maximization, revenue maximization is achieved by charging differing prices to different elasticity markets *i.e.* practicing price discrimination. Furthermore, the profit maximization discrimination result requiring charging a higher price in the less elastic market and a lower price in the market with the lower price elasticity of demand, carries over to revenue maximization even when the profit constraint is binding and, under some circumstances, even when the organization cannot prevent switching of students from the high price to the low price market.

MODEL SPECIFICATION AND DATA

To analyze the price elasticity of demand for online education we use panel data from 2004-2009 of 398 public two and four year postsecondary institutions from the southeast US. Education data come from the Southeast Regional Education Board (SREB), and the Integrated Postsecondary Education Data System (IPEDS).We were restricted to public institutions as SREB does not collect data from private institutions. Attempts to collect data from other regions of the country were not successful. Either other regions do not collect these type of data, or they do not publicize them.

Figure 1 compares average undergraduate e-learning credit hours and average traditional undergraduate credit hours of all institutions from our sample.E-learning credit hours have rapidly increased since 2004, while traditional hours have seen a modest increase. Among the 398 institutions in our sample covering ten states, e-learning credit hours had more than doubled (2.49) since our starting year, whereas traditional credit hours had only had increased by a factor of 1.17. The growth in e-learning hours is also remarkably higher compared to traditional hours. E-learning reached a growth rate of 22% in 2005 and 2007. Moreover, in 2006, the growth in e-learning hours was 30 times that of traditional hours. Among the states in our sample, the average growth rate of e-learning hours was between 15 – 20% compared to the 3 – 5% average growth rate of traditional credit hours. This is not a surprising result as online courses offer convenience over traditional courses, in particular for working students. Moreover, more institutions are adopting e-learning policies and programs to supplement their face-to-face courses.

Figure 1
E-LEARNING HOURS AND GROWTH COMPARED TO TRADITIONAL HOURS AND GROWTH

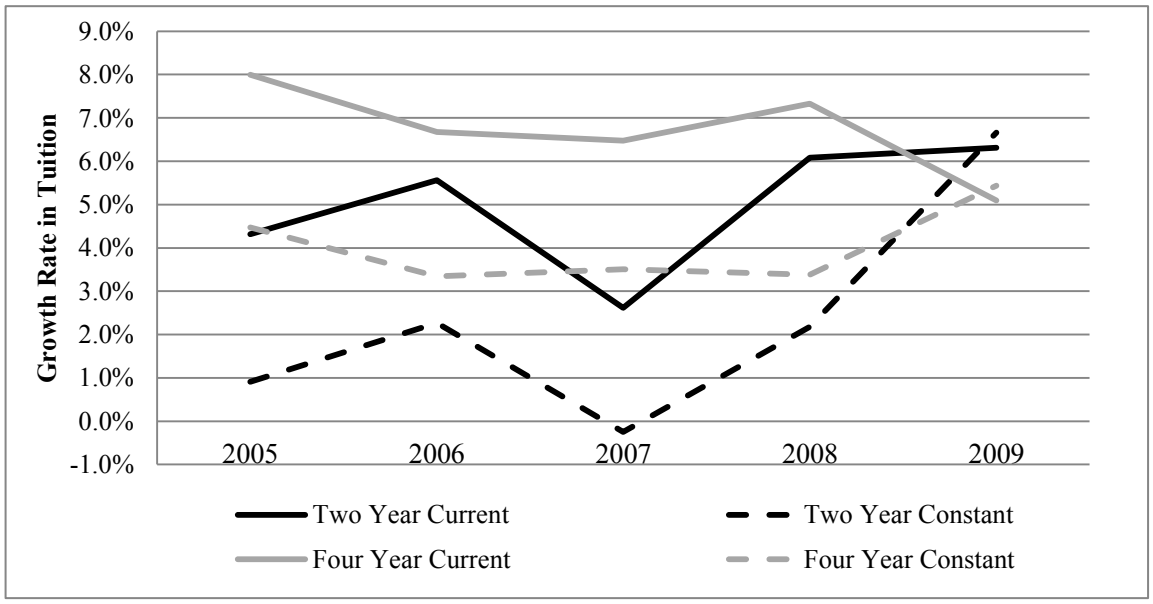


Note: Data for schools from ten states in our sample. E-Learning hours and traditional hours are the total number of hours accumulated in all 10 states. E-learning and traditional growth trends are percentage changes

from year-to year.

With enrollment growth achieving double digit percentage increases in recent years, tuition growth has not lagged far behind. Figure 2 compares the average current and real tuition (in 2004 dollars) growth for two- and four-year colleges. In the vast majority of cases, tuition growth has remained positive and mirrors growth in traditional undergraduate credit hours, Figure 1. Two-year colleges have had less growth in tuition compared to four-year colleges, and this is likely the result of two-year colleges remaining affordable through state charters.

Figure 2
TUITION GROWTH AMONG TWO- AND FOUR-YEAR COLLEGES



Note: Data for schools from ten states in our sample. Growth trends are percentage changes from year-to-year. Two and Four Year Current are tuition growth rates in current dollars. Two and Four Year Constant are tuition growth rates in 2005 constant dollars.

As the growth in e-learning continues, institutions adapt to the change in learning environment. A higher education institution can supplement its traditional tuition and fees revenue with e-learning tuition and fees. The key issues for each institution are to not price themselves out of the market and to charge a high enough price (through increased tuition or fees) to increase their revenue and minimize resource use. We assume that each institution is attempting to maximize revenue, under a minimum profit constraint. Our model attempts to explain e-learning as well as traditional enrollments, measured as credit hours taken. Since enrollment represents demand for education, one of its main determinants will be price, i.e. tuition and fees. Usually, higher education institutions announce their yearly prices as percentage changes over the previous year prices, *i.e*. they base them on these previous year prices, among other factors. This creates an endogeneity problem. To deal with this endogeneity problem and obtain unbiased estimates of the price elasticities of demand for both online and traditional credit hours, we rely on the following two-stage least squares fixed effects regression:

$$lnP_{i,t} = \beta ln\boldsymbol{X}_{i,t} + \gamma ln\boldsymbol{W}_{i,t} + \boldsymbol{a}_i + \boldsymbol{\tau}_t + \varepsilon_{i,t} \quad (17)$$

$$lnE_{i,t} = \zeta ln\hat{P}_{i,t} + \eta ln\boldsymbol{X}_{i,t} + \boldsymbol{b}_i + \boldsymbol{\kappa}_t + \mu_{i,t} \quad (18)$$

Above, price (*lnP*) is endogenous and is estimated (Equation 17) using a set of instruments contained in vector ***W***, and all other regressors (***X***) in the system. The predicted values of (17) are used in (18). We produce elasticity estimates for online education as well as for traditional education. In each case, we use a similar set of equations, but use instrumental variables and regressors that are specific to corresponding type of education, as found in the literature.

As online courses at public institutions are growing, exclusive full time enrollment of all students in only one type of classes is less likely.[3] Therefore, we use the natural log of total number of e-learning undergraduate credit hours, *E*, that were completed[4]. To identify correct pricing per online credit hour, we first consulted tuition policies by state. SREB provides these policies under their downloadable tuition data sets (see Table 1 for a summary of the 10 states' online tuition policies). After identifying each state that has separate policies for traditional tuition and online tuition, we visited each university's website and collected the appropriated assessed fees for online courses.[5] Tuition was then divided by 15[6] to account for an average full time course load over an academic semester. This brought our pricing variable in line with per credit hour tuition that institutions use. After adjusting each institution's tuition per credit hour, we then applied additional fees associated with online programs.

However, as this study focuses on colleges and not student choice, it is impossible to determine which colleges serve as substitutes for one another. Ideally, we would use the price per credit hour for the competitor for college *i*. Since we cannot fully analyze student choice, we instead use a relative price for each college under the assumption that every four-year (two-year) college in our sample serves as a substitute for another four-year (two-year) college. To create this relative price, we divided college *i*'s price per credit hour by the average price per credit hour of all four-year public colleges. The natural log was then taken of the relative price. We applied this procedure to two-year colleges as well. Our final pricing variable is the natural log of relative tuition per online credit hour for each college. We should note that this measure does not take into account the total cost of attendance to a college. However, this measure does have the advantage that students that participate in online courses, in particular those who fully engage in an online degree program, can forgo some additional fees associated with attending a college such as athletic fees.

We also considered the role that an online course played in determining tuition rates for different types of students, *i.e.* in-state and out-of-state. When consulting policies regarding online tuition and fees we also checked to determine if there was a difference beyond what has already been mentioned. We found little difference[7] in tuition or classification of student. Students that participate in an online course have additional fees imposed on their tuition, but do not receive different rates of tuition compared to in-state students. This essentially means that online courses offered by higher education institutions treat students taking online courses as in-state students. Online courses may therefore be viewed as borderless in regards to tuition and the need to alter our original specification to account for trends among states is unwarranted.

We employ the lags of the natural log of tuition, the natural log of state appropriations, the natural log of the average salary of full-time faculty, the natural log of total interest on capital and a premium[8] as instrumental variables in Equation (17), contained in the vector ***W***. The lag of tuition is used as colleges are likely to base current year tuition rates (per credit and full-time) on

last year's tuition rate. State appropriations are also lagged as state congresses determine funding for the following year.

We use the lag of the natural log of the average faculty salary as faculty salaries make up a large portion of university expenditures and universities are likely to increase price to offset this cost. Interest serves as another supply side determinant for each university. As universities expand capital purchases, and accrue more debt, total interest will increases and universities are likely to alter tuition to finance their debt. Lastly, premium is a dummy variable equal to one if if the college charges more for their online course.

Table 1
E-LEARNING COURSE FEE POLICIES

State	e-Learning Tuition Policy	Policy Adoption
Alabama	Varies by Institution	-
Arkansas	No	-
Florida	Per-credit hour course fee	-
Florida College System	Per-credit hour course fee	2009
Kentucky	Some differentiate online rates	2005
Maryland	No	-
Maryland System	Unclear	-
Mississippi	Varies by Institution	-
Mississippi Community/Junior Colleges	No, course fees	2008
North Carolina	No	-
North Carolina Community Colleges	No	-
Oklahoma	Varies by Institution	-
Texas	Not in Statute	-
West Virginia	Unclear	-
West Virginia Community Colleges	No special/unique rate	-

Note: The last column reports when a new e-Learning fee assessment policy was implemented. For states that do not have a year specified, the policy had been established prior to the first year (2004) of data used in this paper. Colleges' websites in states with an unclear policy were visited to accurately determine fee assessment.

The vector of regressors, $\boldsymbol{X}$, included in both equations are based on past literature and theory. These regressors include: undergraduate traditional credit hours, state per capita income, a dummy variable if the institution is a four-year college, total high school graduates per state[9], the number of students receiving any form of financial aid for college i in year j, the mean wage rate per hour for all occupations at the tenth percentile[10], the unemployment rate, the student-faculty ratio.Total high school graduates per state represent potential enrollees, whereas undergraduate traditional credit hours serve as those students in college that create a potential to shift some of their current course work to online programs. In both cases, increases in each, is expected to increase e-learning undergraduate credit hours. College specific fixed effects are represented by $\boldsymbol{a}_i$ in Equation (17) and $\boldsymbol{b}_i$ Equation (18). Year effects, $\boldsymbol{\tau}_t$ Equation (17) and $\boldsymbol{\kappa}_t$ Equation (18) are also included. All regressors are in natural log form except for year dummies and percentages.[11]

The mean wage rate represents the opportunity cost of attending-or in the e-learning case participating in a class, however, the effects on credit hours is unclear. For instance, in the academic year 2007-2008, 85.7% of students who enrolled in at least one distance learning course were considered financially independent from their parents. Further, only 1% of students who took their entire program through distance learning claimed dependency status (Aud *et al*., 2011). It is natural to assume that an increase in the mean wage rate would decrease college

course participation, as students opt for the higher wage. Yet, a large portion of distance learners are nontraditional students-over the age of 24. For some of these students, obtaining a degree online represents the possibility of job advancement and the commensurate wage increase. Therefore, it is possible an increase in the wage rate may stimulate demand for e-learning courses as opposed to decreasing demand, as the burden of financing an education decreases and the potential reward increases.

As mentioned, traditional credit hours are also estimated using equations similar to (17) and (18). We instrument the natural log of out-of-state tuition of traditional credit hours with the natural logs of the lag of tuition per credit hour, the lag of state appropriations, and the lag of average faculty salary. Out-of-state tuition serves as a true cost to the student as in-state tuition is supplemented with state appropriations.[12]

The predicted values are then regressed on the natural log of traditional undergraduate credit hours, the regressors found in (18), the natural log of the total amount scholarship money awarded, the natural log of average faculty salary, and school selectivity.

Selectivity serves as a quality control.A typical quality variable found in much of the literature such as *US News and World Reports* rankings is infeasible, as our sample contains two-year colleges that are unranked. Applying the lowest ranking possible to these institutions could cause bias in our estimates. [13] Instead, selectivity is based on the previous year's admittances to applicants. For two-year colleges and several four-year colleges, this effectively means the open enrollment that many adopt will yield a measure of 1, which serves as an indication of comparatively low quality.

RESULTS

Table 2 provides summary statistics and definitions for the variables used in all models. The one variable that appears to be out of place is *lnPrHour*, our relative price variable. However, its interpretation is simply that some colleges had lower relative tuition per credit hour while other had high relative tuition per credit hour.

Table 2
SUMMARY STATISTICS FOR 398 INSTITUTIONS (2004-2009)

Variable	Mean	St. Dev.	Description (Source)
lnElearn	8.2816	2.7026	Natural log of undergraduate e-learning credit hours (SREB)
lnHours	11.6405	0.9709	Natural log of traditional undergraduate credit hours (SREB)
lnEPrHour (12 hours)	1.7302	0.4038	Natural log of relative tuition per undergraduate credit hour (IPEDS)
lnEPrHour (15 hours)	1.5110	0.4017	Natural log of relative tuition per undergraduate credit hour (IPEDS)
lnTPrHour (12 hours)	6.3275	0.5609	Natural log of tuition per undergraduate credit hour out-of-state(IPEDS)
lnTPrHour (15 hours)	6.1043	0.5609	Natural log of tuition per undergraduate credit hour out-of-state(IPEDS)
lnApprop	16.7400	1.0891	Natural log of state appropriations lagged one year (IPEDS)
Premium	0.2519	0.4342	Dummy = 1 if the college charges extra for online credit hours
lnSalary	10.8332	0.2170	Natural log of average faculty salary (all ranks) equated to 9 months (IPEDS)
lnInt	8.3577	6.4945	Natural log of interest on capital (IPEDS)
lnTotScholar	15.8754	1.9164	Natural log of total scholarships money awarded (IPEDS)
SFR	39.1624	30.8312	Student-to-faculty ratio (IPEDS)
lnIncome	10.4219	0.1329	Natural log of state per capita income (BEA.gov)
lnHSGrad	11.2186	0.8726	Natural log of total number of high school graduates (NECS)

lnTenWage	1.9721	0.0884	Natural log of 10th percentile wage for all occupations (BLS.gov)
lnFinAid	6.1356	1.0388	Natural log of total number of students receiving any financial aid (IPEDS)
Select	0.8966	0.1717	School admissions divided by school applications (IPEDS)
%Fulltime	0.5569	0.2086	Percent of undergraduate students that are enrolled fulltime (IPEDS)
FourYear	0.3541	0.4783	Dummy = 1 if college is a four year institution (IPEDS)
UR	5.6362	1.7338	Unemployment rate by state (BLS.gov)

Results for our models are found in Table 3.[14] Each type of credit hour taken uses tuition divided by 12 credit hours and tuition divided by 15 credit hours to determine tuition per credit hour. We control for individual heterogeneity in each model by using individual college effects. Tests for weak instruments and overidenfication are also employed and reported. Clustered standard errors are used to correct for heteroskedasticity and autocorrelation in the panels.

Elasticity estimates of a traditional college education have been placed in the inelastic and elastic range depending on the type of institution surveyed. The results from our e-learning model suggests that universities face a relative price elasticity of demand that is price elastic for their e-learning courses. Elasticity estimates are -4.54 for tuition adjusted for 12 credit hours and -4.57 for tuition adjusted for 15 credit hours, significant at the 10 percent level. Elasticity estimates for traditional credit hours are -0.40 for tuition adjusted to 12 credit hours and -0.39 for tuition adjusted to 15 credit hours, each at the ten percent level. For the average university, this amounts to having an elasticity for e-learning credit hours being about 11 times greater than that of their traditional credit hours. These estimates are similar to the literature presented earlier (Parker and Summers 1993; Zhang 2007; and Curs and Singell 2010).[15] According to the price discrimination model introduced earlier, the difference in elasticities should translate to a difference in prices, if the organization is to maximize its revenue. Given that our estimates show a traditional education elasticity below one indicates that the average university is not close to maximizing its revenue. It actually means that at the price set marginal revenue is negative. Of course, this follows from the fact that traditional tuition is set via administrative procedures and reflects motives other than revenue maximization. Presumably, universities have more latitude in setting online tuition. Unfortunately, the inelasticity of the traditional education demand, prevents the direct applicability of the conditions derived earlier since we end up with negative numbers!

Nevertheless, our estimates allow us to estimate the sign of the cross price elasticity term used in equation (16').

$$\epsilon_{12} = \frac{\partial q_1}{\partial p_2}\frac{p_2}{q_1} = \frac{\partial q_1}{\partial q_2}\frac{\partial q_2}{\partial p_2}\frac{p_2}{q_1} = \left(\frac{\partial q_1}{\partial q_2}\frac{q_2}{q_1}\right)\left(\frac{\partial q_2}{\partial p_2}\frac{p_2}{q_2}\right)\frac{q_1}{q_2}\frac{q_2}{p_2}\frac{p_2}{q_1} = (0.0014)(-4.54)\frac{q_1}{p_1} < 0$$

In other words, our empirical estimates suggest that traditional and online education are complementary services rather than substitute services. As pointed out above, complementarity implies that the revenue maximizing online price should be below the revenue maximizing traditional education price.

Overall, our price discrimination analysis and empirical estimates suggest that the current pricing structure is entirely inconsistent with revenue maximization, under a minimum profit constraint. To move towards such a goal universities need to increase their traditional prices significantly and reduce their online price significantly to allow them to compete more effectively. To determine how much the average school may gain in revenue from a decrease in the online price, we use the average price per credit hour and average number of e-learning credit

hours. At 12 credit hours, the average price is $658 and the average number of e-learning hours taken is 14,985. Holding other factors constant, a decrease by 10% in the price per online credit hour increases the average institution's tuition revenues by $3.04 million with an elasticity of 4.54. At 15 credit hours, the average price is $528 and the average e-learning credit hours take remains 14,985. Holding other factors constant, a 10% decrease in price per online credit hour increases the average institution's revenues by $2.46 million. This translates into an additional

Table 3
RESULTS FOR PRICE RESPONSE MODEL

	lnElearn		**lnHours**	
Variable	**12 Hours**	**15 Hours**	**12 Hours**	**15 Hours**
lnEPrHour	-4.5358	-4.5701	-	-
	(2.5731)*	(2.5972)*	-	-
lnTPrHour	-	-	-0.3968	-0.3930
	-	-	(0.1684)*	(0.2018)*
lnHours	-0.1518	-0.1506	-	-
	(0.6459)	(0.6459)	-	-
lnElearn	-	-	0.0014	0.0012
	-	-	(0.0035)	(0.0035)
lnFinAid	-0.2313	-0.2317	0.0614	0.0591
	(0.1506)	(0.1509)	(0.0212)***	(0.0233)**
lnTotScholar	-	-	0.0059	0.0059
	-	-	(0.0029)**	(0.0028)**
lnSalary	-	-	-0.0499	-0.0510
	-	-	(0.0396)	(0.0324)
lnTenWage	-5.6815	-5.6768	0.2299	0.2295
	(3.8336)	(3.8354)	(0.2944)	(0.2939)
lnIncome	5.0702	5.0559	-0.6953	-0.6734
	(2.6209)*	(2.6218)*	(0.2446)***	(0.2273)***
lnHSGrad	-2.6549	-2.6742	-0.1104	-0.1378
	(2.0319)	(2.0387)	(0.1559)	(0.1578)
UR	0.2215	0.2223	0.0041	0.0042
	(0.0788)***	(0.0790)***	(0.0056)	(0.0054)
SFR	0.0045	0.0045	0.0009	0.0009
	(0.0029)	(0.0029)	(0.0005)*	(0.0006)*
Select	-	-	0.0001	0.0001
	-	-	(0.0004)	(0.0003)
%Fulltime	1.6623	1.6685	0.0286	0.0269
	(.9470)*	(0.9479)*	(0.0676)	(0.0610)
Fouryear	-8.2253	-8.2393	0.8884	0.0434
	(1.7972)***	(1.8035)***	(0.1455)***	(0.2994)
Year Effects	Yes	Yes	Yes	Yes
School Effects	Yes	Yes	Yes	Yes
First stage *F*	4.16	4.14	4.32	5.78
Hansen *J*	7.3212[†]	7.3427[‡]	2.1243	1.9576
N	1854	1858	1855	1855
R2	0.7732	0.7730	0.9913	0.9913

Note: *, **, *** significant at the 10%, 5%, and 1% levels respectively. Clustered standard errors are given in parentheses. The First Stage *F* rejects the null hypothesis of underidentification. The Hansen *J* statistic for overidentification fails to reject the null hypothesis lending evidence for valid instruments. Additional tests for weak instruments (not reported) reject the null of weak instruments as well.
[†, ‡] p-values are 0.1199 and 0.1188 respectively.

6,803 credit hours and 6,848 credit hours being taken with a $66 and $53 decrease in the average price per credit hour, at the 12 credit hour and 15 credit hour levels respectively. Given these are relative price elasticities, we should caution that the increases in revenue are relative increases to other institutions.

Traditional credit hour revenue can increase by raising the price charged per credit hour. Average tuition for 12 hours is $648 and average credit hours are 183,457. If the average institution raised price by 10%, then total revenues would increase from $118.88 million to $125.5 million or a $6.7 million gain at 12 credit hours. The average institution would also gain $5.45 million in total revenue with a 10% increase in price when considering 15 credit hours.

Another interesting aspect of our results is the year effects (estimates suppressed)[16] are positive and increasing, and significant at the one percent level. The base year is 2004, and each year effect estimate is greater in magnitude than the prior year effect estimate. This suggests there was an increasing trend in e-learning credit hours taken and that in conjunction with our relative pricing variable, colleges could have increased their tuition revenue through lower relative e-learning tuition.

Lastly, we consider the effects of two- and four-year institutions. Estimates show that being a four-year institution decreases the total number of undergraduate e-learning credit hours taken, but increases the total number of traditional undergraduate credit hours take. This is in line with our assertion that the e-learning market is monopolistically competitive and traditional education is a local monopoly. Cost conscious students will shop around for low cost classes that can transfer to their degree programs. Two year institutions offer these low cost transferable credits. On the other side, as students are locked in traditional residential four year institutions, they are forced to take more traditional classes on campus.

We turn to the returns to education literature for added analysis of our postulation. The price sensitivity that two-year college students face may stem from the ability of a student to transition from a two- to four-year institution. The primary issue associated with such a transition may be the lag two-year students face in their returns to education. Long and Kurlaender (2009) find that students who use a two-year institution as a springboard into a four-year institution are 14.5 percent less likely to complete their four year degree in less than nine years. Other studies such as Gill and Leigh (2003) and Reynolds (2012) also report that delaying a four-year education by first entering a two-year institution imposes an earnings penalty and causes the graduate to never "catch up." Such a delay in education prohibits greater earnings in the future. This is not to say that students at two-year institutions will not benefit from an increase in their education as outlined in a synopsis of the literature in Belfield and Bailey (2011). After controlling for heterogeneity, the returns from a four-year degree are, on average, higher, in some cases double, than those of a two-year degree (see Grubb 1997). Such considerations, after factoring in costs and other quality measurements, may be on the minds of students when selecting a two- or four-year online program, leading to the conclusions seen in our results.

CONCLUSION

We have shown that the demand for e-learning undergraduate credit hours is highly price elastic and the demand for traditional undergraduate credit hours is inelastic. These results hold for 398 southeastern US two- and four-year public colleges. Price elasticity estimates ranged from 4.54 to 4.57 for e-learning hours and 0.40 and 0.39 for traditional hours. When considering

two- and four-year institutions, a decrease in e-learning hours was associated with the four-year institutions. We posited several reasons for the change, including the ability to transfer credit to four-year colleges, quality of institutions and earnings premiums.

Our main findings demonstrate that if institutions seek to maximize revenue, subject to a minimum profit constraint, then their current pricing scheme is not achieving their goal.
A correct pricing scheme for the institution to increase its revenue would be to lower the price of its online courses and increase the price of its traditional courses. While the theoretical model may not be able to capture all the complexities a university is dealing with, the empirical estimates suggest that even if the university is already price-discriminating, it is not price-discriminating enough. Further price-discrimination is required if revenue is to be increased.

A caveat to our results is the following: Our data does not distinguish between online classes taken by on-campus students and purely online students. The difference is that on-campus students most likely take the online class as part of their regular load which means that it is part of their fixed tuition. On the other side, online students pay by the credit hour. Our model assumes, implicitly, that a reduction in the cost of the online courses will stimulate additional demand from purely online students, existing and new. The price reduction will have no effect for on-campus students under a fixed fee tuition, since they do not get a discount for the online classes (Except if the institution provide such discounts to economize in new building construction and facilities costs.[17])

Issues still arise for higher education. Many higher education institutions are more adept at offering online courses as they were early adopters of the technology and have built programs that are widely recognized. This does not necessarily mean that these institutions provide higher quality online courses compared to those institutions that offer significantly less online courses and programs, just that they have a first mover advantage in online education. If they still hold the first mover advantage, then they can be price setters and let the market follow. It may also be true that traditional brick and mortar schools have long viewed online education as an inferior product to in-classroom instruction. However, potential students may still recognize the online courses and programs offered by traditional brick and mortar institutions as high quality, thus leading to a better outcome for the institution as it lowers its online price to attract more students.

Several issues remain to be considered in future research. The appearance of Massive Open Online Courses (MOOCs) in 2008, *i.e*. near the end of our sample period, may have some effect on the estimated elasticities, though the fact that such courses do not award college credit and, therefore, have extremely low completion rates, leads us to suspect that such an effect will not be significant. Obviously, expansion of the sample beyond 2009 is an area of future research as well.

ENDNOTES

[1] It is assumed throughout this section that this minimum profit level is well below the maximum profit level, so that the derived solutions exist.

[2] That is online students (q_2) have no effect on traditional campus demand (p_1): $\frac{\partial p_1(q_1,q_2)}{\partial q_2} = 0$

[3] That is to say, some students may choose to take one or two online courses with their traditional course load while others fully choose online courses.

[4] Instead of measures like number of students enrolled or FTE (Full Time Equivalent) enrollments.

[5] In most cases, this required reviewing past academic or undergraduate catalogs.

[6] Tuition was also divided by 12 as a robustness check to account for differences in full-time participation.

[7] In the instances where students were charged different tuition rates or classified differently, adjustments were made accordingly.

[8] Premium is a dummy variable equal to 1 if the school includes a fee for online courses, as indicated by the policy of each state in Table 1.
[9] High school graduate data come from the NCES – Projections of Education Statistics to 2020 with actual data up to 2007, and projected data for 2008 and 2009
[10] All monetary variables were deflated to 2004 dollars. Wage data come from the BLS Occupational Employment and Wage Estimates "State Cross-Industry estimates."
[11] Student debt may also play a pivotal role in continuing education, as greater debt may reduce or stop the continuation of education. The Institute for College Access and Success compiles data on student debt by college and type. Unfortunately, there were no data for two-year colleges in our sample, and only 56% of the four year colleges were partially or fully covered. Using student debt data would reduce our sample by 75%. Therefore, we omitted it from our final model. However, we did run regressions for this reduced sample, and found student debt to be insignificant.
[12] In fact, in-state and out-of-state tuition were highly correlated and the elasticity estimates were not very different.
[13] Using ratings for community colleges available bias the results as well; because, the number one rated community college would be equal to the number one four-year university. For example, Princeton University would be of equal quality as North Florida Community College.
[14] We tested our model for various specification issues and found it to be subject to heteroskedasticity and autocorrelation. Standard errors are clustered around each school to allow for valid statistical inference. In addition, we used a modified Hausman test (Wooldridge 2002) to test for fixed versus random effects. The test revealed fixed effects to be preferred over random effects.
[15] All three studies report an inelastic demand, though Curs and Singell report the highest elasticity at -0.89.
[16] Estimates are available upon request.
[17] We are grateful to a referee for this point.

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EMPIRICAL TESTS OF MONETARY POLICY MEASUREMENTS AND THEIR IMPLICATIONS FOR MACROECONOMICS

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ABSTRACT

A considerable amount of research has explored what is the best indicator for the Federal Reserve's monetary policy and how various macro-economic variables respond to monetary policy. Few existing works explore the Federal Reserve data that was used for measuring monetary policy. This paper investigates the nonborrowed reserves calculation and finds that the accounting method for calculating nonborrowed reserves has changed in an inaccurate way since 2008. This paper tries different ways to correct nonborrowed reserves and explores the indications of the monetary policy. These experiments show the robustness of the well-structured semi-VAR model developed by Bernanke and Mihov (1995), since in this model, bad data never works as well as good data; doctored data never works as well as real data. Furthermore, this paper finds that the best indicator of monetary policy is still the federal funds rate. The inaccurate nonborrowed reserves calculation is at least one of the reasons which accounts for the unclear indications of the Federal Reserve's monetary policy during the recent financial crisis.

INTRODUCTION

Nonborrowed reserves have started to become negative since 1959 (figure 1), which was the first time in the U.S. history.
The formula the Federal Reserve used to calculate nonborrowed reserves up to December 12, 2007 was:
Nonborrowed reserves = Total reserves – Discount Window Borrowings

Then on December 12, 2007, the Federal Reserve started using the following formula:

Nonborrowed reserves = Total reserves – Discount Window Borrowings– TAF borrowing

The negative value of nonborrowed reserves was because total borrowings were larger than the total reserves. Not all TAF borrowing was included in total reserves, thus negative nonborrowed reserves occurred. I have sent e-mails to the Federal Reserve asking how much TAF borrowing was hold in total reserves. Unfortunately, the staff at the Federal Reserve could not give me a satisfactory answer.If the Federal Reserve changed the accounting method for nonborrowed reserves intentionally, then did they also change the monetary policy indicator? Although the Federal Reserve claimed that the federal funds rate is used as the monetary policy instrument, the Federal Reserve does not always do as it says. Thus it makes sense to recheck the monetary policy indicator.

How does the policy stance today compare with what it was in earlier periods? Furthermore, this paper will use the corrected nonborrowed reserves and re-evaluate various implications of the monetary policy. Last but not least, this paper will be an additional support for Barnett's proposal (2012) for creating the Fed's own data bureau by examining another Federal Reserve's inaccurate data.

As a matter of fact, nonborrowed reserves are not the only inaccurate data that is inaccurate.

INACCURATE DATA IN THE FED

Abnormal nonborrowed reserves

Suddenly on January, 1st, 2008, the nonborrowed reserves of U.S. banks became negative. Then they increased to as large as 486 billion in June, 2009 (figure 1).

First of all, this was the first time nonborrowed reserves had been in a negative number. How can borrowed reserves exceed total reserves? It is an accounting error. A simple example: If there is a 6 inch apple pie on the table, what the Federal Reserve was doing was taking an 8 inch apple pie from the original one.

Secondly, the large increase in nonborrowed reserves later was due to the fact that total reserve was expanded by the Federal Reserve, but the Fed was still using an inaccurate accounting method which failed to include all the Term Auction Facility (TAF) borrowing in the total reserves.

Poor monetary-aggregate data

The Federal Reserve still uses the simple sum monetary aggregate data rather than Divisia index monetary aggregate data which has already been applied by many other countries. Simple sum aggregate data is inaccurate. You cannot compare apples to oranges. The Federal Reserve cannot combine money in the checking account to savings account, since they have different costs known as the "user cost"(Barnett & Serletis, 2000).It costs more to hold the money in a checking account than in a savings account. The bank has to be compensated for providing extra liquidity if one holds money in a checking account.

No pre-sweeps data

Barnett (2010) pointed out that M1 aggregates are far below actual data. Banks only provide the Federal Reserve post-sweeps checking account data but no pre-sweeps data. In order to provide the Federal Reserve with less required reserves, banks usually transfer checking account deposits into savings account. In this case, the Federal Reserve is not able to monitor the exact liquidity, since money in the checking accounts is one of the most important channels to provide liquidity. To be accurate, they should have both pre-sweeps and post-sweeps data.

The Fed and the financial crisis

Both Barnett and Chauvet (2011) and Taylor (2008) showed that the monetary excesses were the main cause of the recent financial crisis. Furthermore, Hanke (2011) has updated the recent data and pointed out that no money supply (Divisia M4) and a very "weak" economy will not give us much confidence in the economy at least in the near future.

Barnett and Chauvet (2011) checked the Federal Reserve's simple sum monetary aggregate data and found it is far biased from index number theory, which misled both the public and the Fed's policy to take more risks and provide the market excess money before the recent financial crisis. In consequence, it might be a main cause of the recent sub-prime mortgage crisis.

Taylor (2008) found empirical evidence that government interventions caused the sub-prime mortgage crisis. The Federal Reserve set the interest rate deviating from the historical principles and thus provided the market with excess money.

Although Taylor (2008) did not explain in his paper why the Federal Reserve set the interest rate so low before the financial crisis, one of the underlying reasons can be that the Fed's faulty simple sum monetary aggregate data was far biased from the actual monetary aggregate data. By monitoring the inaccurate simple sum monetary aggregate data, the Federal Reserve set the federal funds rates so low than it should be. In other words, the Fed provided the market excess money before the sub-prime mortgage crisis, which is consistent with Barnett and Chauvet's findings (2011).

Hanke (2011) has updated the recent Divisia M4 data and pointed out that the money supply growth data M2 published by the Board of Governors of the Federal Reserve System has grown rapidly. While the Divisia M2 has decreased, the broader money measurement M4 decreased even more rapidly and is now currently flat. No money supply (Divisia M4) and a very "weak" economy will not give us much confidence in the economy at least in the near future. Once again, the Federal Reserve has misled both the public and itself by using the simple-sum monetary aggregate data M2.

The importance of high quality data in the "information age"

Information is more important today than ever, since we are in the "information age", especially when the internet is so widely used and so many portable wireless devises are invented. Let's take stock market as an example. Stock price may respond to various information shocks. As an investor, the first thing to do is to collect the correct information quickly and analyze how the market will respond to those information shocks and then make an appropriate decision. Before the internet was widely created, people could only trade at a certain place such as the New York Exchange. However, now one can sit at home in Shanghai and trade U.S. stock just by clicking a "buy" or "sell" button on an e-trading platform such as "Scottrade". High quality data and information is so valuable today, people have to pay thousands of dollars to get them. If one wants to get the repo rates data, the only place that provides that historical data so far as I know is the Bloomberg system. However, it is not free.

"In economic theory, the economic system is highly sensitive to information shocks (Barnett, 2012)." The economic system's dynamics could be hurt by even the irrelevant information shocks.

The Term Auction Facility

The Term Auction Facility (TAF) was established on December 12, 2007. It allowed the Federal Reserve to provide funds to depository institutions. First of all, banks were not willing to borrow from the discount windows, because that would signal the bank's insolvency. Secondly, since the Federal Reserve used a new method in setting the discount rate (the rate used when banks borrow at the discount window) since 2003, which thus became the first time in the U.S. history that the discount rates were higher than the federal funds rates during a recession, which will cause an even worse liquidity problem. Thirdly, the credit was so tight at the recent financial crisis; banks were not willing to lend to one another. TAF borrowing was established to accommodate the unique problem of the recent financial crisis.

The TAF provides banks with other benefits as well. For instance, the TAF allows banks to borrow against a wide range of collaterals. Moreover, the TAF has the potential to lower a bank's overall funding cost.

LITERATURE REVIEW

Relevant methodology

Bernanke and his coauthors had a series of papers in exploring a good indicator of monetary policy actions.Bernanke and Blinder (1992) found that the federal funds rate is very informative about future movements of real macroeconomic variables. The federal funds rate was found to be a good indicator of monetary policy actions.Bernanke and Mihov (1995) developed a VAR-based methodology for measuring the stance of monetary policy by applying and extending the approach of Strongin (1992), Bernanke and Blinder (1992), and Christano, Eichenbaum, and Evans (1994). Bernanke and Blinder (1992) used structural VAR model to study the relationships among money, credit and income. Strongin (1992) proposed a new method of identifying monetary policy by using nonborrowed reserves.

Bernanke and Mihov (1995) developed a "semi-structural" VAR approach, which makes restrictions on policy block but leaves the macroeconomic variables unrestricted. The methodology nests earlier VAR-based measures and can be used to choose the best monetary policy indicator for macro economics. By using this model, Bernanke and Mihov (1995) successfully found that during 1979 to1982, the nonborrowed reserve model was strongly accepted, which suggested that nonborrowed reserve is the best indicator for monetary policy.This period overlaps Volcker’s experimental nonborrowed reserve targeting period exactly.

Bernanke and Mihov (1998) further applied a "semi-structural" VAR model for exploring monetary policy's effects on macroeconomic variables.

The effects of the Federal Reserve's faulty data on financial crisis

Both Barnett and Chauvet (2011) and Taylor (2008) showed that the monetary excesses were the main cause of recent financial crisis. Barnett and Chauvet (2011) checked the Federal Reserve's simple sum monetary aggregate data and found it is far deviated from index number theory, which misled both the public and the Federal Reserve's policy to take more risks and provide the market with excess money before the recent financial crisis.

In consequence, it may have contributed to the recent sub-prime mortgage crisis. Taylor (2008) found empirical evidence that government interventions caused the sub-prime mortgage crisis. The Federal Reserve set the interest rate deviating from the historical principles and thus provided the market with excess money. Although Taylor (2008) did not explain why the Federal Reserve set the interest rate so low before the financial crisis, one of the underlying reasons can be the Fed's faulty simple-sum monetary aggregate data misled the Fed's decision on setting the low federal funds rate, which is consistent with Barnett and Chauvet (2011)'s findings.

Furthermore, Hanke (2011) has updated the recent Divisia M4 data and pointed out that the money supply growth data M2 published by the Board of Governors of the Federal Reserve System has grown rapidly. While the DIvisia M2 has decreased, the broader money measurement M4 decreased even more rapidly and is now currently flat. No money supply (Divisia M4) and a very "weak" economy will not give us much confidence in the economy at least in the near future. Once again, the Federal Reserve has misled both the public and itself by using the simple-sum monetary aggregate data M2.

METHODOLOGY AND MODELS

This paper will use semi-structural VAR methodology developed by Bernanke and Mihov in 1995. The so called "Semi-structural VAR" means that half of the model is unrestricted, while the remaining half is restricted. In particular, the semi-structural VAR model which this paper is going to apply imposes restriction on block of policy indicators and no restrictions on macroeconomic variables. How to impose appropriate restrictions on block of policy indicators is extremely important. The effectiveness of this semi-structural VAR comes from the success of imposing the specific restrictions on these policy indicators. In order to do this, Bernanke and Mihov (1995) made a progress in exploring the underlying relationships and connections among policy indicators, which made this VAR model closer to the real world and thus more applicable.

$$\boldsymbol{Y}_t = \sum_{i=0}^{k} \boldsymbol{B}_i \boldsymbol{Y}_{t-i} + \sum_{i=1}^{k} \boldsymbol{C}_i \boldsymbol{P}_{t-i} + \boldsymbol{A}^y \boldsymbol{v}_t^y \quad (1)$$

$$\boldsymbol{P}_t = \sum_{i=0}^{k} \boldsymbol{D}_i \boldsymbol{Y}_{t-i} + \sum_{i=0}^{k} \boldsymbol{G}_i \boldsymbol{P}_{t-i} + \boldsymbol{A}^p \boldsymbol{v}_t^p \,. \quad (2)$$

"**Y**" are vectors of macroeconomic variables including real GDP, GDP deflator and consumer-price-index for all urban consumers.

"**P**" are policy indicators containing federal funds rate, total reserves and nonborrowed reserves.

In order to connect the observable VAR residuals and the unobservable shocks in the policy block, a specific model is needed. Five models are tested here, which are federal funds rate model (FFR), nonborrowed reserves model (NBR), orthogonalized nonborrowed reserves (NBR/TR), borrowed reserves model (BR) and just identified model (JI) respectively.

This paper uses quarterly data from the first quarter of 1959 to the third quarter of 2009. The six variables are the real GDP, GDP deflator (implicit price deflator for GDP), federal funds (effective) rate, consumer-price-index for all urban consumers (all items), total reserves, and nonborrowed reserves of depository institution, respectively.

in this study, except for the fact that Dow--Jones index of spot commodity price was used instead of consumer price index for all urban consumers (all items).

ESTIMATION AND IMPLICATIONS

The Semi-VAR methodology was applied for all the five models to test 1965-1996, 1965-2007 and 1965-2009 sample periods, respectively. The five models are federal funds rate model (FFR), nonborrowed reserves model (NBR), orthogonalized nonborrowed reserves (NBR/TR), borrowed reserves model (BR) and just identified model (JI) respectively.

First important implication

ϕ^d is the coefficient that describes the Fedederal Reserve's tendency to accommodate reserve demand shocks. ϕ^d is found to be greater than 1 most of the time. This estimation outcome contradicts the nonborrowed reserves (NBR) model, which assumes that $\phi^d = 0$, indicating that the nonborrowed reserve NBR model is strongly rejected.

ϕ^b describes the strength of the Fed offsetting the demand for borrowed reserves shocks. ϕ^b is always found to be negative and often close to -1.This result coincides with the federal funds rate model, implying that federal funds rate (FFR) model is accepted. In conclusion, the federal funds rate model is strongly selected by the semi-VAR approach for all the sample periods. In other words, the Federal Reserve is still targeting the federal funds rate just as it claimed.

Second important implication

Comparing the estimation results of the sample period 1965-2007 with that of the sample period 1965-2009, the coefficients significantly different from zero estimated for period 1965-2009 tend to be not significantly different from zero for period 1965-2007, which suggests the parameter changed dramatically by simply adding two more years' worth of data (2008 and 2009). This further supports that 2007 is very likely to be a break point, which reconciles the historic record.

INDICATIONS OF IMPULSE RESPONSES TO MONETARY POLICY SHOCKS

This paper ran the impulse responses to see how the macro economic variables responded to the monetary policy shocks. It updated the sample period of earlier studies to include data up to 2009. It has found that the indications of monetary policy are not always clear, because the impulse response of real GDP to monetary policy shocks becomes abnormal. This finding supports the hypothesis that the incorrect nonborrowed reserve is at least one of the contributing factors to the unclear indications of monetary policy. During the recent financial crisis, much data became abnormal: total reserves were expanded by a large amount; TAF borrowing was included in the borrowed reserves but not included in the total reserves; real GDP shrunk, all of which might contribute to the unclear indications of monetary policy.

First of all, impulse responses of GDP to federal funds rate shock was tested in the federal funds rate model for the periods of 1965-1996, 1965-2007 and 1965-2009 respectively.

The six variables that Bernanke and Mihov (1998) used are the same as the variables used 2009, the result was not satisfactory.

Then, the impulse response of GDP to nonborrowed reserve shocks was checked in the nonborrowed reserve model for the time frame of 1965-1996, 1965-2007 and 1965-2009 respectively, similar result was obtained, the impulse response is normal for the first two sample periods, but when adding the data of 2008 and 2009, the result was not satisfactory.

What factors were there that contributed to the abnormal impulse response to policy shocks? During the recent financial crisis, much data became unusual. Among all six time series data (real GDP, GDP deflator, CPI, federal funds rate, total reserves and nonborrowed reserves) used in this paper, real GDP, federal funds rate, total reserves and nonborrowed reserves were obviously unusual during this period of time. Please see figure 1.10 through figure 1.14 for their graphs. Real GDP went down during the recent financial crisis, but it was not the first time in the U.S. history. Federal funds rate became close to zero, which was never happened before. Total reserves were largely expanded by the Federal Reserve. Moreover, nonborrowed reserves became inappropriate. All of the above factors may contribute to the abnormal impulse response to policy shocks, which implied an unclear indication of monetary policy. However, the Federal Reserve can prevent one data from being calculated wrong, that is, nonborrowed reserves data.

This paper will correct the nonborrowed reserve data. There are two ideal ways to correct the data. One way is to include TAF borrowing data in both total reserves and borrowed reserves; the other way is to exclude TAF borrowing data from both of them. It is expected that the correct data will result in smoothing the impulse response or making the impulse response less volatile.

CONCLUSIONS

Federal funds rate is found to be the best indicator of monetary policy, which is also claimed to be the monetary policy targeting instrument by the Federal Reserve. The semi-structural VAR model used in this paper was also applied by Bernanke and Mihov

(1998), who successfully found that during 1979 to1982, the nonborrowed reserve model was strongly accepted. This period overlaps Volcker's experimental nonborrowed reserve targeting period exactly, which showed the robustness of the semi-structural VAR model.

Comparing the estimation results of the sample period 1965-2007 with that of the sample period 1965-2009, the coefficients significantly different from zero estimated for period 1965-2009 tend to be not significantly different from zero for period 1965-2007, which suggests the parameter changed dramatically from simply adding two more years data (2008 and 2009). This further supports that 2007 is very likely to be a break point, which is consistent with the fact that the financial crisis started in the same year.

This paper tried to correct the nonborrowed reserve data, but unfortunately there is no way to fix it in an ideal way at this point due to the lack of data. If the data can be fixed, it is expected the corrected nonborrowed reserve data will result in smoothing the impulse response or making the impulse response less volatile.

Since the two ideal ways to correct data are not at all practical, this paper tried to fix the nonborrowed reserve data when discount window borrowing exceeded total reserves. It was found not only total borrowing (borrowing at the discount window + TAF borrowing) exceeded total reserves, but even discount window borrowing exceeded total reserves in both September and October of 2008. The only way can be thought of is to ignore the data of September and October of 2008, since there is no way to fix it at this point with discount window borrowing exceeding

total reserves. However, the impulse responses of GDP to shocks in both federal funds rate and nonborrowed reserves models are not satisfactory either.

Furthermore, all the negative nonborrowed reserve were ignored and impulse responses were run once again. It turns out that the impulse responses of GDP to shocks in both federal funds rate and nonborrowed reserve models are unsatisfactory, actually even more volatile than simply ignoring two periods' data, which was just as expected. The economic system created to model the real world crashes by missing more data.

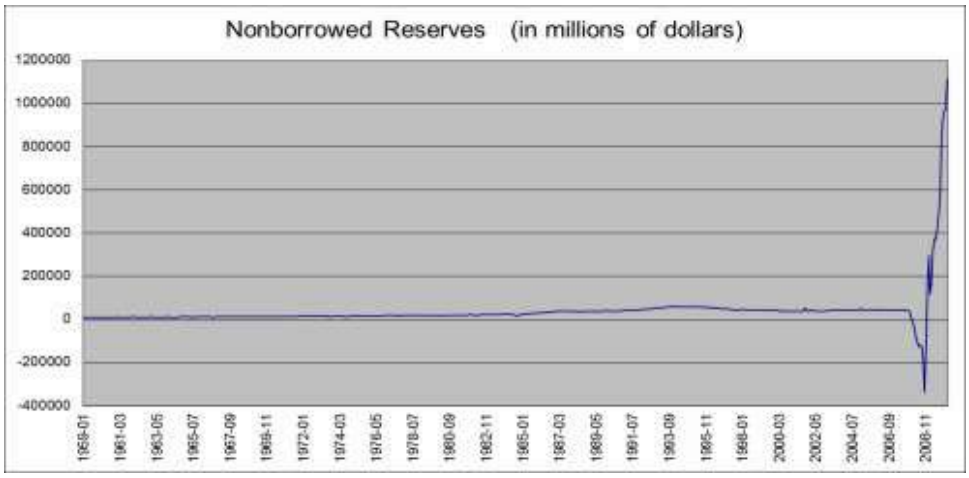
The experiments for fixing the nonborrowed reserve data were not successful. The reason for the failure of new impulse responses is when the data was ignored, even two periods of data, the balance of the whole economic system was destroyed. Let's recall our model. Macroeconomic variables Y depend on current and 13 lagged values of macroeconomic variables and on 13 lagged values of policy indicators. At the same time, the policy variables depend on both current and 13 lagged values of policy variables and macroeconomic variables. In other words, all six variables have complicated relationships with each other up to 13 lagged periods. If any period data was ignored, the relationships were destroyed, which explained the unsatisfactory impulse response.

The failure of these two experiments further showed the robustness of this semi-structural VAR model. In this well-structured semi-structural model: bad data (Fed's wrong nonborrowed reserves) never works as well as good data; doctored data (Experiments of ignoring two periods' data and ignoring all negative nonborrowed reserve data) never works as well as real data.

Last but not least, the abnormal impulse responses to monetary shocks showed that the Federal Reserve is at least one of the reasons for the unclear indications of monetary policy. This will become an additional support for Barnett's proposal (2012) of creating the Federal Reserve's own data bureau. During the recent financial crisis, much data went abnormal. Total reserves were expanded by a large amount. From Jan.1, 2008, the nonborrowed reserves of U.S. banks became negative and increased to as large as 486 billion in June, 2009, since part of the TAF borrowing was included in the borrowed reserves but not included in the total reserves. Real GDP shrunk and federal funds rate went to almost zero, all of which might have contributed to the unclear indications of monetary policy.

A caveat to the findings is that, because of its focus on the importance of recent changes, it was unavoidably left with short sample periods. It's impossible to do semi-structural VAR on only 2008 and 2009 data (quarterly), because 13 lags were picked by both AIC and SBC. In this case, the sample period 1965 to 2007 was used to compare with the one from 1965 to 2009.

Figure 1
NONBORROWED RESERVES (IN MILLIONS OF DOLLARS)



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WAGE DISPERSION'S EFFECTACROSS TEAM UNITS: EVIDENCE FROM THE NATIONAL FOOTBALL LEAGUE (NFL)

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ABSTRACT

Wage dispersion refers to the variance of wages across a firm. Two competing theories examine the effect of this dispersion on the firm's success. One theory (tournament theory) proposes that the larger the disparity, the better the firm performs. The other theory, based on cooperation and fairness, predicts a negative relationship between performance and disparity. Using a panel data approach, this paper separates NFL teams into offensive and defensive units. Results show support for the tournament theory on both sides of the ball and provide insight into why earlier work produced conflicting outcomes.

BACKGROUND

Wage dispersion (or wage inequality) refers to the variance of wages across a firm. Two competing theories examine the effect of this dispersion on the firm's success. One theory (tournament theory) proposes that the larger the disparity, the better the firm performs. This outcome results from lower-paid workers (behaving as if they are in a competition) striving to perform at the highest level in order to obtain a higher salary. This theory predicts a *positive* relationship between the level of dispersion and firm performance - higher dispersion leads to better performance. The other theory is based on cooperation and fairness (equity theory). This theory proposes that with greater pay inequity, the lower-paid workers, dissatisfied with their pay, refuse to cooperate and act to sabotage the firm's performance. As a result, equity theory predicts a negative relationship between dispersion and firm performance - higher dispersion leads to poor results for the firm.

Seminal research in wage dispersion has focused on firms (Lazear and Rosen, 1981; Lazear,1989; Ramaswary and Rowthorn, 1991). Recently, wage dispersion has progressed into studying professional sports teams (Sommers, 1998; Depken, 2000; Frick, Prinz and Winkelman, 2003; Dole and Kassis, 2008, Borghesi, 2008). This work has produced mixed results. In some cases, a positive relationship has been found between wage dispersion and winning percentage in professional hockey and major league baseball. In other cases, no relationship or a negative relationship has been found in professional baseball and football. In one study, a negative relationship was found between wage inequality and team success in professional basketball.

This research presents a more refined approach to team structure to examine the lack of consensus in results. It should be noted that in basketball, hockey and baseball, offensive and defensive players are on the court (field) simultaneously, and they are the same players. In football, however, offensive and defensive squads are separate groups of players. Therefore, it would be more difficult for a low-paid defensive player to sabotage or act cooperatively with a running back. Because most previous research grouped offensive and defensive football players together, it is not surprising that a clear relationship between wage dispersion and team performance is hard to find.

Following Borghesi (2008) and noting this difference between other professional sports and the National Football League (NFL), this paper divides NFL teams between offensive and defensive squads. Next, the degree of wage dispersion for each squad is computed and then compared to its (the squad's) performance using a panel data approach. Offensive performance is judged on "points scored" and "total yards gained" while defensive performance is based on "points allowed" and "total yards allowed". Results show support for the tournament theory on both sides of the ball. An increase in wage dispersion leads to more touchdowns scored and more yards gained. And for the defensive side of the ball, an increase in wage dispersion leads to fewer touchdowns allowed and fewer total points allowed.

In addition, offensive and defensive performance can also be judged based on efficiency in scoring. Once a team moves inside its opponent's 20-yard line, it's considered to be in the "red zone". This paper actually broadens this measure of the red zone and looks at the scoring of touchdowns as a percent of all scoring. A team is considered more successful when these trips result in touchdowns, not settling for a field goal. Likewise on the defensive side of the ball, can the more cohesive squad force the opponent into a field goal and not allow a touchdown?

The remainder of this paper presents a literature review, a description of the data and then the methodology. Results with conclusions close the paper.

LITERATURE REVIEW

The fairness of wages has been examined in a variety of frameworks starting as early as Adam's (1963) equity approach and the psychological impact on worker behavior. Theoretical work has continued to be divided between the two groups of thought. Akerlof and Yellen (1990), Milgrom and Roberts (1988), Lazear (1989) and Levine (1991) modeled the equity viewpoint. For example, Milgrom and Roberts suggested that because highly unequal wages encourage workers to engage in non- productive behavior (i.e. workers try to get around the system to get the higher wage without more productive work), it is more optimal for the firm to offer more equal wages. On the other hand, Lazear and Rosen (1981) developed

a tournament model and showed that higher wage dispersion should lead to more productivity. Ramaswary and Rowthorn (1991) also modeled the tournament theory; their work showed that employees with the largest ability to sabotage the firm should be paid the highest salaries. This creates greater wage dispersion and higher productivity.

To substantiate these theories, a limited amount of empirical work has shown support for both. For example, Cowherd and Levine (1992) examined 89 corporations and found that lower wage dispersion led to better product quality. Pfeffer and Langton (1992) used data for university professors and showed that greater wage dispersion led to lower productivity.

One reason for this lack of empirical work at the firm level is the difficulty of finding data on wages at individual firms and the ability to link those wages to productivity. As a result, empirical work moved to the sports world where prizes, salaries and performance are more readily available and apparent, respectively. This work, examining both individual behavior and team behavior, has produced mixed results. Becker and Huselid (1992) used auto racing data and found that the prize structure did not affect driver performance. While Ehrenberg and Bognanno (1990a) found support for the tournament theory using professional golfers, Ehrenberg and Bognanno (1990b) and Orszag (1994), using different golf data, failed to confirm initial results.

Sommers' (1998) research focused on professional hockey and showed a weakly negative significance between dispersion and team performance. Bloom (1999) used data from Major League Baseball (MLB) and showed that the level of wage dispersion negatively impacts individual and team performance. Depken (2000), using a fixed effects approach, also examined professional baseball and found that more wage dispersion hurt team performance. Results from DeBrock et. al (2004) are less clear, but tend to show a negative relationship between wage dispersion and performance in professional baseball.

Frick et. al (2003) examined the four major professional sports leagues in the United States and found conflicting results. For example, for basketball and hockey, they find that more inequity leads to better performance. However, for baseball, the opposite was true. For football, the amount of dispersion did not affect performance. Adding to the confusion, Berri and Jewell's (2004) research on the National Basketball Association failed to find a relationship between wage dispersion and productivity. Dole and Kassis (2008) find that wage dispersion only affects team performance in post-season play, not the regular season. Borghesi (2008) creates measures of dispersion but splits those measures between starting and back-up players and for base versus bonus pay. Results show no relationship between dispersion and performance for the unit's performance except for one measure of bonus pay for offensive starters. Dispersion tends only to negatively impact performance for players in back-up roles, though it is unclear if the players were on the field when the performance suffered. Mondello and Maxcy (2009) examine NFL data and find conflicting results within their own paper. More equal salaries deliver better on-field performance while greater dispersion leads to higher team revenue.

This paper also takes into account that the theories imply workers at firms must have the ability to positively or negatively affect co-workers. Because the offensive and defensive squads on football teams are separate entities and have a smaller chance of impacting the

other's performance, it's not surprising that previous studies produce conflicting results.[1] By grouping all starting and back-up offensive (or defensive) players and their total salary by unit, the impact of wage dispersion should be more clear.

DATA AND METHODOLOGY

Using salary data from *USAToday*, a wage dispersion variable is created using aHerfindahl-Hirschman Index (HHI) method using data from 2000 through 2008 covering 31 of the 32 NFL teams for a total of 279 observations.[2] This paper uses each player's salary as the amount credited to his salary cap figure for the team that year (player cap value). A player's salary has several components: a base salary and bonuses based on performance or other standards. Depending on the structure of the salary, parts or all of these components are credited to the player's salary that year. Per NFL regulations, each team's total salary cannot exceed a team salary cap which is the same for each team. But the team is not required to spend the total amount either. The best representation of a player's value would be that salary cap figure.[3] In addition, the NFL requires a minimum salary for players depending on their experience. Any player not earning this minimum was omitted from the data set. Few NFL salaries are guaranteed, so while a player might be paid the minimum, he could be fired after one game and only earn 1/16 of that salary (based on a 16-game season). In some cases, a player's cap value may only be $40,000 while he is listed as having a total salary that meets the league minimum. In either of these cases, the $40,000 salary doesn't mean that the player received a relatively low salary, only that the player spent a short time on the team. As a result, the player would have little chance to impact the team and therefore was omitted from the sample. [4]

Next, the players for each team were separated between offensive and defensive squads. Special teams players were also omitted from the data set.[5] The HHI for each team's offensive and defensive units for each year was generated using this formula:

$$HHI_{i,t} = \sum \left(\frac{player\ cap\ value}{total\ team\ salary} \right)^2 x\ 100$$

where *i* represents each team and *t* represents the year. The denominator for the HHI is the total team salary because it reflects the idea that team management must still meet the salary cap requirement and divide this amount between *all* players. A defensive back knows that the amount he can be paid depends on the amount left over once the other players (offense and defense) are paid. However, his performance will only show up on the defensive side of the ball.

Team performance is based on several factors. In previous work the performance variable typically was "winning percentage", but in this paper the performance variable becomes more specific, depending on which side of the team we're focusing on. Using data for the regular season, the offensive squad can be judged on total yards gained per year, total points scored or total touchdown (TD) points scored. For defense, the squad's performance can be evaluated on total yards allowed, total points allowed and total touchdown (TD) points allowed.

Following Depken (2000), the total salary paid by the team serves as a proxy for part of the team's production function.[6] Depken's approach notes that while separating some effects across a team may be difficult, using the team's total salary still serves as a valid proxy for a team's production function and its willingness to spend more money to acquire better performing players.This remains true even in a world of salary caps; teams still do spend different amounts on pay each year. And while teams may appear to violate the league's salary cap, they still meet the cap by structuring player contracts with multi- period payouts. It should be noted that while the NFL has a "hard" salary cap (i.e. no teams are allowed to go over the cap as compared to "soft" caps in other professional leagues), teams do spend different amounts on players each year. We expect this reflects a team's willingness to invest in player quality. For example, in 2008 the Oakland Raiders paid total salaries of $152,389,371 while the Kansas City Chiefs paid$84,000,016. The Raiders paid over $16,000,000 to quarterback Jamarcus Russell (the NFL's number one draft pick in 2007), about $14,000,000 to defensive tackle Tommy Kelley, and over $12,000,000 to wide receiver Javon Walker. Still, due to the restructuring of these contracts, the Raiders met the salary cap. It should be recognized that these total salaries can be noisy: a team usually lands a top draft pick because it performed poorly the previous year and ends up facing a "winner's curse" (overpaying for an inexperienced, unproven player). Both the Raiders and the Chiefs finished with losing seasons in 2008 (and Russell only lasted three years in the NFL).

Besides the impact of wage dispersion and total salary on squad performance, other explanatory variables for each year include whether the team has a new coach (a dummy variable where 1= new coach); years of head coaching experience; and years of head coaching experience squared. Additionally, to allow for the other squad to impact performance through time on the field, a "total yards" variable is also included. For example, the offense's ability to score points (or gain yards) could be a function of how long its defense stays on the field. If the defense is lousy and stays on the field a long time, the offense has a smaller chance of scoring points or gaining yards. Or the team may run an up-tempo offense. This quick-scoring approach may put more pressure on the defense making its job more difficult. A final variable, injury, captures the impact of injuries on a unit's performance. Using data from JT-SW.com, the number of players per game that could not play due to injury by squad is tabulated.

By including players' salary cap values in the HHI variable, the regression captures the idea that teams are ultimately on a level playing field. In other professional sports, management may pay for a team of stars (i.e the 2012 NBA champion Miami Heat), but that is not possible in the NFL. That is, without a cap, a team's winning performance could be due to the fact that it spent twice as much as other teams. The NFL's hard salary cap, instituted to provide league parity, provides an instrument to compare performance across teams while allowing individual teams to spread the salary in the most effective method.

Replicating earlier work that combined both defensive and offensive units, an initial regression is estimated.[7] "Performance" in this case is winning percentage and all
the subscripts *i,t* refer to team *i* in period *t*. The intercept variable common across cross sections is "$a_{i,t}$". The wage dispersion variable is combined HHI for each team for each period.

Dummies for time periods are included. The error is the last term in the regression.

$$\text{Performance}_{i,t} = a_{i,t} + \beta_1 \text{HHI}_{i,t} + \beta_2 \text{Newcoach}_{i,t} + \beta_3 \text{Experience}_{i,t} + \beta_4 \text{Experience}^2_{i,t} + \beta_5 \text{L Toatalsalary}_{i,t} + \beta_6 \text{Injury}_{i,t} + \beta 7 \text{YearDummies}_i + \varepsilon i,t \quad (1)$$

Expectations for the other explanatory variables include: a negative relationship between "Newcoach" and "Performance". It takes time for a new coach to get the team to adapt to his style and methods of coaching. We expect typical labor market outcomes for "Experience": initially, experience improves performance, but at some point, the relationship becomes negative. "Totalsalary" is used as a proxy for the willingness of the team to invest in player quality and expected to be positive. As the number of injuries increases, we expect performance to suffer.Results for both a fixed effects and random effects regression are presented in Table 1. As expected in light of earlier work, the results show that wage dispersion (the HHI variable) does not play a role in explaining a team's success.Neither theory, tournament or equity, finds support in this regression.

Table 1
REGRESSION OUTPUT FOR COMBINED OFFENSIVE AND DEFENSIVE UNITSP-VALUES PROVIDED. DATA FOR TIME DUMMY VARIABLES AVAILABLE UPON REQUEST.LEVEL OF SIGNIFICANCE: * = 1%; ** = 5%; * = 10%.**

	Fixed Effects	Random Effects
Independent Variables	**Winning Percentage**	**Winning Percentage**
Constant	-0.81 (0.32)	-0.96 (0.22)
HHI	0.00 (0.99)	0.00 (0.66)
New Coach	-0.06 (0.08)*	-0.04 (0.17)
Experience	0.01 (0.49)	0.01 (0.14)
Experience^2	0.00 (0.93)	-0.00 (0.41)
Log (Total Salary)	0.17 (0.11)	0.18 (0.07)*
Injury - offense - defense	0.00 (0.05)* 0.00 (0.17)	0.00 (0.04)** 0.00 (0.04)**
F-Test (279 observations)	1.06 (0.13)	
Hausman Test (p value)[8]		13.58 (0.55)
Breusch-Pagan Test (p value)		1.38 (0.24)
Wald Test (p value)		8.82 (0.36)

Addressing the hypothesis proposed in this paper, the next set of regressions to be estimated requires the data to be split between offensive and defensive units. These regressions follow this equation:

$$\text{Performance}_{i,t} = a_{i,t} + \beta_1 \text{SquadHHI}_{i,t} + \beta_2 \text{Newcoach}_{i,t} + \beta_3 \text{Experience}_{i,t} + \beta_4 \text{Experience}^2_{i,t} + \beta_5 \text{Totalsalary}_{i,t} + \beta_6 \text{Yards}_{i,t} + \beta_7 \text{SquadInjury}_{i,t} + \beta_8 \text{YearDummies}_i + \varepsilon_{i,t} \quad (2)$$

where "$\text{Performance}_{i,t}$" represents the productivity variable for each *i* squad for year *t*; "$a_{i,t}$" is an intercept variable common across cross sections; and "$\text{SquadHHI}_{i,t}$" represents the HHI for each *i* offensive or defensive squad for year *t*. An additional variable in this set of regressions includes "Yards". We expect "Yards" to be negative; the more yards the offensive unit gains, the less the defensive unit has to work. The more yards the defensive unit allows, the less time the offensive unit has to score. This variable allows for team's style of play to impact the other side of the ball. The number of injuries on either unit should negatively impact performance.

RESULS

For robustness, six regression equations are estimated for each performance variable, one set of regressions is estimated for a fixed effects model and another set for a random effects models. The random effects model is shown in Table 2.[8]

Table 2
RANDOM EFFECTS MODEL RESULTS FOR OFFENSIVE AND DEFENSIVE SQUADS
P VALUES PROVIDED. DATA FOR TIME DUMMY VARIABLES AVAILABLE UPON REQUEST. (279 OBSERVATIONS)

	Offensive Variables			**Defensive Variables**		
Independent Variables	**Total Yards Gained**	**Total Points Scored**	**Total TD Points Scored**	**Total Yards Allowed**	**Total Points Allowed**	**Total TD Points Allowed**
Constant	881.52 (0.72)	273.76 (0.30)	-227.61 (0.39)	5107.36 (0.01)**	78.47 (0.01)**	549.27 (0.02)**
HHI	115.52 (0.00)***	7.38 (0.07)*	7.39 (0.04)*	-47.19 (0.19)	-1.07 (0.07)*	-7.47 (0.07)*
New Coach	-174.53 (0.07)*	-27.99 (0.01)***	-26.12 (0.01)**	-47.6 (0.54)	0.87 (0.50)	6.11 (0.49)
Experience	9.98 (0.64)	-0.65 (0.79)	-1.29 (0.58)	-236.62 (0.07)*	-0.47 (0.11)	-3.27 (0.11)
Experience^2	0.26 (0.83)	0.17 (0.21)	0.20 (0.13)	2.58 (0.01)**	0.03 (0.07)*	0.22 (0.07)*
Log (Total Salary)	554.87 (0.08)*	85.54 (0.01)**	64.33 (0.05)*	63.61 (0.79)	-4.83 (0.24)	-33.81 (0.24)
Total Yards Allowed	-0.07 (0.41)	-0.02 (0.05)**	-0.01 (0.21)			

Total Yards Gained					-0.09 (0.07)*	-0.00 (0.89)		-0.00 (0.89)
Injury	-11.64 (0.04)**	-1.30 (0.03)**		-1.18 (0.05)**	9.16 (0.04)**	0.22 (0.00)***		1.56 (0.00)***
Hausman Test (p value)[7]	4.88 (0.67)	9.12 (0.82)		6.06 (0.96)	3.72 (0.99)	5.31 (0.99)		5.31 (0.99)
Breusch-Pagan Test (p value)	0.00 (0.97)	.26 (0.61)		0.02 (0.90)	0.72 (0.39)	3.10 (0.08)		3.10 (0.08)
Wald Test (p value)	17.93 (0.00)***	27.15 (0.00)***		30.48 (0.00)***	30.09 (0.00)***	17.93 (0.02)**		17.93 (0.02)**

The results help explain the conflicting results in previous studies. For the offensive side of the ball, the coefficient β_1 on HHI is positive. That is, higher wage dispersion for offensive players leads to better performance (more total yards gained, more total pointsscored and more touchdowns scored). It appears that the lower-paid players work harder to achieve a similar, higher salary and the unit performs better. This result supports the tournament theory.

On the defensive side of the ball, the coefficient on the HHI variable is negative. But this result also supports the tournament theory. Higher wage dispersion leads to fewer yards allowed and fewer TDs allowed. That is, the defensive unit works together to prevent the other team from scoring and gaining yards.

As expected, a new coach negatively impacts performance while total salary has a positive impact, but only on the offensive side. This could result from the growing complexity of offensive schemes and requisite specialization of players for those schemes; acquiring players to fit these schemes does not happen over one season. The data suggest that the new coaches do not experience the same problem on the defensive side. Teams that spend more (as allowed by the salary cap) perform better offensively, but spending more on the defensive side does not appear to have the same impact. As expected, injuries negatively impact performance. The remaining variables do not appear to play a consistent role in explaining variability in team performance.

EFFICIENCY PERFORMANCE

Squad performance inside the 20-yard lines is another way to assess the effectiveness of team units; specifically, this is called "red zone" performance. This paper broadens the scoring area and considers how efficient teams are in scoring when getting into field goal range. That is once inside this range, the team has the choice of kicking for three points or continuing progress into the end zone for six points.[9] Does the team have the offensive prowess to make a touchdown or is it limited to a field goal? A proxy for this performance is the percent of scores that result in a touchdown versus a field goal. On offense, the tournament theory would expect a higher HHI to generate a higher percent of scores to come from touchdowns and not field goals. On defense, we consider the performance of the squad to force a team into settling for a field goal (and being kept out of the end zone for a touchdown) - a "bend-but-don't break" attitude. The tournament theory suggests a higher HHI would lead to a lower number of touchdowns in relation to total scoring when

the opponent moved into scoring range. "Performance" in this set of regressions is the percentage of total scoring from touchdowns.

$$Performance_{i,t} = a_{i,t} + \beta_1 SquadHHI_{i,t} + \beta_2 Newcoach_{i,t} + \beta_3 Experience_{i,t} + \beta_4 Experience^2_{i,t} + \beta_5 LTotalsalary_{i,t} + \beta_6 SquadInjury_{i,t} + \beta_7 YearDummies_i + \varepsilon_{i,t} \quad (3)$$

Results from random effects regressions are presented in Table 3. These results reinforce the scoring and yardage results in the second set of regressions.
For offense and defense, the tournament theory is supported. The HHI variable is significant and of the correct sign in both regressions. Better performance results from a larger dispersion in salary.

Table 3
REGRESSION OUTPUT FOR EFFICIENCY
PERFORMANCE BY SQUAD
P-VALUES PROVIDED. DATA FOR TIME DUMMY
VARIABLES AVAILABLE UPON REQUEST

	Offense	**Defense**
Independent Variables	**Percent of Scoring from TDs**	**Percent of Scoring Allowed from TDs**
Constant	93.71 (0.01)***	0.91 (0.00)***
HHI	0.61 (0.06)**	-0.01 (0.07)*
New Coach	-1.36 (0.10)*	-0.02 (0.15)
Experience	-0.26 (0.17)	0.00 (0.29)
Experience^2	0.02 (0.05)*	0.00 (0.10)
Log (Total Salary)	-2.41 (0.37)	-0.04 (0.11)
Injury	-0.04 (0.37)	0.00 (0.37)
Hausman Test (p value)[8]	3.63 (0.99)	4.81 (0.99)
Breusch-Pagan Test (p value)	0.55 (0.56)	0.72 (0.40)
Wald Test (p value)	26.67 (0.00)***	29.07 (0.00)***

On offense, a higher percentage of scores came from touchdowns. On defense, the squads with the higher HHIs forced opponents into settling for field goals more often; a lower percent of scores came from touchdowns.

SUMMARY

In summary, the results support the tournament theory that higher wage dispersion leads to better performance among players. The players are more productive as they act to achieve a higher salary. By keeping the unit's performance together (including both starting and back-up players) along with salaries focusing on salary cap requirements, these results also confirm support for the tournament theory. The results also help explain why other papers fail to find a consensus for two reasons. By mixing the defensive and offensive squads, the ability to recognize sabotage or cooperation may be masked. Next, the coefficient on the dispersion measure will be opposite for the offensive and defensive squads even though the same theory is supported.Further support for the tournament theory is evidenced by efficiency performance. Offensive squads with higher wage dispersion have more of their scoring from touchdowns, and defensive squads with more dispersion force their opponents into field goals more often.

ENDNOTES

[1] This paper discounts the impact that a low-paid player can impact the whole team by creating a negative effect in the locker room, etc. As a reviewer has pointed out, the ability to sabotage a team could be mistaken for the play of a lower-paid player who just has less skill. It should also be noted that the offensive style of a team may have some impact on the defense. For example, if a team plays an up-tempo offense, its defense may be on the field longer. This possibility is taken into account in the regression analysis.

[2] The Houston Texans was a new team that did not start playing until 2002.

[3] For example, in 2009 the Washington Redskins signed defensive tackle Albert Haynesworth to a $110 million contract payable over seven years. His cap value for 2009 was $7,007,280. It should be noted that Borghesi's (2008) paper estimates "explained compensation" for players regardless of whether the total for a team exceeds the salary cap. Here, the team's ability to address a player's value *and* the salary cap is addressed by using "cap value."

[4] Omitting these players also seems reasonable given that most are lower quality players who rarely see time on the field and are instead hired for a game or two to fill in an a temporary basis. It should be also noted that the data omit payments made if a team makes the playoffs. These payments are made by the NFL (not the team) with players earning a standardized playoff payment for post-season games.

[5] Special team players include punters, kickers and long snappers. The long snapper's job is to snap the ball to the punter or field goal kicker. One long snapper was paid $591,000 in 2005. These three positions are not considered part of the offense or defense.

[6] This model follows Scully (1989, 1995) and Depken (2000) who note that estimating a team's production function recognizes a number of factors impacting a team's success and that these factors are difficult to observe and disentangle. For example, the interaction of players (even Pro- Bowlers and sixth round draft picks) always occurs on the field and determining exactly how one player affects the other's performance would be hard to discover.

[7] With panel data, several options exist for estimation. Assuming that each team's squad has its unique intercept, a *fixed effects* regression can be estimated In addition, we can allow for these intercept terms to vary over time by adding year dummies. Instead of including the dummy variable for each team, a *random effects* regression can also be estimated. Results from a Hausman test determine which specification should be used. Random effects models do not produce an F- statistic for overall fit of the regression.

[8] Because the Hausman Test shows that the random effects model is the proper regression to estimate, the fixed effects model is included in the Appendix. The Breusch-Pagan test shows that the hypothesis for homoskedasticity cannot be rejected.

[9] The average field goal is made from the 36-yard line.

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APPENDIX

Table A
FIXED EFFECTS MODEL RESULTS FROM OFFENSIVE AND DEFENSIVE SQUADS

	Offensive Variables			Defensive Variables		
Independent Variables	**Total Yards Gained**	**Total Points Scored**	**Total TD Points Scored**	**Total Yards Allowed**	**Total Points Allowed**	**Total TD Points Allowed**
Constant	728.56	-274.81	-215.39	4984.97***	512.88**	547.53**
New Coach	-214.54**	-34.33**	-31.9**	-17.35	8.36	11.55
Experience	-16.13	-2.37	-2.62	-25.33	-2.28	-2.38
$Experience^2$	2.03	0.27**	0.28**	2.10*	0.14	0.17
Log (Total Salary)	577.28*	83.93**	62.49*	61.51	-16.12	-33.81
Total Yards Allowed	-0.09	-0.02*	-0.01			
Total Yards Gained				-0.07	-0.01	-0.00
Injury	-7.56	-1.21*	-1.13*	9.08*	1.73***	1.49***
HHI	92.82**	7.37*	7.15*	-43.95	-8.98**	-8.55*
F Test (p value)	2.26***	2.13***	2.02***	1.51**	1.31*	1.23

ROLE OF DEMOGRAPHIC FACTORS IN POVERTY MOBILITY IN THE PHILIPPINES

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ABSTRACT

Poverty is a global phenomenon that stunts the growth and quality of life of the population. This study aims to examine the relationship between demographic factors and poverty mobility in the Philippines. Specifically, it measures the effect of age, family size, and education on the movement in and out of poverty for the years 2008 and 2011. Using binary logistic regression, results reveal that the demographic factors included in the study significantly affect state of poverty of Filipino households. Furthermore, it estimates a causal model to examine mobility in and out of poverty in the Philippines using repeated cross-sections analysis.

Keywords: *poverty, demographic, repeated cross-sections, logistic regression*

INTRODUCTION

Poverty is a global problem characterized by a lack of resources. In economic terms, poverty is defined by a dollar-a-day subsistence or more specifically, the revised USD1.25 daily survival income. Sachs (2005) enumerated six kinds of capital that the extremely poor lack, including human, business, infrastructure, natural, public institutional, and knowledge. The poor start with very low capital and find themselves trapped in a cycle of poverty as capital diminishes from generation to generation.

In the Philippines, the incidence of poverty is pegged at 32.9 percent in 2006, still a far cry from the target of 22.7 percent by 2015 (Lim, 2009), as the first agenda of the Millennium Development Goals (MDG), which calls for halving the number of people living in extreme poverty. The different administrations of the Philippine government took turns in prioritizing the alleviation of poverty with programs to combat it, although change in administration goes with altering the direction for tackling poverty. For example, the Philippine President Fidel V. Ramos administration's poverty program focused on villages (from 1992-1998), while Philippine President Estrada's administration emphasized the poorest individuals in the country (from 1998 to 2001).

REVIEW OF RELATED LITERATURE

Poverty is a global phenomenon that stunts the growth and quality of life of the population. It has been defined in terms of income or economic well-being (Arcilla et al., 2011; Durrani, Usman, Malik, & Ahman, 2011; Krishna, 2010; Wagle, 2008) and non-income dimensions such as well-being (Chambers, 2007), equality of opportunities or social inclusion

(Marlier & Atkinson, 2010; Wagle, 2008), and capabilities or the freedom of a person to choose one's functioning (Ataguba, Ichoku, & Fonta, 2013; Sen, 2000; Wagle, 2008).

Literature showed various poverty mobility or movements from a poverty state to another or to out of it and for a number of reasons. Krishna (2010) employed the Stages-of-Progress method to determine who the poor are, what made them poor, and who escaped poverty. His research was conducted for seven years employing interviews of 35,567 households in 398 communities of India, Kenya, Uganda, Peru, and North Carolina. The tiers he used to classify the poor included: (a) remained poor (poor earlier and poor now); (b) escaped poverty (poor earlier but not poor now); (c) became poor (not poor earlier but poor now); and (d) remained not poor (not poor earlier and not poor now). The primary reasons stated for escaping poverty included diversification of income, private/public sector employment, and government or non-government organization assistance. Meanwhile, the causes of slipping into poverty included poor health and health related expenses, marriage/dowry, funeral-related expenses, interest on debt, drought, and unproductive land.

Rahman et al. (2013) studied the upward or downward mobility and the causes behind these movements in rural Bangladesh. He used panel data from 2004-2009. The authors used four categories, namely (a) chronically poor (household income always below the poverty line for a long period of time); (b) descending non-poor (household income above the poverty line 10 years ago but now descended to poverty); (c) ascending poor (household income below the poverty line 10 years ago but escaped poverty); and (d) nonpoor (household income above the poverty line). The study concluded that one third of all households changed poverty status, in which 76 percent had upward mobility and 24 percent had downward mobility. Increase of work opportunity, diversified income sources, crop diversification and progress in business such as engaging in informal business and trading of local products were cited as reasons for upward mobility. Reasons for downward mobility included high family expenses, natural disasters, loss of money for employment abroad, and high treatment cost for illnesses, last of which was similar to a cause cited in Krishna (2010).

In the Philippines, Reyes, Tabuga, Mina, Asis, and Datu (2010) also studied income poverty movement using data from the Annual Poverty Indicators Survey (APIS; 2004, 2007, and 2008), Family Income Expenditure Survey (FIES; 2003 and 2006), and combined APIS and FIES five-year panel data set. The authors used poverty status as dependent variable, and household head profile, income from agriculture, housing characteristics, ownership of assets, access to basic amenities or social services, and location as independent variables. They categorized poverty status as follows: (a) chronic poor, consistently income poor in each of the covered year; (b) transient poor, poor during a given period of time and non-poor for at least one year during the year under study; (c) previously poor, non-poor during a given point in time but poor for at least a year during the year under study; and (d) never poor, never been poor during the period of study.

METHODOLOGY

Empirical results generated in this study were based on repeated cross-section model developed by Dang, Lanjouw, Luoto, and McKenzie (2011); and on the binary logistic

regression technique developed by Cameron and Trivedi (2005) that was adapted by Conchada and Rivera (2012).

In tracing the influence of demographic factors on the probability that a household will be poor or non-poor, the data on household characteristics and demographics were sourced from the Annual Poverty Indicator Survey (APIS), which is a poverty and policy-impact monitoring system using database of household information. The households were selected for 2008 and 2011 surveys by APIS to capture the entire Philippine behavior, with ample representatives from Luzon, Visayas, and Mindanao.

In establishing the interrelationships of the variables affecting the state of poverty and examining the mobility into and out of poverty of households across the Philippine regions, cross-section data on household characteristics and demographics of 190,171 households for 2008 and 42,063 households in 2011 were used.

Maximum Likelihood Estimation (MLE): The Binary Logistic Regression

Categorization is done on the how a typical Filipino household is classified according to whether or not it is considered poor or non-poor. Measuring poverty incidence in the Philippines commonly uses per capita income. For the purpose of this study, I have chosen to measure income-based poverty through the use of per capita income data from National Statistical Coordination Board (NSCB), which is reported at the poverty threshold of PHP16,871.00 per year or PHP1,405.92 per month or PHP46.86 per day or the equivalent of approximately one USD.

Since the dependent variable, state of poverty, is a dummy variable, it has been modeled as a standard logit probability model. For a binary outcome data, the dependent variable, y, takes one of two values as shown by

$$y = \begin{cases} 1 & \text{with probability } p \\ 0 & \text{with probability } 1 - p \end{cases} \qquad (1)$$

From Equation 1, the dependent variable assumes a value of 1 if the household has per capita income at poverty line of PHP16,871.00 per year and assumes a value of zero if otherwise. There is no loss of generality in setting the values to 1 and 0 if all that is being modeled is p, which determines the probability of the outcome (Cameron & Trivedi, 2005).

Based on the studies of Cameron and Trivedi (2005) and Gujarati and Porter (2009), a regression model is formed by allowing the probability p to depend on a regressor vector $\mathbf{x}$ and a $K \times 1$ parameter vector β via a parametric technique. The model is of single-index form with conditional probability given by

$$p_i = \Pr[y_i = 1|\mathbf{x}] = F(\mathbf{x}_i'\beta), \qquad (2)$$

where $F(\cdot)$ is a specified function. Specifying $F(\cdot)$ to be a cumulative distribution function (CDF) is done to ensure that $0 \leq p \leq 1$. Hence, we come up with a logistic model if $F(\cdot)$

is the CDF of the logistic distribution. According to Cameron & Trivedi (2005, as cited in Conchada & Rivera, 2012), if $F(\cdot)$ is a CDF, it is only being used to model the parameter p and does not denote the CDF of y itself .

We need to be particular to determine the marginal effect of change in a regressor on the conditional probability that $y = 1$. For any probability model, given by Equation 2, and change in the j^{th} regressor assumed to be continuous, as shown by

$$(\partial \Pr[y_i = 1|x_i])/(\partial x_{i,j}) = F'(x_i\beta)\beta_j \tag{3}$$

where $F'(z) = \partial F(z)/\partial z$. The marginal effects differ with the point of evaluation x_i, as for any nonlinear model, and differ with different choices of $F(\cdot)$.

In estimation given a sample (y_i, x_i) for i = 1, …, N, where independence over i is assumed, the outcome is Bernoulli distributed for the binomial distribution with one trial. The probability mass function for the density of y_i is shown as

$$f(y_i \mid x_i) = p_i^{y_i}(1-p_i)^{1-y_i} \text{ for } y_i = 0,1 \tag{4}$$

where $p_i = F(\mathbf{x}_i'\beta)$. This yields probabilities p_i and $(1 - p_i)$ since $f(1) = p^1(1 - p)^0 = p$ and $f(0) = p^0(1 - p)^1 = p$. The density shown in Equation 5.4.3 shows log density $\ln f(y_i) = y_i \ln p_i + (1 - y_i)\ln(1 - p_i)$. Given independence over i and Equation 2 for p_i, the log-likelihood function is given by

$$L_N(\beta) = \sum_{i=1}^{N}\left\{y_i \ln F(x_i'\beta) + (1-y_i)\ln(1-F(x_i'\beta))\right\} \tag{5}$$

Differentiating with respect to β, the MLE $\hat{\beta}_{ML}$ solves Equation 6

$$\sum_{i=1}^{N}[((y_i/F_i)F_i'x_i)/((1-y_i)/(1-F_i)F_i'x_i'))] = 0 \tag{6}$$

where $F_i = F(\boldsymbol{x}_i'\beta)$, $F_i' = F'(\boldsymbol{x}_i'\beta)$, and $F'(z) = \partial F(z)/\partial z$. Converting to fractions with common denominator F_i $(1 - F_i)$ and simplifying yields the maximum likelihood (ML) first order condition shown by

$$\sum_{i=1}^{N}(y_i - F(x_i'\beta))/\left(F(x_i'\beta)\left(1-F(x_i'\beta)\right)\right)F'(x_i'\beta)x_i = 0 \tag{7}$$

According to Cameron and Trivedi (2005, as cited in Conchada & Rivera, 2012), we need to specify correctly the conditional density of y given $\boldsymbol{x}$ for MLE to be consistent to avoid misspecification since the density is Bernoulli. Thus, the MLE is only consistent if $p_i = F(\mathbf{x}_i'\beta)$.

Consequently, the logistic regression model is specified in Equation 8. Since the binary logistic model is the simplest unordered model that allows regressors to differ between two

alternatives (Cameron & Trivedi, 2005; Gujarati & Porter, 2009), the marginal effect for binomial data is computed as a separate marginal effect on the probability of each outcome (Cameron & Trivedi (2005). These marginal effects sum to zero since probabilities sum to one.

$$p = \Lambda(x'\beta) = (\exp(x'\beta))/(1 + \exp(x'\beta)) \quad (8)$$

where $\Lambda(\cdot)$ is the logistic CDF, with $\Lambda(z) = e^z/(1+e^z) = 1/(1+e^{-z})$. Hence, we can simplify the logistic MLE first order condition to:

$$\sum_{i=1}^{N}(y_i - \Lambda(x_i'\beta))x_i = 0 \quad (9)$$

since $\Lambda'(z) = \Lambda(z)[1 - \Lambda(z)]$. Thus, the raw residual, $y_i - \Lambda(\mathbf{x}_i'\beta)$, is orthogonal to the regressors, similar to the Ordinary Least Squares (OLS) regression. While regressors x_i include an intercept, Equation 9 implies that $\sum_i (y_i - \Lambda(x_i'\hat{\beta})) = 0$, so the logistic residuals sum to zero (Cameron & Trivedi, 2005). Hence, this denotes that the average in-sample predicted probability $N^{-1}\sum_i \Lambda(x_i'\hat{\beta})$ necessarily equals the sample frequency $\bar{y}$.

We obtain the marginal effects for the logistic regression model from the coefficients, since $\partial p_i/\partial x_{ij} = p_i(1 - p_i)\beta_j$, where $p_i = \Lambda_i = \Lambda(\mathbf{x}_i'\beta)$. Evaluating at $p_i = \bar{y}$ yields a crude estimated marginal effect of $\bar{y}(1-\bar{y})\hat{\beta}_j$. Given this, we interpret the coefficients by their marginal effects on the odds ratio rather than on the probability (Cameron & Trivedi, 2005). We denote the specification of the logistic regression model by

$$\ln(p_i/(1 - p_i)) = x'\beta + \varepsilon \quad (10)$$

where $p_i/(1 - p_i)$ measures the probability that $y = 1$ relative to the probability that $y = 0$, which is called the odds ratio or relative risk (Gujarati & Porter, 2009). For the logistic regression model, the log-odds ratio is linear in the regressors (Cameron & Trivedi, 2005, as cited in Conchada & Rivera, 2012).

Model Specification of Baseline Model

Using the data of households from APIS for 2008 and 2011 to trace the influence of factors on the probability that a household will be poor or non-poor, the logistic specification is given by,

$$\ln\left(\frac{p_i}{1-p_i}\right) = f(FSIZE_i, AGE_i, EDUC_i, WAGE_i, URBAN_i, ENTREP_i, GOVS_i) + \varepsilon_i$$

where:

p_i is the probability that a household is considered poor while $(1 - p_i)$ is the probability that a household is non-poor.

FSIZE, family size, is the number of family members in the household. This demographic factor is expected to produce negative effect of poverty status of being poor such that the greater the number, the smaller becomes the income distribution and thus the dwindling of purchasing power to access basic necessities such as food, clothing, shelter, sanitation, or to invest on human capital such as health and education.

AGE indicates the age of the household head, reported in terms of the number of years completed, that is, his/her age as of last birthday. This demographic factor is expected to produce the opposite effect of poverty status of being poor.

EDUC is defined as the highest grade completed by the household head in any educational institution, public or private, for formal academic education at levels categorized into no grade completed, pre-school, elementary, elementary graduate, secondary (high school), high school graduate, post-secondary school, post-secondary school graduate, college level, college graduate or higher. The lack of this human capital limits job opportunities. Low educational attainment limits job options to unskilled job openings with lower pay; and the higher chance of being unemployed. Hence, it is expected that the higher the level of education, the lower the possibility of the household of having per capita income at poverty line or below.

WAGE refers to the amount of gross basic salary or wage in PHP earned by the household head from all his/her jobs, including any allowance for family living, transportation and representation, cost of living, clothing, housing, overtime pay, tips, bonuses, longevity pay, productivity pay, commissions, medical benefits, etc. received in cash. Wages also include deductions made for retirement, insurance premiums, social security, union dues, PAG-IBIG fund, Philhealth, salary loans and other deductions reflected in the payroll. Hence, it expected that a household that receives wages from employment would get the lower chance of earning per capita income at poverty line or below.

URBAN is a dummy variable assigning the value of 1 if the household is residing in urban area and 0 in rural area. Urban-rural duality spells the difference in household income. Hence, holding other factors constant, it is expected that household per capita income would be higher for a household in urban area than one in rural area.

ENTREP assumes a value of 1 if the household is engaged in entrepreneurship and assumes a value of zero if otherwise.

GOVS assumes a value of 1 if the household received government support under Kalahi-CIDSS program and assumes a value of zero if otherwise. Kalahi-CIDSS program is a poverty reduction project implemented at the barangay level, with community members working closely with local government units in planning and implementing projects consistent with their development needs (Asian Development Bank, 2012).

ε_i is the error term that captures all other variables that are not included in the equation.

Repeated Cross-Sections Model

To examine the mobility into and out of poverty in the Philippines using repeated cross-section analysis, I adapted the model from the derivation of Dang, Lanjouw, Luoto, and McKenzie (2011), an alternative statistical methodology for analyzing movements in and out of poverty based on two or more rounds of cross-sectional data. Compared to many traditional pseudo-panel studies, the method is less data demanding, and importantly allows for investigation of income mobility within as well as between cohorts (Dang et al., 2011). This procedure estimates a model of income or consumption in the first round of cross-section data using a specification, and applies the parameter estimates to the same variables in the second survey round, which provides an estimate of the unobserved first period's income for the individuals surveyed in that second round. Hence, poverty mobility is estimated by the use of the actual income of households in the second round and estimate from the first round. Dang et al. (2011) showed that, under mild assumptions, one could derive upper and lower bounds on entry into and exit from poverty.

Model Specification: Poverty Mobility with Repeated Cross-Sections

Using repeated cross-section approach by Dang et al. (2011), two rounds of cross-sectional surveys are considered and denoted round 1 and 2. Both survey rounds are assumed to be random samples of the underlying population of interest, and each consists of a sample of η_1 and η_2 households respectively.

Let x_{i1} be a vector of characteristics of household i in survey round 1, which are observed (for different households) in both the round 1 and round 2 surveys. For instance, variables such as whether or not the household head is employed in round 1, and his or her occupation, as well as their place of residence in round 1 could be included in x_{i1} if asked in round 2.

Then, the linear projection of round 1 income, y_{i1} onto x_{i1} for the population as a whole is given by:

$$y_{i1} = \beta_1^{rx_{i1}} + \varepsilon_{i1}$$

Likewise, letting x_{i2} denote the set of household characteristics in round 2 that are observed in both round 1 and round 2 surveys, the linear projection of round 2 consumption or income, y_{i2} onto x_{i2} is given by:

$$y_{i2} = \beta_2' x_{i2} + \varepsilon_{i2}$$

Let z_1 and z_2 denote the poverty line in the period 1 and period 2 respectively. Then estimate the degree of mobility into and out of poverty. For instance, to estimate the fraction of households in the population who are non-poor in round 2 after being poor in round 1, estimation is expressed as:

$$P(y_{i1} < z_1 \text{ and } y_{i2} > z_2)$$

which represents the degree of mobility out of poverty for households over the two periods. Not knowing y_{i1} and y_{i2} for the same households, which is the constraint of repeated cross-sections, the probability could not be point-identified but possibly be obtained by deriving bounds. Hence, this probability can be re-written as:

$$P(\varepsilon_{i1} < z_1 - \beta_1' x_{i1} \text{ and } \varepsilon_{i2} > z_2 - \beta_2' x_{i2})$$

This probability depends on the joint distribution of the two error terms ε_{i2} and ε_{i1}, capturing the correlation of those parts of household consumption and income in the two periods, which are unexplained by the household characteristics x_{i1} and x_{i2}.

RESULTS AND DISCUSSION

A. Descriptive Statistics

Using APIS 2008 and 2011 datasets, following are the statistical information of the variables.

Table 1
DESCRIPTIVE STATISTICS FOR FAMILY SIZE

Panel A (2008)					
	Observations	Mean	Standard Deviation	Minimum	Maximum
Poor	130,135	6.08203	2.279111	1	22
Non-Poor	60,036	4.911187	2.113828	1	19
Overall	190,171	5.712401	2.239374	1	22
Panel B (2011)					
	Observations	Mean	Standard Deviation	Minimum	
Poor	22,920	5.185558	2.227062	1	24
Non-Poor	19,143	3.878389	1.984146	1	16
Overall	42,063	4.590662	2.21763	1	24

A.1 Family Size

Poor households have larger family size than non-poor households, as shown in Table 1. For the 130,135 poor households in 2008, family size of households ranges from one to 22 family members while for the 60,036 non-poor households, members range from one to 19. In 2011, 22,920 poor households have family members between one and 24 while 19,143 non-poor households have family members between one and 16.

Table 2
DESCRIPTIVE STATISTICS FOR AGE

Panel A (2008)				
	Poor		Non-Poor	
Age	Frequency	Percentage	Frequency	Percentage
21-30	8,230	4.33	3,369	1.77
31-40	34,259	18.01	11,389	5.99
41-50	40,255	21.17	16,536	8.70
51-60	26,693	14.04	15,102	7.95
60-65	7,438	3.91	4,975	2.62

Panel B (2011)				
	Poor		Non-Poor	
Age	Frequency	Percentage	Frequency	Percentage
21-30	1,622	3.86	1,359	3.23
31-40	5,447	12.95	3,167	7.53
41-50	6,299	14.98	4,740	11.27
51-60	4,606	10.95	4,691	11.15
60-65	1,715	4.08	1,797	4.27

A.2 Age

Majority of household heads age between 41 and 50 years for both APIS 2008 and 2011, whether poor or non-poor. In both 2008 and 2011 and for both poor and non-poor, the number of household heads increases from age 21 to 50 and then decreases, as shown in Table 2.

Table 3
DESCRIPTIVE STATISTICS FOR EDUCATION

Panel A (2008)				
	Poor		Non-Poor	
Highest Educational Attainment	Frequency	Percentage	Frequency	Percentage
No grade completed	5,600	2.90	386	0.20
Pre-school	219	0.12	38	0.02
Elementary (Grades 1-6)	36,327	19.10	4,806	2.53
Elementary graduate	31,336	16.48	7,222	3.80
High school	18,307	9.63	4,981	2.62
High school graduate	25,355	13.33	15,301	8.05
Post-secondary school	1,051	0.55	958	0.50
Post-secondary graduate	1,267	0.67	1,397	0.73
College level	7,400	3.89	9,636	5.07
College graduate or higher	3,273	1.72	15,311	8.05
Total	130,135	100.00	60,036	100.00

Panel B (2011)				
	Poor		Non-Poor	
Highest Educational Attainment	Frequency	Percentage	Frequency	Percentage
No grade completed	1,125	2.67	172	0.41
Pre-school	37	0.09	22	0.05
Elementary (Grades 1-6)	6,884	16.37	1,890	4.49
Elementary graduate	5,406	12.85	2,532	6.02
High school	3,138	7.46	1,731	4.12
High school graduate	4,290	10.20	4,962	11.80
Post-secondary school	129	0.31	242	0.58
Post-secondary graduate	137	0.33	406	0.97
College level	1,319	3.14	2,880	6.85
College graduate or higher	455	1.08	4,306	10.24
Total	22,920	100.00	19,143	100.00

A.3 Education

As shown in Table 3, highest educational attainment of majority of the poor household heads included in APIS 2008 and 2011 were at elementary levels. On the other hand, majority of non-poor household heads in APIS 2008 were secondary (high) school graduates, college graduates and higher levels (i.e., with master's and doctoral units or degree); while secondary graduates for APIS 2011.

B. Marginal Effects of Binary Logistic Regression

Table 4
MARGINAL EFFECTS BASED ON LOGIT ESTIMATES

	2008	2011
Y= poor: Probability	*.7416693*	*.51060522*
Exogenous Variables		
Family Size	.1105319***	.1599913***
Age	-.0070555***	-.0070898***
Age Squared	.0000259***	.0000248 ***
Wages	-6.76e-06***	-8.69e-06***
No Grade Completed	.1966439***	.302918***
Elementary Graduate	.0987187***	.1157421 ***
High School Graduate	-.030664***	-.0694932 ***
Post-Secondary Grad	-.1522777***	-.2765478 ***
College Graduate	-.3701875***	-.3605692 ***
Urbanity	.221244***	.2911865 ***
Government Support	-.0143485***	.1755928 ***
Entrepreneurship	-.1596564***	-.1967397 ***

Note: *significant at 10%, **significant at 5%,, ***significant at 1%,

As shown in Table 4, poverty incidence in 2008 of 74% decreased to 51% in 2011. Poverty gap lowered because of all the significant factors.

B.1 Family Size

Results of marginal effects after the logistic regression analysis show that independent variable family size significantly increases the probability of the household of being poor for both 2008 and 2011. The results indicate that family size increases the 74% probability of the households of being poor in 2008 by 11%, while it increases the 51% probability in 2011 by 16%.

B.2 Age

Age of the household head is statistically significant that decreases the probability of household of becoming poor for both 2008 and 2011 by 0.7%. Household head age decreases the probability of the household of becoming poor of 74% and 51%, for 2008 and 2011, respectively.

B.3 Education

Table 4 presents interesting results about variable education. The results suggest some kind of threshold, i.e., educational attainment of the household head below high school (secondary education) increases the probability of being poor for both 2008 and 2011.

A more interesting result is that the marginal negative effect increases for higher educational attainment, i.e., higher levels of education past the threshold (secondary education) reduces the probability of being poor for both 2008 and 2011 at an increasing rate. This would mean increasing 'returns' to higher educational attainment, with returns measured as "reduced probability of being poor", most likely due to greater capacity for earning but also lower deprivation in other aspects including education, obviously, but also in terms of health care, civic engagement, etc.

C. Marginal Effects of Poverty Mobility

Table 5
MARGINAL EFFECTS BASED ON LOGIT ESTIMATES

Probability	**Poor in 2008; Non-Poor in 2011** *(Lower Bound) .00091673*	**Non-Poor in 2008; Non-Poor in 2011** *(Upper Bound) .40239353*	**Non-Poor in 2008; Poor in 2011** *(Lower Bound) .43887057*	**Poor in 2008; Poor in 2011** *(Upper Bound) .03840095*
Exogenous Variables				
Family Size	-.0034466	-.1189075	.1199204	.0062098
Age	.0001405	.0063334	-.0040118	-.0009676
Age Squared	-5.69e-07	-.0000247	***4.47e-06***	7.29e-06
Wages	1.92e-07	5.26e-06	-7.03e-06	-4.99e-07
No Grade Completed	-.0011347	-.2464443	.257211	***-.0020216***
Elementary Graduate	-.0012697	-.0869634	.0878724	.0076874
High School Graduate	.0024014	.0736575	-.048542	-.0040988
Post-Secondary Grad	.2535384	.2602366	-.2210779	-.0149135
College Graduate	***.0060688***	***.1618242***	-.2919128	0
Urbanity	-.0003303	-.2442892	.232598	.0142158
Government Support	***-.000294***	-.158339	.1554446	***-.0072136***
Entrepreneurship	.0002913	.1225551	-.1608232	-.0093148

Note: All values are significant, except those in bold.

C.3 Demographic Factors

Results in Table 5 suggest that family size has a negative effect on poverty mobility in the Philippines in 2008. The same results are found for 2011 except for 'poor to poor' state that shows positive effect, the probability of which however, is very low and barely significant (0.18%). This implies that poor households having large family size face the difficulty of moving out of poverty; and the non-poor are vulnerable to move into poverty.

Large families suffer from financial issues due to greater amount of income required for the caring of family members. It is expected that a larger family often has more expenses than a smaller family and a higher amount of income must be budgeted to meet the basic necessities of family members. This finding reinforces the results in Table 4, which show that family size is statistically significant in increasing the probability of a household of being poor. In addition, this finding conforms to the studies of Orbeta (2003, 2005), Reyes et al. (2010), Arcilla et al. (2011), and Son (2003) that identified household size as a determinant for households being poor.

Larger households with more dependents shrink the income distribution, and dwindle purchasing power to afford basic services such as education, sanitation and health. This agrees with Gasparini et al. (2010) that links the size of household to the degree of income poverty.

Likewise, this finding offers evidence to the argument of Rowntree (2012) that a larger family size, especially households with more than four children, is responsible for primary poverty (defined as families whose earnings are insufficient to obtain the minimum necessaries

of the maintenance of merely physical efficiency). Moreover, this finding validates the study by Reyes (2002) that made use of the 1997 FIES, 1998 and 1999 APIS. Following the pattern of poverty mobility of households over the period, Reyes (2002) shows that as family size of household increases, the probability of being non-poor decreases and vice-versa.

Another demographic factor, age of the household head, as presented in Table 5 suggests a positive effect on poverty mobility in 2008. The same effect was found in 2011 except for 'poor to poor' state that shows negative effect, probability of which is extremely low and barely significant (0.03%). Based on the statistics presented in Table 2 wherein majority of household heads are found in the bracket of 41 to 50 years of age, I would surmise that these household heads are at their optimum to take on work that could significantly contribute to income. Most poor people rely on their physical strength to earn an income. As such, their opportunities to engage in the same types of work and earn the same income are reduced in old age. Declining capacity for labor in informal sector and exclusion from formal labor market could be a cause of poverty.

This validates the study by Reyes et al. (2010) who found that prime-aged household heads increased the probability of household being non-poor. In contrast, if the household heads are younger or older, the probability of the household being poor increases as well. Literature is fraught with evidence that old age determines poverty as the age adds to dependency burden (Todaro & Smith, 2011) and the dependency ratio, and the higher it is, the higher the burden it places on the working members of the household, thus the higher the probability of poverty.

Another demographic factor presented in Table 5, education exhibits a variation in its effect on poverty mobility. A household head having low educational attainment such as no grade completed and elementary graduate decreases the probability of moving out of poverty and staying out of poverty while increases the probability of moving into poverty and staying below the poverty line. This suggests that low educational attainment has negative effect on poverty. However, household head with higher educational attainment such as high school graduate, post-secondary graduate, college graduate and higher is found to have positive effect on poverty mobility.

These results suggest that the probability of moving out of poverty and remaining above the poverty threshold increases, as educational attainment of household head gets higher due to greater capacity for earning and lower deprivation of other basic necessities including education.

Results also reaffirmed the study by Reyes et al. (2010) about the education qualification of the household as contributing to a household being poor or non-poor. In general, the proportion of chronic poor decreases as educational level increases. Other relevant facts shown in the study included 40 percent of chronic poor had no formal education, 7.4 percent had at least high school education, 50 percent did not finish elementary, and 2.8 percent reached at least tertiary level.

Education increases the quality of human capital and opportunities for a higher paying job (Reyes et al., 2010) as jobs in the agriculture sector still contributed to households being poor (Reyes et al, 2010, 2012). It also contributes to adult literacy (Chatterjee, 2005; Hala & Ali, 2013; Kim & Terada-Hagiwara, 2013), a facet of quality human capital.

CONCLUSIONS

In the Philippines, addressing poverty remains a challenge given the limits to the effectiveness of government's poverty alleviation policies despite several government administrations' good intentions.

Emerging from the study were the effects of some economic, demographic and social factors to be significant in reducing poverty incidence in the Philippines. In particular, demographic factors such as family size, age, and educations were found significant to decrease poverty incidence from 74% in 2008 to 51% in 2011.

Using a more refined analysis to further test the demographic factors in estimating poverty mobility namely, poor to non-poor, non-poor to non-poor, non-poor to poor, and poor to poor (i.e., whether or not family size, age and education lead to poverty alleviation, escape from poverty, poverty, further poverty; or has no effect on poverty status) of Filipino households, this study used repeated cross-section analysis modeled by Dang et al. (2011).

This study adds to the accumulating evidence that family size negatively affects poverty mobility. Literature points out that larger family size makes it difficult for poor families to move out of poverty and makes the non-poor more susceptible to move into poverty. Similar to related studies, the results suggest the significance of fertility and population control policies and programs to promote small family size and thus, to combat against poverty.

Linked to family size, Reyes, (2002) revealed the probability of being non-poor increases with higher educational attainment and that the probability of being non-poor for the same educational attainment decreases with family size. Reyes (2002) further noted that for families whose household heads have the same level of educational attainment, larger-sized families tend to be poorer than smaller-sized families.

It is assumed that the greater the number of household members, the smaller the income distribution and limits access or invest on basic services such as education. This study confirms the existing literature that shows lower educational attainment of the household head increases the probability of being poor and higher educational attainment decreases the probability of being non-poor. This indicates that since education is connected to the state of poverty of a Filipino household, it is more difficult for those with lower educational attainment to earn income to get out of poverty. Similar to previous studies, the results suggest the importance of improving access to education by the poor to achieve the goals of the government to fight against poverty.

Another demographic factor, age of the household head, has been found in this study to have a positive effect on poverty mobility. Majority of household heads surveyed aged in the bracket of 41 to 50 years of age, range that I would assume at their optimum to take on work that could significantly contribute to income. Reyes et al. (2010) found that prime-aged household heads increased the probability of household being non-poor. On the other hand, the probability of the household being poor increases if the household heads are younger or older. Rowntree (1902) also identified old age of the household head earner as among the incapacitating factors that could lead to primary poverty.

However, contributions by elderly members of the household are often not considered. Often in the culture Filipino households, older people make efforts for other family members to find employment, assist in raising grandchildren, act as mentors, and secure the home while other family members are at work. Although these contributions will not be counted toward traditional measures of economic growth that focus on real GDP, they are clearly welfare enhancing and do contribute to economic development.

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THE BUREAUCRAT'S DEMAND FOR NETWORKING TIME

Funderburk Ballard

ABSTRACT

Bureaucracy is the ubiquitous form of organizational structure among large scale enterprises and undertakings, both public sector and private. A great irony is that while bureaucracies are intended to perform complex tasks efficiently, they frequently fail to produce the desired outcomes. Bureaucracies, especially public sector bureaucracies, almost always are created with the best of intentions, but the results-often in the form of unintended consequences-all too frequently are disappointing. Why? Being human, bureaucrats attempt to maximize their own well-being. We offer a behavioral model representing bureaucrats' decisions to allocate time so as to improve their present and future consumption. All such decisions involve opportunity costs. Given the bureaucrats' incentive structures, they may choose more personal networking time as opposed to allocating more time to improving the methods and models they use to promote the public good.

1. INTRODUCTION

"Everyone talks about the weather but no one does anything about it." If one takes that famous Mark Twain quote and substitutes the word "bureaucracy" for "weather" the quote loses little of its irony or accuracy. Like the weather, bureaucracies impact us all. And also like the weather, bureaucracies seem beyond the capability of humans to control. To argue that no one does anything about bureaucracy is not to argue that no one attempts to do anything about it. Indeed, the numbers and methods of attempted "fixes" of specific bureaus as well as bureaucracies in general are legend: organizational redesigns, leadership changes, investigations, downsizings, privatizations, recruiting mechanisms, etc. Politicians and academicians have analyzed, spoken and written volumes on the topic. However, the fundamental nature of, and challenges presented by, bureaucracy has changed little over time.

Bureaucracy is the ubiquitous organizational structure for large-scale enterprises and undertakings, both public sector and private. Whether dealing with the IRS over a tax dispute, with a university HR-Equal Opportunity-Diversity Office when trying to hire new faculty, a credit card company over a billing error, a large insurance company (of any kind on any issue), or virtually any aspect of the health care system, one invariably finds oneself mired in the rules and red tape of a bureaucratic maze. The word "bureaucrat" rarely is preceded by a descriptor such as "fair-minded," "efficient," "versatile" or "helpful." Politicians rarely campaign for office promising to add more bureaucrats to the public payroll, or to add more "bureaucratic red tape" to public sector activities. Corporate executives rarely think of adding to the bureaucracy as a strategy for streamlining operations or "turning around" their organization.

That presents an interesting dichotomy. Why is bureaucracy such a widely used organizational structure if it is so widely described and regarded in negative tones? If bureaucrats are so widely criticized and the concept of bureaucracy so widely reviled, why do we continue to create new ones and enlarge existing ones? Those questions bring to mind a second famous quote-famous, at least, among economists: "…things are the way they are for some powerful reason or reasons, which have to be understood if effective social solutions are to be devised…." (Johnson, 1975, p. 18). Applying the obvious implications of this observation by Harry G. Johnson to the topic at hand, one could surmise that there must be strong reasons why the bureaucratic structure has become so pervasive among large organizations, but also there must be some strong reasons why bureaucracies seem so often not to perform as efficiently and effectively as we would desire.

2. BUREAUCRACY AND BUREAUCRATS: DEFINITIONS AND CHARACTERISTICS

As the general public knows and views bureaucracy and bureaucrats, the concepts apply to any group of non-elective government officials and/or some administrative policy-making group. Even more generally, the term "bureaucracy" is used to refer to the administrative system governing any large institution. From the viewpoints of management and organizational structure, the consideration of bureaucracy traces back to the work of German sociologist-philosopher-political economist Max Weber. In the spirit of Weber and managerial behavior, and in perhaps the most positive light, bureaucracy is described as an organizational model rationally designed to perform complex tasks efficiently. Most economists, on the other hand, generally tend to view bureaucracies and bureaucrats in a less favorable light. That's another aspect of the dichotomy referenced above. Bureaucracies, especially public sector bureaucracies, almost always are created with the best of intentions, but the results-often in the form of unintended consequences-almost always are disappointing. Relative to that observation, it is important to note what is (and is not) at the heart of the problem. As Milton Friedman (1993, p. 11) often pointed out in his assaults on the ill effects of bureaucratic regulations, it is not a problem that bureaucrats are bad people or that their intentions are not noble, but rather a problem with the system. "The self-interest of people in the government leads them to behave in a way that is against the self-interest of the rest of us."

Weber lays out several key characteristics that define bureaucracies. Because the structure of any organization tends to have an important impact on its behavior and performance, these are considered briefly. First, Weber considered a formal hierarchy a key characteristic of any bureaucracy. The nature of that hierarchy is that it is composed of power levels that control each subsequent level, with a top person in power controlling all levels. Weber also observed that bureaucracies invariably develop well-defined sets of rules, regulations and decisions that must be followed with consistency throughout all levels of the structure. In short, the Weber bureaucracy refers to the management of large organizations characterized by hierarchy, fixed rules, impersonal relationships, rigid adherence to procedures, and a highly specialized division of labor. But Weber (1947, p. 7) also observed: "There is a system of promotion according to

seniority, or to achievement, or both. Promotion is dependent on the judgment of superiors." However, he failed to deal with the important issue of promotion more specifically, an omission for which he often has been criticized. For example, Blau and Scott (1962, p. 35) argue that the issue of promotion and advancement is one of "the most fundamental problems in the study of formal organizations." Ironically though, they also fail to address the issue.

It has long been recognized that not all bureaucracies are as rigid and regimented as the Weber treatment implies. Public sector bureaus come in a broad array of sizes and shapes, and their "charges" or missions and routines range from the very menial/mechanical to critical, regulatory/policy making entities. In most if not all cases, however, the degree to which the objectives or mission of the bureau is clearly defined and measurable is critical. Heckman (1997, p. 292) observes: "When agency goals are vague and do not define clear objectives, the tasks performed by a bureaucracy are often defined by the agency employees and not the agency directors." Brehm and Gates (1997) explore the question of what bureaucrats maximize when making decisions and who or what influences their choices. They argue that bureaucratic decisions fall into three types: working, when bureaucrats direct their efforts toward accomplishing goals that match their supervisors' goals; shirking, when they direct their effort toward non-policy goals (such as leisure); or sabotage, when they exert effort toward accomplishing policy goals that differ from the goals of their supervisors. In general, they conclude, supervisors are very limited in their ability to control subordinates' behavior.

In fact, it is clear that the behavior of the employees of bureaucracies is influenced not only by incentives controlled by the agency, but also by external reference groups, such as the professional mores of social workers. The more vaguely a job is defined, the more likely it is that these other factors influence employee job performance." Benson (1995), Peters (2002) and Page and Jenkins (2005) all have noted that bureaucrats at all levels can and do exert a direct impact on the behavior of the bureau, and even on policy. As Peters (2002, p. 12) notes, "Although the emphasis on policy-roles played by public servants is usually at the upper levels of the system, the lower echelons also play these roles." And while Brehm and Gates (1997) argue that the decisions of street-level bureaucrats are explained primarily by their own preferences and the preferences of fellow bureaucrats, they ultimately conclude that these preferences generally are aligned with fulfilling their policy missions. Golden (2000) makes a similar argument in her study of federal executives.

Gordon Tullock, a pioneer of public choice economics, paints a less rosy picture of bureaucrats and bureaucratic decision making, focusing on the personal relations and advancement procedures within bureaucratic organizations. He examines the ways in which the bureaucrat gets ahead in the bureaucratic world, as well as the ways in which bureaucrats get their subordinates to do what they want them to do. In a none-too-flattering assessment, Tullock (1965, p. 31) describes the "typical" politician/bureaucrat who rises in the bureaucratic environment as an "intelligent, ambitious, and somewhat unscrupulous man in an organizational hierarchy." Seeing a high potential for a principal-agent problem, Tullock (1965, p. 23) warns, "If the general atmosphere of his organization requires actions contrary to the attainment of the

objectives of the organization in order to secure promotion, the [bureaucrat] can hardly be expected to choose a course of action detrimental to his own advancement."

The bureaucrat can follow a strategy that on the surface sounds positive and beneficial, but in a less visible way benefits the individual bureaucrat at the expense of the public. If the personal cost to the bureaucrat for his mistakes is small, then we can expect mistakes. As expressed by another public choice economist, Steven Richardson (2011, p. 25), "Bureaucratic behavior is an environmental phenomenon that is not limited to certain types of individuals. Rational people inherit and propagate different attitudes and strategies in what we describe as a bureaucracy because their institutional environments create different incentives. Without a clear bottom line, officials are free to emphasize activities and information that advances their own interests. These behaviors are not unique to government organizations, but they are more pronounced and destructive because they are not eliminated via natural selection of market forces."

3. A Bureaucratic Behavioral Model: Theoretical Underpinnings

The view taken in this paper, consistent with the tenets of public choice theory, is that bureaucrats, like other human beings, are very well in tune with and motivated by, their own rational self-interest. They attempt to maximize their own well-being. Accordingly, bureaucrats tend to act in such a way as to preserve and improve their position in the bureau. Given a regime under which the bureaucrat is promoted and prospers based on seniority and/or political connections rather than on pure performance merit, we expect the self-interested bureaucrat to desire growth in the size of their bureau (*a la* a Niskanen-type budget maximization model). Given the desire to have more people working for the bureau (and bureaucrat)-a condition that the bureaucrat expects will translate into more power, prestige and income-the size of the bureaucracy will tend to grow over time. Given the contributing factors of principal-agent issues, rational ignorance among voters, difficulties and costs of monitoring and controlling the quality, quantity and value of the output of the bureau, it is not surprising that that bureaucratic growth is often accompanied by inefficiency and non-optimal behavior.

In what follows, we suggest a behavioral time allocation model for the bureaucrat and the bureau. Inasmuch as the individual bureaucrat has the incentive to pursue his own self-interest—whether or not it aligns closely with the public interest, one can expect a tendency toward such behavior. Further, to the extent that the bureau's objectives are not clearly defined and/or measurable, the individual bureaucrat may also have the opportunity to affect the daily activities and attitudes as well as the overall behavior and direction of the bureau. One would expect both the individual bureaucrat and the overall bureaucratic agency to favor a course that promotes growth of the bureau. At the same time, a key question confronting the individual bureaucrat is how to allocate his/her time so as to maximize their personal well-being. A key component of that question is how does the bureaucrat insure promotion and advancement within the bureau? Because the questions posed above relative to the expected behavior of the self-interested bureaucrat involve time allocation issues, that is a central focus of this paper. Our point of departure is a Gary Becker-style time allocation model. In "A Theory of the Allocation of Time"

Becker (1965) stated that his goal was to provide "a basic theoretical analysis of choice that includes the cost of time on the same footing as the cost of market goods." So, where Becker's effort was directed toward developing a household production function in which the various competing uses of time were accounted for (through utility and opportunity costs), we aim to perform a similar task for bureaucracies. In the model presented here we divide the bureaucrat's total time into four uses: (1) labor time, or time spent on the job for which the bureaucrat receives a wage; (2) "networking" time-as described more fully below-but which the bureaucrat views as an avenue for improving her present and/or future consumption; (3) time spent to purchase goods and services; and (4) there is a transactions time element associated with each of the above. In terms of constraints and definitions in the model, we assume first that the bureaucrat allocates some positive amount of time to each of these four uses, but has the flexibility to alter the allocations.

4. ANTICIPATING CRITICISMS OF APPLYING PUBLIC CHOICE TO PUBLIC SERVANTS

The study of bureaucracy falls within the purview not only of economics, but also of political science, public administration, management/organizational behavior, psychology, sociology, and other social and behavioral sciences.Many who are politically and/or philosophically predisposed toward viewing bureaucracy in a more favorable light (especially "big government" political liberals) consider public choice theory unkind toward public service, and find especially repugnant the notion of applying a market based behavioral model to explain the behavior of public servants. Among the frequently voiced objections coming from this group are that (1) many if not most public servants-bureaucrats-are public minded; dedicated and devoted to the mission of the bureau for which they work, and are not motivated solely by self-interest, (2) individual bureaucrats are largely constrained from personally benefiting from enhanced revenues associated with budget-maximization behavior *a la* Niskanen, (3) bureaucracies are not uniform, homogeneous agencies that can be painted with a single brush, or analyzed with a single, general model, and (4) it is not possible to classify and measure the myriad uses of time expended by the typical bureaucrat.

Relative to these criticisms in general, it is important to keep in mind that the purpose of theory is to explain and to predict. In that respect, economic theory differs from mere description that carries limited applicability. As Friedman (1953), Becker (e.g., Clement), Glaeser (2004) and others have pointed out on many occasions and for many years, the great achievement of economics is understanding aggregation. In order for a theory to have explanatory and/or predictive value, it is not necessary that every individual attempt to maximize his/her income, or that a bureaucrat succeeds in capturing the fruits of growing the bureaucracy-so long as in the aggregate they attempt to do so.

An Aside on Public Service Motivation (PSM) -- The concept of "public service motivation," developed and formalized in the late 1970s and early 1980s by a group (consisting primarily) of public administration academicians, stands in stark contrast with the basic tenets of public choice

theory. As initially presented, PSM can be described as a theorized attribute of government employees that provides them with a desire to serve the public. Asserting that some public service ethic (higher calling?) exists, PSM proponents argued that the phenomenon explains why some people choose careers in the government (and non-profit sectors) despite the potential for more lucrative careers in the private sector. In the words of James L. Perry (1996), one of the early contributors/developers of PSM, "The public administration literature makes many assertions that the motivations of individuals who pursue public service careers differ in important ways from other members of American society." Naff and Crum (1999) suggest, for example, that the public employee places the mission of the organization and the betterment of society over financial rewards, when compared to private sector workers.

In their "Public Service Motivation: A Systematic Literature Review and Outlook," Ritz, Brewer and Neumann (2013) point out that to date most PSM research and publishing has been concentrated among the Public Administration scientific community, and that the exchange of ideas between PSM and other fields is mostly one-way, involving PSM scholars importing knowledge from other fields but exporting relatively little back to them. And while they by no means dismiss PSM research as invalid or unimportant, they do describe it as "not there yet." However, we find in PSM no convincing evidence that bureaucrats are so different from humankind in general that they do not pursue their own self-interest. We find much more convincing the arguments of three noted non-PSM philosophers who offer a different view of human behavior. The views of Adam Smith, as reflected in this famous quote from The Wealth of Nations (1776) and his pivotal role in shaping the thinking and models of economists are well known: "It is not from the benevolence of the butcher or the baker that we expect our dinner, but from their regard to their own self-interest." Smith was by no means the first to recognize and write about the role of self-interest in decision making. More than 500 years earlier, in his Summa Theologica, St. Thomas Aquinas observed, "Every man is more careful to procure what is for himself alone than that which is common to many or to all since each one would shirk the labor and leave to another that which concerns the community." And, in the words of Dale Carnegie (1936, p.88), "A person's toothache means more to that person than a famine in China which kills a million people." We note that none of these famed students of human behavior excepted bureaucrats from their observation.

Finally, it is important to note that this is a theoretical, not an empirical, study. For that we make no apologies. Theory has long been a mainstay in the economist's tool bag. It has often been noted that Becker, a Nobel laureate, engaged in extensive "casual empiricism" in showing how his model can be used to interpret "a host of observed economic phenomena…" In that same vein, we do not attempt any formal identification or estimation of parameters. We readily accede to the contention that one cannot readily observe, categorize and measure the various uses of time-much less costs and benefits of the various uses-in a bureaucratic setting. Asking a bureaucrat how he spends his time is hardly likely to produce valid or useful results. Additionally, we believe that experiments have not proven particularly beneficial in such tasks. We take the view that whether the economist/social scientist conducts her experiments in the

laboratory or in the field, it is still experimentation and thus subject to the adulterating effects of the process. As the great theoretical physicist Werner Heisenberg (1958), noted, "[T]he measuring device has been constructed by the observer, and what we have to remember is that what we observe is not nature itself, but nature exposed to our method of testing." If the quantum physicist cannot eliminate the uncertain impact introduced by his testing methodology, how likely is it that the economist or psychologist can do better?

5. DEFINING NETWORKING-AS USED HERE

Inasmuch as the term and concept "networking" has taken on innumerable new and nuanced meanings in recent years-especially in management/executive development literature-some explanation of and justification for our use of the term seems in order. In their classic treatment of bureaucratic behavior, Breton and Wintrobe (Benson, 1995, p. 101) argue that "informal networks within and across bureaucracies are the non-market institutions of exchange through which individual bureaucrats cooperate in order to obtain information and benefits, and to circumvent various administrative rules." In this sense we are using the term "networking" as involving unofficial and/or "personal" networking time versus official "teaming" or "networking" that is a recognized part of the job description. In the more traditional, "human relations" use of the term, Lussier (2010, ppt. Ch. 11, #23) defines networking as "a form of political behavior—the ongoing process of building interconnected relationships for the purpose of politicking and socializing."

In the model presented, the bureaucrats produce consumption (present and future) by combining labor time, networking time and purchases in a production function. They sell labor time for a wage and they purchase products and services (present and future). There is a transaction time associated both with job and with purchases, and that transactions time is assumed not to be independent of the bureaucrat's choices (see equation 4 below). Networking time is defined as time used to network (as the term is explained above) with those individuals who the bureaucrat believes can help in improving his/her present and future ability to consume. All available time is assumed to be taken up by four uses of time in the model.

6. THE MODEL

We posit that the bureaucrat attempts to maximize equation (1)

$$U = U(C), \tag{1}$$

where (U) represents current and expected future utility, and (C) represents current and expected future consumption. The utility function is assumed to be twice differentiable and to have the usual curvature. Note, current and future consumption are subsumed in (C). The bureaucrat produces consumption by combining products and services purchased (G) and networking time (N) to produce that consumption in equation (2)

$$C = C(G, N), \text{ where } \frac{\partial C}{\partial G} > 0 \text{ and } \frac{\partial C}{\partial N} > 0, \tag{2}$$

where (G) is a composite of products and services currently consumed and expected future consumption, (N) is networking time. The bureaucrat's choice of a particular combination of current and future consumption (C) and networking time (N) depends on variables such as the wage rate, income tax rate, etc.

We assert that the bureaucrat faces an income equation (3) and a time constraint (equation 4)

$$W(1-t)L = PG(1+\sigma) \tag{3}$$

$$1 = L + N + T \tag{4}$$

$$T = T^L + T^G \tag{5}$$

$$T^L = T^L(L, \alpha), \text{ where } T_L{}^L,\ T_\alpha{}^L > 0 \tag{6}$$

$$T^G = T^G(G, \beta), \text{ where } T_G{}^G,\ T_\beta{}^G > 0 \tag{7}$$

where (W) represents the wage rate, (t) is the tax rate on wages, (L) is time for which he/she is paid (labor time), (β) is an income shift parameter, (P) is a price index for present and future products and services, (σ) is a sales tax, (N) represents time used networking, which the bureaucrat believes will affect his/her present and future consumption, (T) represents total transactions time. (T^L) is a positive function of (L) and a constant (α) which is a shift parameter that represents changes in the efficiency of transaction time associated with the bureaucrat's job. A positive change in (α) represents a decrease in efficiency, since a given number of hours on the job is associated with a larger transactions time (e.g. information costs). Also, variables affecting transportation to and from (e.g. congestion on roads) will affect transaction time associated with the job). However, all variables affecting (α) are considered exogenous in our model. (T^G) represents transactions time associated with purchasing products and service, where (T^G) is a positive function of products and service purchased and a constant (β), where (β) is a shift parameter representing changes in the efficiency of transactions time associated with purchasing products and services. A positive change in (β) represents a decrease in efficiency, since a given amount of purchases are associated with more transactions time. (β) is assumed to be a function of conditions in the market (e.g. information costs). However, again (β) is considered to be exogenous in our model. Now the constraints on the bureaucrat's choices, equations (3) – (7) above, can be combined to obtain equation (8). Recall, the model assumes that all uses of the bureaucrat's time are positive. We can then write the constraints as equation (8).

$$W(1-t)\{1 - N - [T^L(L, \alpha) + T^G(G, \beta)]\} + \gamma - PG(1+\sigma) = 0 \tag{8}$$

In attempting to maximize utility the bureaucrat is considered as maximizing the augmented function, equation (9), which is a Lagrangian function with choice variables (N),

time used networking, (G) present and future products and services purchased, and (L) is labor time for which a wage is paid

$$U\,[C(G,N)] + \lambda\{w(1-t)[1-N-[T^{L}(L,\alpha)+T^{G}(G,\beta)]]\} + \gamma - PG(1+\sigma) = 0 \qquad (9)$$

Note that (N), (G), and (L) are not independent by reference to equation 4 above. Therefore, only (G) and (N) need be considered in the objective function equation (9) above. The first order or necessary conditions for maximization of the objective function equation (9) are represented by equations (10), (11), and (12).

$$U_{C}C_{G} = \lambda[P(1+\sigma) + w(1-t){T_{G}}^{G}] \qquad (10)$$

$$U_{C}C_{N} = \lambda[w(1-t)] \qquad (11)$$

$$[w(1\text{-}t)\{1\text{-}N\text{-}[T^{L}(L,\alpha)+T^{G}(G,\beta)]\}\,\gamma\text{-}PG(1+\sigma) = 0 \qquad (12)$$

We explain these first order (necessary) conditions as follows: Equation (10) shows that the marginal utility from products and services through their effect on consumption must equal their marginal opportunity cost in terms of the price of products and services, including sales tax plus forgone earnings due to transaction time associated with purchases-valued by the marginal utility of income. Now, since equations (10), (11) and (12) are three equations with three unknowns, (G, N,λ), with seven parameters, we can solve for the demand for networking time, as in equation (13)

$$D_{N} = D_{N}(w,t,\alpha,\beta,\sigma,P,\gamma) \qquad (13)$$

Now, totally differentiating equations (10) - (12) to obtain partial derivatives, then solving for changes in the demand for networking time (D_{N}) with respect to changes in parameters, we can write equations (14:1-7) where H is the bordered Hessian determinant of the utility function with first derivatives of the constraint equation (12) as the border. We note that it is both necessary and sufficient that the elements of the Hessian be associated with a quadratic form which must be negative definite with one constraint. So, H>0 is necessary and sufficient for utility to be maximized.Next, the task is to determine how the demand for networking time (D_{N}) changes as parameters change. To accomplish this, income and substitution effects must be identified and their signs determined. This is done in equations (14: 1-7) below:

$$\frac{D_{N}}{W} = \frac{\lambda H_{GN}(1\text{-}t){T_{G}}^{G}}{H} + \frac{\lambda H_{NN}(1\text{-}t)}{H} + \frac{H_{\gamma N}\{-(1\text{-}t)[1\text{-}N\text{-}[T^{L}(L,\alpha)+T^{G}(G,\beta)]]\}}{H} \qquad (14.1)$$

$$\frac{D_{N}}{t} = \frac{\lambda H_{GN}(-W)T_{G}^{G}}{H} + \frac{\lambda H_{NN}(-w)}{H} + \frac{H_{\gamma N}\{-(w)[1-N-[T^{L}(L,\alpha)+T^{G}(G,\beta)]]\}}{H} \qquad (14.2)$$

$$\frac{D_N}{\alpha} = \frac{H_{\gamma N}[-(w)(1-t)(-T_{\alpha}^{L})]}{H} \tag{14.3}$$

$$\frac{D_N}{\beta} = \frac{\lambda H_{GN} * W(1-t)T_{G\beta}^{G}}{H} + \frac{H_{\gamma N}[-W(1-t)(-T_{G\beta}^{G}))]}{H} \tag{14.4}$$

$$\frac{D_N}{\alpha} = \frac{\lambda H_{GN}(P)}{H} + \frac{H_{\gamma N}(PG)}{H} \tag{14.5}$$

$$\frac{D_N}{P} = \frac{\lambda H_{GN}(1-\sigma)}{H} + \frac{H_{\gamma N}\, G(1+\sigma)}{H} \tag{14.6}$$

$$\frac{D_N}{\gamma} = -\frac{H_{\gamma N}}{H} \tag{14.7}$$

Again, (H) is the bordered Hessian. Notice that equation (14:7) is determined by taking partial derivatives of equations (10) – (12) with respect to the income shift parameter (ɣ) while holding time on the job (labor time) constant and using Cramer's rule to find $\frac{D_N}{\gamma}$. Equation (14:5) is determined by taking partial derivatives of equations (8) – (10) with respect to the price index for current and future purchases of products and services. $\frac{D_N}{P}$ is also solved for by Cramer's rule. Note that the last term in equation (14:6) is equivalent to equation (14:7) except that equation (14:7) does not contain$(G(1+\sigma))$. This allows one to identify the last term in equation (14:6) as the income effect of a change in the price index of purchases. It is possible then to identify the first term in equation (14:6) as a cross substitution term that shows the effect of change in the price index on the demand for networking time(D_N) while holding utility constant. Therefore, equation (14:6) may be identified as a Slutsky-type equation. Now, one can determine the signs of equation (14:6). Assuming products and services and networking time are normal inputs in the production of the bureaucrat's consumption function (C), and with the assumption of normal inputs and with second order condition for utility maximization, one can determine the sign of $\frac{H_N}{\gamma}$. An increase in wages will have a positive effect on the demand for products and services and on networking time. In equation (14:6), $\frac{D_N}{P} = \frac{H_N}{H}$, and by normality, $\frac{D_N}{\gamma} > 0$, so it must be that $\frac{H_{\delta N}}{H} < 0$. Since G > 0 and σ > 0, by assumption, the income effect in equation (14:6) is negative. One might conclude that the higher the income of the bureaucrat, the less networking time he will demand. As a possible explanation, perhaps higher income bureaucrats are nearer retirement and attach less importance to additional networking time.

The next task is to determine the sign of the cross substitution terms in equation (14:6). Since networking time and products and services are substitutes, $H_{GN} > 0$ and by second order conditions for utility maximization, H > 0, since λ >0 and the sales tax rate (σ) is assumed to be positive or zero, one can conclude that $\frac{H_{GN}}{H} > 0$. Having identified and determined the signs for the terms in equation (14:6), one can now determine the sign for equation (14:6) as a whole.

Since income and substitution terms in equation (14:6) have opposite sign, the sign for equation (14:6) depends on the relative size of the terms-which cannot be determined *a priori*. An intuitive explanation is that an increase in the price index produces an income and substitution effect on the demand for networking time(D_N). The net effect will depend on the relative importance to the bureaucrat of products and services and networking time (N) as inputs to his/her consumption function (C). One would expect younger bureaucrats to value networking time as being more important to their present and future consumption than will older bureaucrats-for reasons suggested above. If networking time is indeed more important to younger bureaucrats, then the cross substitution effect will dominate the income effect, so the sign of equation (14:6) will be negative.

The effect on the bureaucrat's demand for networking time of a change in wage rate is given by equation (14:1). Again, to determine the sign for$\frac{D_N}{W}$, income and substitution terms can be identified and their signs determined. The first term in equation (14:1) can be identified as a cross substitution term by referring to equation (14:6). We know that $H_{GN} > 0$, since (G) and (N) are substitutes and that the second order condition for utility maximization is H > 0, so $\frac{H_{GN}}{H} > 0$ and since λ, $T_G{}^G > 0$ (eq.5) and (1-t) > 0 by assumption, then the first term in equation (14:1) is identified as the own substitution effect (see equation 15 below). Taking the derivative of equation (11) with respect to W (1-t) and solving by Cramer's rule for the change in the demand for the working time one can write equation 15)

$$\frac{N}{W(1-t)} = -\frac{H_{NN}}{H}, \tag{15}$$

and using second order conditions for utility maximization, H>0 and since H_{NN}(a main diagonal of the Hessian) is negative, so $\frac{H_{NN}}{H}$< 0. Since (1-t)>0 by assumption and λ>0, we determine that the second term in (eq. 14: 1) is negative. The last term in equation 14: 1) is an income effect by reference to equations (14:7) and (14:6). That last term in equation (14: 1) must be positive since $\frac{H_{\dot{y}H}}{H}$<0 and (1-t) > 0, so, (1-t) < 0. The remaining part of the term, $\{[1 - N - [(T_{GL}^{L}, \alpha) + T_{G\beta}{}^{G}]\}$ is positive by assumption. The net effect on the bureaucrat's demand for networking time (N) due to a change in his wage rate depends on the relative sizes of two substitution terms and an income effect term because their signs are opposite. The two substitution terms have opposite signs, but the net substitution effect is negative, given the assumptions. This can be seen by dividing equation (10) by equation (11) to obtain equation (16),

$$\frac{W(1-t)_G{}^{TG}+P(1+\sigma)}{W(1-t)} = \frac{U_c C_G}{U_c C_N} \tag{16}$$

which shows the marginal rate of substitution of goods and services for networking time. Now, taking the derivative of equation (16) with respect to the wage rate, where we let ø= (1-t), allows us to write equation (17).

$$\frac{MRS_{GN}}{W} = \frac{\emptyset\{W\emptyset\, T_G^G - [W\emptyset\, T_G^G + P(1+\sigma)]\}}{(w\emptyset)^2} < 0 \qquad (17)$$

Since ø, p, w, σ>0, by assumption and $T_G{}^G$>0 by (eq.5), therefore equation (17) is negative. So, an increase in wage rate results in a decrease in the price of products and services relative to the opportunity cost of networking time. And an increase in wage rate reduces the bureaucrat's demand for networking time used to increase present and future consumption. Recall that present and future consumption are subsumed in (C). One can say that the own substitution effect dominates, so the net substitution effect is negative. We expect less networking time to be used by high wage bureaucrats if age and networking time are negatively related. Due to spatial constraints, the effects on the bureaucrat's demand for networking time due to changes in income tax (t), etc. are not developed herein, but should be obvious. The same procedure can be used in identifying and signing partial derivatives for the parameters, (t), (α),(β) etc.

7. CONCLUSION

Bureaucrats have the incentive, and often the opportunity, to behave in such a way as to maximize their own well-being. We offer a behavioral model representing bureaucrats' decisions to allocate time so as to improve their present and future consumption. Given the bureaucrats' incentive structures, they may choose more personal networking time as opposed to allocating more time to improving the methods and models they use to promote the public good. Does the bureaucrat's penchant for personal networking negatively impact the public interest that the bureau is created to promote? Public sector bureaus come in a broad array of sizes and shapes, and their "charges" or missions and routines range from the very menial/mechanical to critical, regulatory/policy making entities. In some instances, one might argue that time the bureaucrat spends doing personal networking (or playing solitaire on their "work" computer) is of no great concern or cost—and might even be beneficial in that it distracts from their doing harm. In other instances, the opportunity cost associated with the bureaucrat's inattention to the (paid) task at hand may be great. While we are not able to identify with a great deal of precision the problem list of bureaucratic policy outcomes, the issue is nonetheless one of great importance, and also fertile ground for research.

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HOSPITAL ACCREDITATION AND FINANCIAL CONDITIONS OF PUBLIC HOSPITALS: EVIDENCE FROM HOSPITALS IN CHUBU

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ABSTRACT

Japanese public hospitals often confront difficult financial conditions that cause public hospitals to downgrade care quality and to close hospital wards or departments. This study examines the relations among the quality of care, efficiency, and the financial condition of public hospitals. Models were estimated to explain the efficiency and revenue with particular items related to the quality of care. Results show that the efficiency positively correlates with the real revenue rate. In some care processes, the quality of care has a negative correlation with the efficiency score. Our results suggest that public hospitals need financial support to improve the quality of care.

INTRODUCTION

Japan has 863 public hospitals, which provide high-quality medical services for regional communities.[1] However, 48.1% of public hospitals report a financial deficit. Local governments have introduced private company management methods to public hospitals, but such policies have not brought outstanding results. Some public hospitals close wards or abolish departments to decrease hospital deficits. Closing wards diminishes the quality of care, thereby degrading the welfare of local residents. Therefore, public hospitals should reduce financial deficits to maintain high care quality and to provide efficient medical services. To solve this problem, this study explores the links among hospital financial conditions, efficiency, and the quality of care.

Preceding studies have investigated the causes of Japanese public hospitals' persistent reports of financial deficits. Suzuki (2003) reports that hospital deficits are caused by gaps in salary and construction costs per bed between private and public hospitals. Nakajima et al. (2012) find that public hospitals lose revenue opportunities by having shortages of doctors. Moreover, Japanese public hospitals face a soft budget constraint problem: hospital managers who expect remedies for ex-post deficits do not operate their hospitals efficiently. Ishii (2006) claims that local governments subsidize hospitals to compensate for deficits. Nakayama (2004) and Nozao (2007) explore the link between subsidies for public hospitals and efficiency. They demonstrate that the efficiency of a public hospital decreases with the level of subsidy.

Data envelopment analysis (DEA) is frequently used to measure hospital efficiency (Register & Bruning, 1987; Byrnes & Valdmanis, 1994; Nan & Gunji, 1994; Aoki et al., 1996; Nakayama, 2004; Nozao, 2007; Kawaguchi, 2008). DEA uses a linear programming method and searches for the optimal combination of inputs and outputs. Nan & Gunji (1994) estimate the

human resource efficiency of Japanese public hospitals. They demonstrate that 7 of 17 studied hospitals are inefficient. Kawaguchi (2008) reports a lack of efficiency improvement at public hospitals during 1999-2003.

Donabedian (1978) demonstrates that the quality of care comprises structures, processes, and outcomes. Structures encompass the quality and quantity of hospital resources or hospital systems for providing medical services. Processes denote the quality of decision-making processes. The outcomes are results of treatment. Outcome quality measures, i.e. mortality rate, are used by the preceding studies to explore the relation between the quality of care and efficiency (Deily & Mckay, 2006; Ferrier & Valdmanis, 1996). Kawaguchi et al. (2010) estimates the efficiency of Japanese hospitals controlled by the hospital standardized mortality ratio using DPC data.[2] Whereas the outcomes to measure the effect of treatments are clear, structures and processes play a major role in leading to desirable outcomes. Ferrier & Trivitt (2013) estimate the efficiency of US hospitals using process and output measures. We explore the relation between efficiency and process measures of quality in Japan.

The hospital efficiency is affected by managerial performance, i.e. medical revenue and profit. Besstremyannaya (2011) explores the relation between financial performance and efficiency, demonstrating that Japanese public hospital efficiency increases with the medical revenue ratio. However, that analysis shows no link between financial conditions of hospitals and the process measures of quality. Bazzoli et al. (2007) explore the link between the financial conditions of US hospitals and the Joint Commission on Accreditation of Health Care Organization scores which indicate the quality of care or function of hospitals. Desombre et al. (2006) demonstrate that raising the organizational flexibility of hospitals enhances financial performance. Kodera et al. (2013) explore the link between the process quality measures and the financial conditions of private hospitals in Aichi prefecture, but that analysis does not specifically assess public hospitals. Therefore, we attempt to ascertain the link between the financial condition of hospitals and the process measures of quality.

First, the efficiency of public hospitals using DEA is measured. After estimating a correlation between the efficiency scores and financial performances, we examine how process quality measures affect the efficiency scores and financial performance, controlling for economic or environmental factors such as the population in the secondary medical region.

The remainder of the paper is organized as follows. Section 2 presents the methods and data used for this study. Section 3 shows the results of estimations. Finally, we discuss the results and conclude the paper.

METHODS AND DATA

These analyses use DEA to measure the efficiency of Japanese public hospitals similarly to the method reported by Nozao (2007). Actually, DEA has been used to estimate hospital efficiency.[3] Nozao (2007) uses three inputs and two outputs to estimate the efficiency scores: inputs are the number of hospital beds, average daily salary, and average daily material costs; outputs are average daily inpatient revenue and average daily outpatient revenue. Different assumptions about the production frontier of hospitals exist in the DEA model: one is constant returns to scale (CRS); another is variable returns to scale (VRS). The efficiency scores run from 0 to 1, with higher scores indicating higher efficiency: the most efficient hospitals have 1.

We derive the datasets to estimate the efficiency scores from Chiho Koei Kigyo Nenkan 2012, which includes data from April 2011 to March 2012. Moreover, the paper specifically

examines public hospitals in the 10 prefectures of the Chubu region: Aichi, Gifu, Mie, Shizuoka, Ishikawa, Toyama, Fukui, Nagano, Niigata, and Yamanashi. We use the real revenue rate as financial condition data derived from Chiho Koei Kigyo Nenkan. The real revenue rate uses real revenues as defined by subtracting subsidies from medical revenues, divided by medical costs.

Data which indicate the process quality of care are the grades of Hospital Accreditation accredited by the Japan Council for Quality Health Care. The Hospital Accreditation evaluates the quality of care for the structure and process. About 30% of Japanese hospitals are accredited. The sample for this study comprises 61 public hospitals. The Hospital Accreditation changes evaluation items every few years. We use ver. 5 and ver. 6 of the Hospital Accreditation, which consists of large items (categories), medium items, and small items. The medium items are scored on a scale of 1-5: 5, extremely; 4, appropriately; 3, intermediate; 2, lacking appropriateness; 1, inappropriate. We use 24 medium items in ver. 5 that are the same as ver. 6. Table 1 presents the efficiency values (CRS and VRS) and descriptive statistics of variables.

After calculating the efficiency values, we address the question of the links among efficiency, financial conditions, and the quality of care. First, to examine the link between efficiency and the quality of care, we estimate the following equation.

$$Y_i = \alpha Q_i + \beta X_i + \gamma Z_r + \delta_p + \varepsilon_i.$$

Therein, Y_i denotes the CRS or VRS efficiency score for hospital i located in region r and prefecture p, Q_i are scores for the process quality of care, X_i are other characteristics for each hospital, Z_r are regional characteristics, and δ_p are prefecture fixed effects. The CRS and VRS efficiency scores run from 0 to 1. Therefore, we estimate the equation above using a Tobit model.

The proxy for the process quality of care, Q_i, includes the scores of 24 medium items related to hospital accreditation. The medium items belong to five categories. Category 1 assesses the sufficiency of managers' leadership or ideals to manage their hospitals. Category 2 assesses whether hospitals have an established system for safety assurance or medical accidents. Support systems for patients are assessed in category 3. Category 4 assesses the establishment of an organization to provide care. Category 6 assesses the operational management quality.

We use the number of hospital beds and the prior year subsidy rate as proxies for hospital characteristics, except for the quality of care. Nakayama (2004) and Nozao (2007) examine the link between the efficiency and subsidy. Similarly to Nozao (2007), we use the prior year subsidy rate, which is the sum of government subsidy, local government subsidy, and provision of other accounts, divided by total revenue.

We employ variables as proxies for regional characteristics. Population density, share of the population under 15 years and share of the population over 65 years are proxies for potential medical demand in a region. We calculate these data for populations based on the second-tier medical region. The second-tier medical region is a standard to control the medical provision or the number of hospital beds in the region. Moreover, Kishida (2001) criticizes that there are a few patients move from their second-tier medical region to receive medical care. Prefecture dummies control for health care policies of each prefecture. The number of hospitals and the number of general beds are proxies for the degree of competition.

Table 1

SUMMARY STATICS				
Variables	(N = 153)		(N = 61)	
	Mean	Std. Dev.	Mean	Std. Dev.
DEA output variables:				
Average daily inpatient revenue	9772.18	9933.57	13866.52	9659.11
Average daily outpatient revenue	4709.81	4594.85	6373.86	4417.07
DEA input variables:				
Number of hospital beds (for general patients)	262.22	191.67	349.44	183.24
Average daily salary	8123.05	6713.29	11091.75	6388.32
Average daily material cost	3927.22	4617.57	5487.37	4421.38
DEA efficiency score :				
CRS	0.86	0.10	0.87	0.09
VRS	0.90	0.09	0.91	0.09
Financial condition:				
RREV Ratio of real revenue to ordinary expenditure	86.26	11.23	89.75	9.74
Hospital and regional characteristics:				
BED Number of hospital beds	289.73	199.82	371.07	179.30
SUBSI Subsidy rate (last year)			0.08	0.06
POP Population density	699.20	1282.56	850.29	1324.73
U15 Share of the population under 15 years	13.99	4.16	14.23	2.95
O65 Share of the population over 65 years	25.89	8.04	24.46	6.36
HOS Number of hospitals per 1000 km2 (ln)	2.76	1.02	3.02	1.00
GEBED Number of beds for general patient per 100,000 population (ln	6.46	0.26	6.44	0.29
Hospital accreditation score:				
1.1.1 Hospital establishes its ideals and basic policies			3.80	0.40
1.2.1 Hospital administrators/executives exercise their leadership in hospital administration			3.64	0.48
1.3.1 Hospital management is based on organizational rules			3.30	0.46
2.3.1 System is established for safety assurance			3.77	0.42
2.4.1 System is established for medical accidents			3.82	0.39
2.5.1 System is established for hospital infection			3.66	0.48
3.1.2 Hospital gives consideration to queueing time of outpatients			3.51	0.50
3.2.1 Hospital properly responds to requests from patients/families			3.87	0.34
3.3.1 Consideration is given to convenience of patients/visitors			3.56	0.50
4.1.1 Medical care section is established			3.36	0.48
4.2.1 Nursing section is established			3.44	0.50
4.3.1 Drug control section is established			3.59	0.50
4.4.1 System of laboratory test is established			3.84	0.37
4.6.1 System of diagnostic imaging is established			3.56	0.53
4.17.1 System of medical treatment at home is established			3.84	0.37
4.18.1 System of outpatient treatment is established			3.66	0.48
6.1.2 Human resource management is properly conducted			3.20	0.44
6.2.1 Financial management is properly conducted			3.67	0.47
6.2.2 Budgetary management is properly conducted			3.80	0.40
6.2.3 Business management is properly conducted			3.46	0.53
6.2.4 Medical administrative work is properly carried out			3.54	0.50
6.2.5 Bed management is properly conducted			3.54	0.50
6.3.1 Facilities and equipment management system is established			3.69	0.47
6.4.2 Hospital supplies are properly managed			3.56	0.50

EMPIRICAL RESULTS

Efficiency and the Quality of Care

Table 2 presents the results of estimations. The results show that medical administrative work (6.2.4) is negative and significant for both efficiency scores, which implies that efficiency decreases with medical administrative work consisting of counter services and processing of insurance claims. To carry out proper medical administrative work, public hospitals may employ many staffs. This phenomenon conflicts with the findings of Shimomura & Kubo (2011) who report that the processing of insurance claims of profitable hospitals is more efficient than that of unprofitable hospitals. Bed management (6.2.5) is positively significant for both efficiency scores. The positive sign implies that conducting bed management avoids elimination of opportunities for revenue, which corresponds to a report by Kawaguchi (2010). Establishment of a medical care section (4.1.1) or nursing section (4.2.1) was found to be negative and significant for the VRS efficiency score. This result implies that the efficiency decreases with the number of doctors and nurses, as reported by Nakayama (2004) who describes that the efficiency decreases with the number of nurses per patient. Establishing for hospital infection (2.5.1) and considering to queueing time of outpatients (3.1.2) are positively significant for the VRS efficiency score.

Moreover, the prior year subsidy rate is negatively significant for both efficiency scores. Therefore, hospitals that were heavily subsidized the prior year tend to be inefficient. This phenomenon indicates that a soft budget constraint problem exists, which corresponds to reports by Nakayama (2004) and Nozao (2007).

Financial Condition and the Quality of Care

This subsection first examines the relation between the real revenue rate and efficiency. The respective correlation coefficients associated with the CRS and VRS efficiency scores are 0.606 and 0.5547. The results complement the findings of Besstremyannaya (2011), who uses stochastic frontier analysis of Japanese public hospitals to examine the link between the efficiency and medical revenue ratio.

We estimate the model described above, which uses the real revenue rate as a dependent variable. Table 3 presents the results of estimation. Results show that the impact of the quality of care differs between the efficiency and the financial condition. A medical treatment system at home (4.17.1) is negative and significant for the real revenue rate, which implies that using medical workers to establish a medical treatment system at home is costly. The Ministry of Health, Labor and Welfare expanded medical treatment fees for home medical treatment from April 2012 to resolve this problem. Future research must be undertaken to ascertain whether this revision of medical treatment fee improves hospital financial conditions or not. Establishing a system of outpatient treatment (4.18.1) is positively significant for the real revenue rate. It implies that the real revenue rate increases with improvement of outpatient services.

Table 2

ESTIMATION RESULT. EFFICIENCY AND THE QUALITY OF CARE			
Dependent variable	RREV		
	Coeff.	S.E.	
Hospital and regional characteristics:			
BED	0.010	0.009	
SUBSI	-123.000	8.727	***
POP	0.002	0.002	
U15	248.300	75.910	***
O65	-174.100	35.640	***
HOS	-8.159	3.179	**
GEBED	12.220	7.735	
Hospital accreditation score:			
1.1.1	2.261	2.946	
1.2.1	7.261	4.449	
1.3.1	-2.381	2.834	
2.3.1	-0.554	3.747	
2.4.1	-1.972	3.314	
2.5.1	-2.269	2.648	
3.1.2	-1.258	2.513	
3.2.1	-4.075	3.446	
3.3.1	-1.147	2.535	
4.1.1	0.793	2.583	
4.2.1	-1.107	2.876	
4.3.1	-1.653	2.295	
4.4.1	4.434	3.293	
4.6.1	2.929	2.828	
4.17.1	-10.070	3.189	***
4.18.1	5.068	2.828	*
6.1.2	-3.621	3.022	
6.2.1	0.523	2.633	
6.2.2	-5.150	4.052	
6.2.3	-3.375	2.755	
6.2.4	2.391	2.524	
6.2.5	-0.520	2.301	
6.3.1	2.035	2.605	
6.4.2	3.943	2.726	
Observations	73		
R-squared	0.924		
Note: Each equation includes a constant and 9 prefecture dummy variables. *** p<0.01, ** p<0.05, * p<0.1.			

Table 3

TIMATION RESULTS. FINANCIAL PERFORMANCE AND THE QUALITY OF CA			
Dependent variable	RREV		
	Coeff.	S.E.	
Hospital and regional characteristics:			
BED	0.010	0.009	
SUBSI	-123.000	8.727	***
POP	0.002	0.002	
U15	248.300	75.910	***
O65	-174.100	35.640	***
HOS	-8.159	3.179	**
GEBED	12.220	7.735	
Hospital accreditation score:			
1.1.1	2.261	2.946	
1.2.1	7.261	4.449	
1.3.1	-2.381	2.834	
2.3.1	-0.554	3.747	
2.4.1	-1.972	3.314	
2.5.1	-2.269	2.648	
3.1.2	-1.258	2.513	
3.2.1	-4.075	3.446	
3.3.1	-1.147	2.535	
4.1.1	0.793	2.583	
4.2.1	-1.107	2.876	
4.3.1	-1.653	2.295	
4.4.1	4.434	3.293	
4.6.1	2.929	2.828	
4.17.1	-10.070	3.189	***
4.18.1	5.068	2.828	*
6.1.2	-3.621	3.022	
6.2.1	0.523	2.633	
6.2.2	-5.150	4.052	
6.2.3	-3.375	2.755	
6.2.4	2.391	2.524	
6.2.5	-0.520	2.301	
6.3.1	2.035	2.605	
6.4.2	3.943	2.726	
Observations	73		
R-squared	0.924		
Note: Each equation includes a constant and 9 prefecture dummy variables.			

CONCLUSION

The links among efficiency, financial condition, and the quality of care of public hospitals in the Chubu region were examined. This study used DEA to measure the efficiency scores. Results demonstrated that efficiency scores positively correlate with the real revenue rate. The results of the estimations show that medical administrative work is negatively significant for efficiency scores. The VRS efficiency score decreases with establishment of a medical care section and nursing section. Establishing a medical treatment system at home is negative and significant for the real revenue rate.

The analyses presented herein entail two important shortcomings. One is that the datasets were limited to public hospitals in the Chubu region. Future research must use expanded datasets to include private hospitals and other regions. Another problem is the hospital accreditation scores. Each version of hospital accreditation uses different items and standards. Therefore, it is necessary to refine the hospital accreditation data or incorporate other quality scores.

ACKNOWLEDGMENT

Toshiki Kodera acknowledges financial support from the Health Care Science Institute.

ENDNOTES

1 See Ministry of Internal Affairs and Communications (2012). Public hospitals are hospitals to which chihokoei kigyo ho (Local Public Enterprise Act) is applicable. Public hospitals include hospitals established by local governments (such as, prefecture, city or town) or a union of local governments.

2 Matsuda & Fushimi (2012) discuss hospital management by using the DPC data.

3 Kawaguchi (2008) argues methods to estimate the efficiency of hospitals including the DEA.

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THE SCOPE OF PROFESSIONAL ADMINISTRATORS IN ACADEMIA AND ITS IMPLICATIONS

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ABSTRACT

The managerial structure of a typical university has evolved very significantly since the past few decades. Todays' universities borrow more and more practices from their counterparts in the corporate world. In the current study, we argue that the managerial structure shift occurred in the higher education institutions intensifies the separation of ownership and control which translates into many forms of agency costs. Indeed, our empirical evidence suggests that from 1987, the employment of administrators and professional staff substantially outpaces those of full time faculty which in part contributes to the escalating tuition and fees. The year of 2011 marked the first year in the history of higher education that part-time faculty outnumbered full-timers. We speculate that this is an effort of trying to mitigate rising tuition. Yet, the tuition and fees a typical student paid for higher education service still doubled since 1987 measured by 2011 ~ 2012 constant dollars.

INTRODUCTION

Universities have always employed administrators. However, where the administrators are drawn as well as how they function is very different today as comparing to a few decades ago. In the 1970s and earlier periods, top administrators as well as midlevel managerial tasks were generally drawn and directed by the faculty. They typically occupied the administrative slots on a part-time basis and planned (and certainly did) in due course to return to full-time teaching and research (Ginsberg, 2011). Given this very special system of managerial tasks assignment and rotation, the stakeholders (largely the faculty) and the management of universities greatly overlap resulting in a reasonably aligned interest of both groups. By the language of the Principal-agent Theory, the agency problems/costs are not as serious or substantial as they are in a corporate firm.

Yet, the managerial structure of a typical university has evolved very significantly since then and is not as it seemed before. Todays' universities adopt more and more practices from the business world. Consider, for example, universities fill their top administration positions mostly by professional administrators recruited externally. Although some middle-level managerial tasks are still drawn and directed by the faculty, those administrators tend to view management as an end in and of itself. Most hope to make management their life's work and have no plan of returning to faculty.

As a result, the managerial structure of universities shares many similarities with a typical corporate firm. However, we contend that they also incorporate many drawbacks as well. Particularly, while the management level largely views the tasks as their very final end, it inevitably intensifies the separation of ownership and control. Consequently, the majority of the

stakeholders are no longer involved in the managerial tasks, at least not as it used to be. Agency problems are natural outcomes.

Some solutions have been proposed and experimented to solve the difficulties derived from the separation of ownership and management in the context of corporate firms. However, we believe those solutions are not readily applicable in the academic world because of its very natural. In turn, the drawbacks universities inherited from the practices leaning toward business firms are further intensified. For instance, universities seem to allocate much more budget toward administrative tasks although their purpose is doubtfully on the academic side. Also, today's professional administrators tend to pay much attention to some short-term priorities. Yet there are barely any mechanisms discouraging such a behavior. We further believe that the increasingly separation of ownership and control brings out the agency problems which are related to many issues such as rising tuition rates, mounting student loans, and some irrational racing for ranking as well as accreditations.

In the current effort, we study the management structural shifts of a typical university. We believe that today's universities management share many similarities with corporate firms resulting in more pronounced agency problems than commonly believed. The paper is organized as following. Section II includes a literature review. The empirical evidences are in Section III. Section IV concludes.

LITERATURE REVIEW

The managerial structural shift in higher education institutions occurred since the 1970s and its implications can be understood in the context of the Principal-agent Theory (or Agency Model). Similar to a corporate firm, in a typical university, there are principals as well as agents. The principals are the stakeholders including (but not limited to) the board of regents, faculty, students, parents, and alumnus. On the other hand, the agents would largely include administrators and professional staff. An agency relationship exists in any situation that involves the delegation of duties to an agent (i.e. administrators) who is expected to act in the best interest of the principal (i.e. stakeholders) (Jensen and Meckling, 1976). The agency costs may result because complete convergence of the interests between the two parties is highly improbable (Lin, 2014). In other words, the seriousness of agency problems depends primarily on the degree of the separation of ownership and control.

The agency problems on the realm of academia did not attract too much scholarly attention in the past because the separation was not substantial. This is true when the faculty occupied most of the administrative slots on a part-time basis and returned to full-time teaching and research. Given this very special system of managerial tasks assignment and rotation, the groups of ownership and control in universities largely overlap. A reasonably (if not perfectly) aligned interests of the two groups is only a natural outcome without too much need of designing an incentive mechanism. Consequently, the agency problem is at its minimum which explains the lack of scholarly interest. Yet, we speculate that ever since universities adopt more practices from the corporate world, the separation of ownership and control becomes substantial. The agency problems in turn come to be as serious as they are in a corporate firm.

Indeed, in his 2011 book, Ginsberg contends that the external recruitments in universities are usually organized and overseen by corporate search firms. Before the 1960s, corporate search firms were seldom retained by universities. Today, however, as college administrators imitate the practices of their corporate counterparts, search firms are a fixture of academic life. This common practice enlarges the market for professional administrators. Yet, it also generates

incentives of being a professional manager in higher education institutions. Further, while there is a degree of a separation of ownership and control, the asymmetric information generates many misalignments of the interests of the principal and the agents. The agents may pursue the interests of their own in the cost of the principal's welfare. Many forms of agency costs occur in academia. For instance, Niskanen (2007) argues that administrators have strong incentive to maximize the power and prestige of their office by attempting to increase its staff and budget. One of common ways to accomplish this would be inventing new functions. Indeed, according to Ginsberg (2011), between 1937 and 1995, administrative costs increased from barely 9% to nearly 15% of college and university budgets. Over the same periods, overall university spending increased by 148%. Administrative spending increased by a whopping 235%. Yet instructional spending increased only 128% which is even 20 points less than the overall rate of spending increase. As a result, today's institutions of higher education are mainly controlled by professional administrators and staffers who make the rules and set more and more of the priorities of academic life.

Moreover, for many of these career managers, promoting teaching and research is becoming less important than expanding their own administrative domains. They hope to make administration their life's work and have no plan of returning to faculty. Hence, under their supervision, the means unfortunately have become the end. This unfortunate development widens the separation and deepens the interest conflicts among the different groups. We speculate it further generates many current issues in the sector of higher education such as rising tuition.

Many solutions to the agency problems have been proposed and experimented with some success in the corporate world. Consider, for instance, the bonus/equity component in a typical executive compensation arrangement is developed in an attempt to align the interests of shareholders (principals) and managers (agents) (Lin, 2014). The design serves as a solution to the agency problems in corporate firms. Borrowing from this practice, performance bonuses are becoming increasingly acceptable in higher education and throughout the nonprofit world. According to the Chronicle of Higher Education's survey of executive compensation at public colleges in 2013, about 18% of the institutions surveyed made some kinds of performance bonus payment.

However, one of the common difficulties in designing a managerial compensation with the intended effects is the meaningful measurement of the manger's performance. Such a measurement has to be quantifiable and can truly reflect the executive's idiosyncratic performance instead of capturing the general economic factors that are greatly out of her control. Otherwise, the firm would be rewarding or punishing the executive for something she could never be held responsible for. According to a survey by the College and University Professional Association for Human Resources (2014), the most common executive only benefits at colleges were performance-based incentives, often in the form of bonuses, designed to push priorities like improved retention rates or fun-raising goals. More than 25% of single-institution presidents had the opportunity to earn performance-based incentives. According to the report, those percentages have grown as more executives are recruited from the private sector. However, these "new" compensation practices are frequently controversial because of the natural of higher education institutions.

Universities are the places where cutting-edge researches are conducted and where students mature and acquire their lifetime-valuable human capital (Nelson, 2014). Unfortunately, these optimal goals cannot be easily (if not impossible) quantified. Therefore,

while it makes theoretical sense to relate administrators' compensation to some pre-specified and readily quantifiable goals such as enrollment growth or fund-raising targets, such a built-in relation can be very misleading and may derive further agency problems on its own. For example, a growing number of the deans of colleges or schools of business are recruited externally. One of their embedded employment conditions is improving student enrollment and retention. Yet, instead of carefully strategizing a long-term plan of accomplishing those goals, many deans choose to spend too much effort and resources on pursuing and maintaining the Association to Advance Collegiate Schools of Business (AACSB) accreditation due to the impression that AACSB is the primary key of attaining those goals. The multi-task principal-agent model (Holmstrom and Milgrom, 1991) also implies that with the emphasis being placed on pursuing AACSB, more resources are being devoted to the process and less resource goes to some long-term tasks such as better-structured course design. The outcome would be a management education that seemingly corresponds to the market demand; yet it produces students who are lack of fundamental basics to comprehend the complexity of the business world (Lin, 2015). In other words, perhaps the most difficult task in the contract design in academia is how to promote long-term strategic thinking while discouraging the over-emphasis on some short-term priorities given the growing trend of employing professional administrators.

In what follows, we document the employment trend of professional administrators and staffers in the sector of higher education from 1987 to 2011. We further show the growth rate of tuition and fees that an average student paid for educational services over the same period.

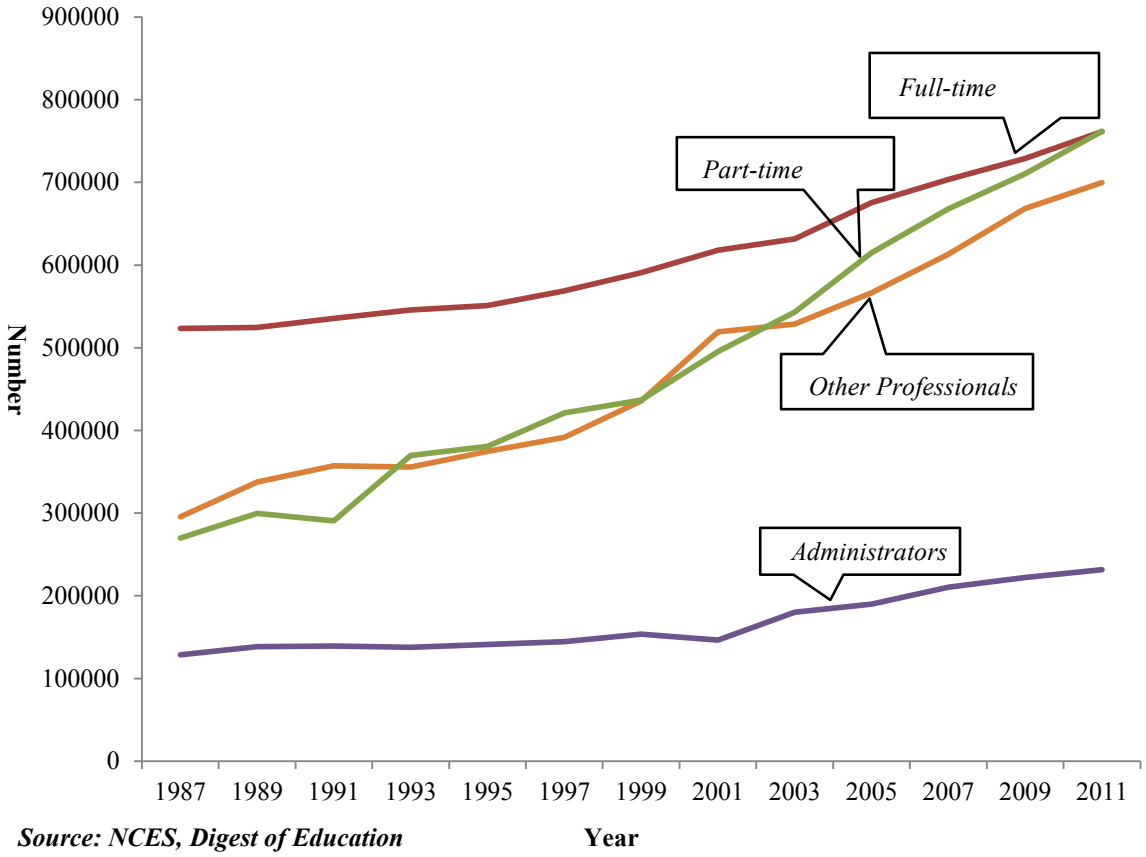
EMPIRICAL EVIDENCE

In this section, we present the evidence showing the structural changes in universities over the past two decades. The empirical evidence is compiled by hand-examining the Digest of Education Statistics published by the Center for Education Statistics from 1987 to 2011 (which is the most recent year the data is available).

Figure 1 illustrates the growth of faculty and administrators. There are four categories of university personnel – Full-time faculty, Part-time faculty, Administrators, and Other Professionals. Other Professionals are not administrators, but they work for the administration, hence, representing the bulwark of administrative power in a typical university. Over the sampling years, both full-time faculty and administrators show very steady increase. During the same time, the employments of part-time faculty and other professionals (staffers), on the other hand, show very substantial growth. Their growth rate significantly outpaces it is of full-time faculty. Further, the gap between the employments of full-time faculty and other professionals are quickly narrowing. It suggests that it is just a matter of a few years until when the total number of professional staffers would exceed full-time faculty. Perhaps, the most astonishing fact is that, for the first time in the history of higher education, in 2011, part-time faculty outnumbered full-time faculty.

Figure 1

THE GROWTH OF FACULTY AND ADMINISTRATORS

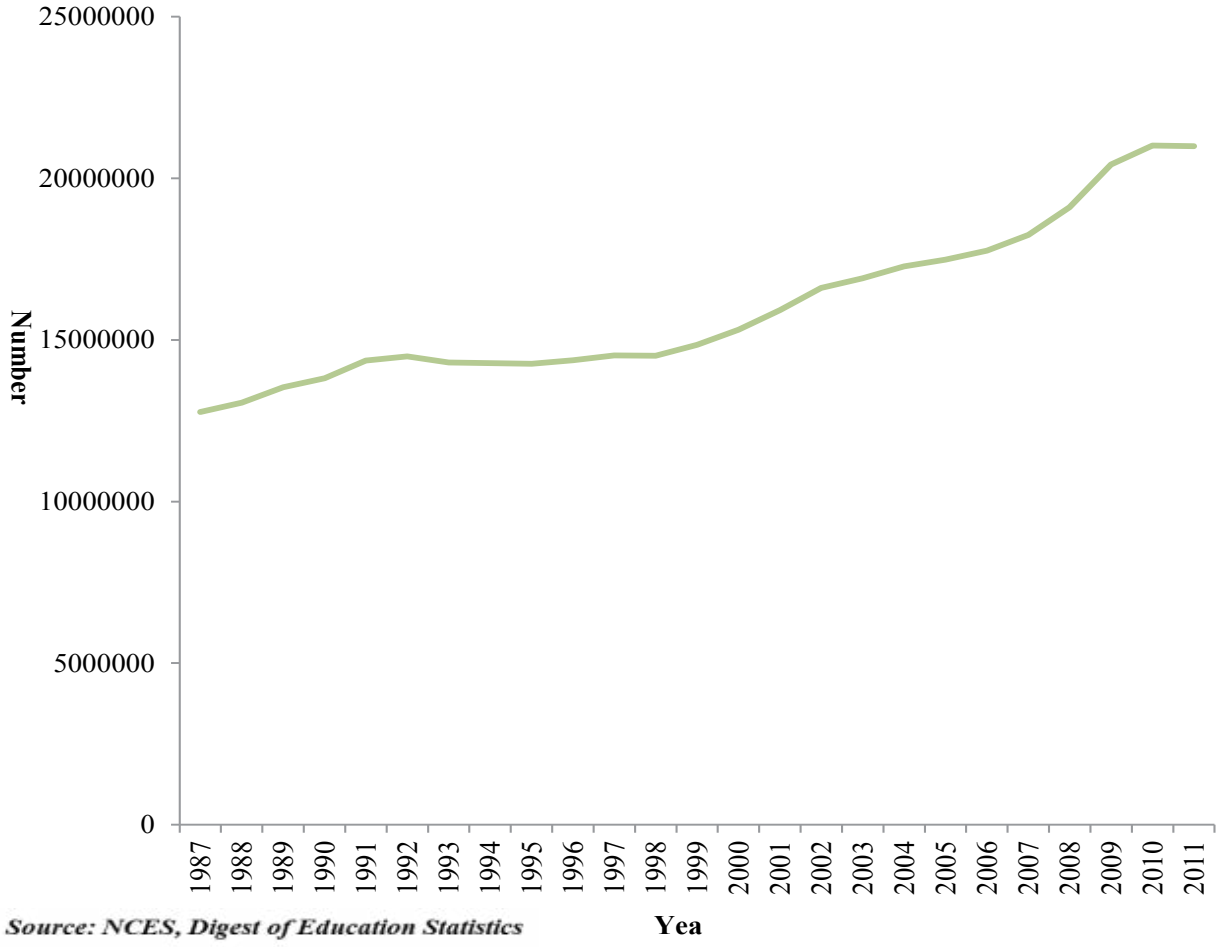


Source: NCES, Digest of Education

The trend shown in Figure 1 should be compared to the enrollment growth over the same years. The purpose of higher education institutions, by its very natural, is to provide educational services. While student enrollment increases, more faculty and supporting services (provided by administrators and staff) are needed. Hence, a reasonable growth pattern of the employment of faculty, administrators, and professional staff should be in parallel with student enrollment. Figure 2 shows the trend of student enrollment from 1987 to 2011. Indeed, student enrollment illustrates a steady increase over the sampling years. However, while contrast to Figure 1, one can immediately observe the very disproportionate growth of part-time faculty and other professionals. The two categories seem to grow at a much faster pace than student enrollments.

Figure 2

TREND OF ENROLLMENT GROWTH



Source: NCES, Digest of Education Statistics

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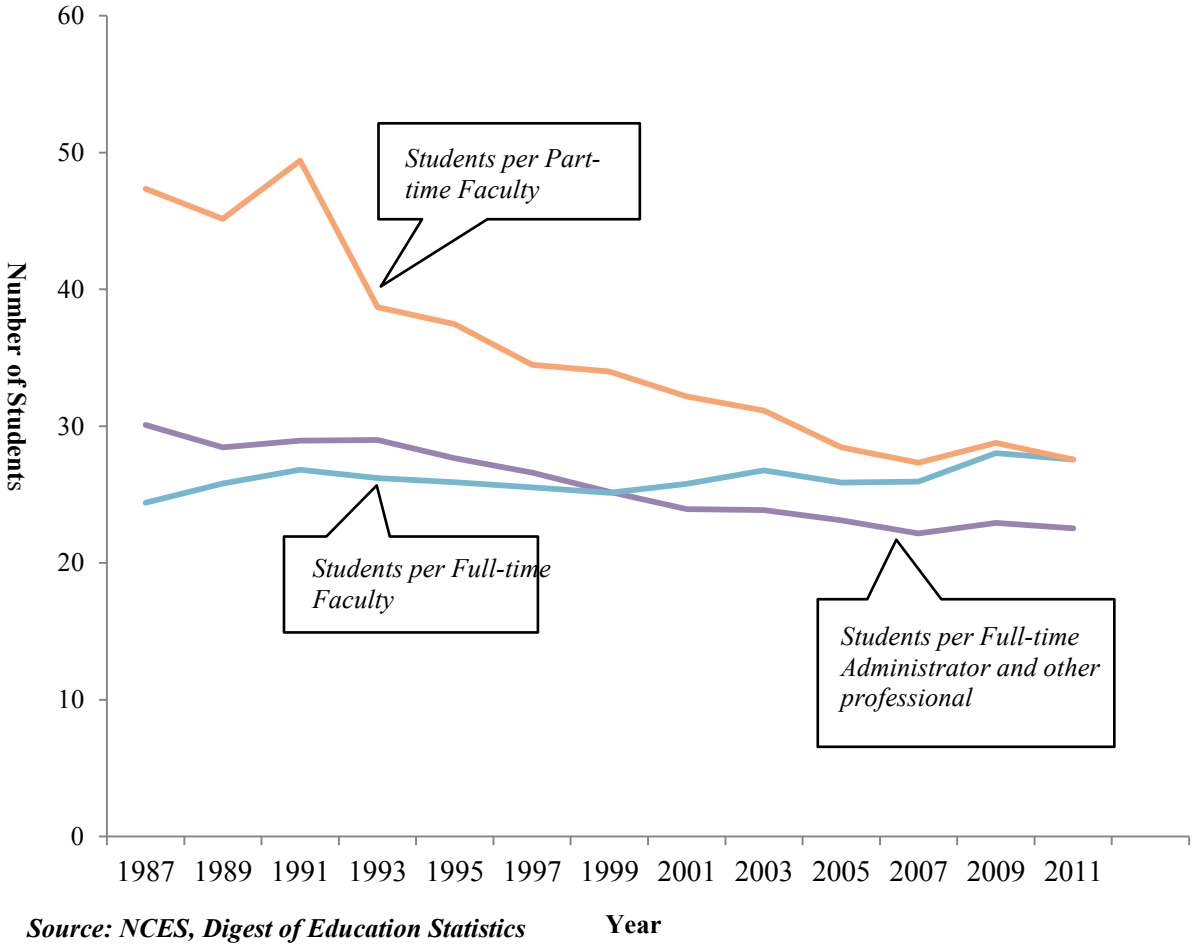
Figure 3

TREND OF STUDENTS PER ADMINISTRATOR AND FACULTY RATIOS



Source: NCES, Digest of Education Statistics

Figure 3 shows the trend of students per full time faculty, per part time faculty, as well as students per full time administrators and other professionals. The number of students per part-time faculty experienced a very significant drop over the sampling years while the students per full-time faculty remained relatively flat. This, in other words, suggests that the growth of full-time faculty is in parallel to it is of student enrollments. Yet, the number of students per full-time administrator and other professional showed a very steady decline over the years. In the year of 2001, the ratio declined to a level lower than the students per full time faculty. These evidence, apparently, suggest that colleges and universities largely prefer to spend money on expanding administrative and staff resources instead of investing on instructional domain. In turn, student will have more opportunities to interact with more administrative personnel, though not more professors.

Turning to Table 1 where we calculate the percentage growth of faculty, administrators, professional staff, as well as student enrollments and U.S. population, it anchors the observations from the above figures. Over the sampling years, while student enrollment increased by 64%, full-time faculty grew by a comparable 46%. Yet, the full-time administrators increased by 80%

and the professional staff employed by universities increased by a shocking 137%. Perhaps the most stunning, part-time faculty employed over the same periods grew by 183%, a rate more than triples the growth of full-time faculty. At 2011, universities hired 761,996 part-time faculties which are more than the 716,619 full-time faculties employed. The year of 2011, indeed, marks the first year that more than 50% of the instructional duties are conducted by part-timers. Further, while the growth rates are calculated using 1975 as the base year, the percentage change shows an even more staggering picture. The administrators and professional staff grew by 126% and 320%, respectively, while the student enrollment increased by a not-even-comparable 88%. The category of full-time faculty, yet, showed a reasonable and healthy 70% increase.

Perhaps a quick comparison of the figures to those of a corporation can yield a much helpful understanding. In the year of 2011, the institutions of higher education collectively had 931,469 full-time administrators and other professionals serving 20,944,112 students. At the same year, Apple sold around 90 ~ 100 million iPhones which is about 4 to 5 times total college enrollment in that year. Since Apple has about 90% product retention rate, we can safely assume it serves 80 ~ 90 million customers. Yet, Apple had around 93,000 employees, which is only one tenth of the employment of full-time administrator and other professionals, serving that gigantic customer base.

Table 1
%CHANGE OF FACULTY AND ADMINISTRATORS

	1975	1987	2011	%Change from 1975	%Change from 1987
Full-time faculty	446,830	523,420	761,619	70%	46%
Full-Time Administrators	102,465	128,809	231,602	126%	80%
Full-Time Other Professionals	166,487	295,504	699,867	320%	137%
Part-time faculty	N/A	269,650	761,996	N/A	183%
Enrollment	11,184,859	12,766,642	20,994,112	88%	64%
U.S. Population	215,970,000	242,289,000	311,582,564	44%	29%

Sources: NCES, Digest of Education Statistics, World Bank; The 1975 figures are from Ginsberg (2011).

Overall, the trend of the employment of faculty and administrators suggest that the number of full-time faculty employed was comparable to the growth of student enrollment but the employment of administrator and other professional staff grew at a disparate rate. As mentioned in the previous section, one form of the agency cost is that administrators have strong incentive to enlarge their domain by attempting to increase its staff and budget. The empirical data seems to agree to this argument. Further, this surpassing growth of the sizes of administrators and professional staff inevitably translates costs to the consumers, namely the students, in the higher education sector. In an attempt to control the rising costs, we believe administrators try to substitute part-timers for full-time faculty which explains the outpacing growth of part-time faculty.

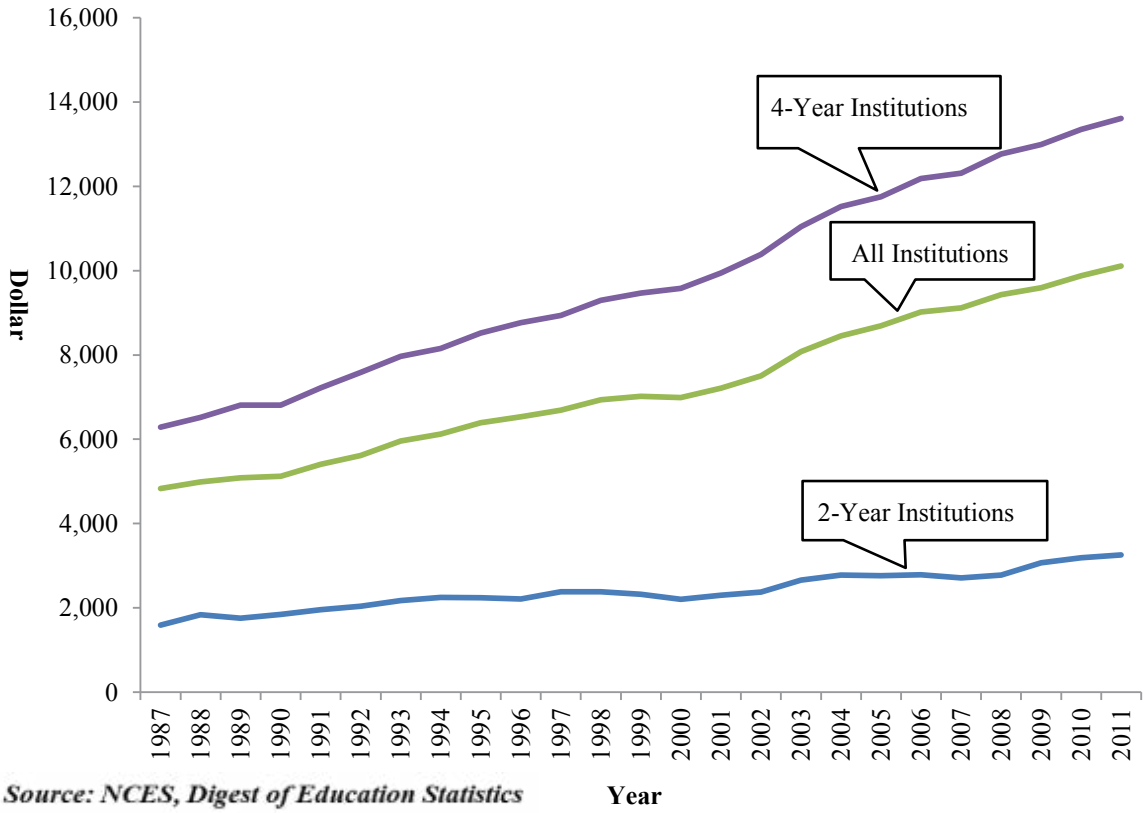
Table 2 and Figure 4 further show the growth of tuition and fees. The tuition and fees are deflated using 2011 ~ 2012 constant dollars. From 1987 to 2011, the tuition and fees grew at a rate of 109%. This growth rate is comparable between 4-year and 2-year institutions. However,

if from 1975, it increased by a whopping 197%. In other words, the tuition and fees a typical student paid for higher education almost tripled over three decades! And this increase is on top of the inflation rate which approximates at 160% from 1975 to 2011. Over the same periods, the size of full-time faculty grew only by 70%. The mounting tuition and fees clearly cannot be justified by the growing size of full-time faculty. This is particularly true while we consider the 88% increase in student enrollments. As a result, the escalating tuition and fees can be largely attributed to the astounding increases in the sizes of administrators and professional staff.

Table 2
THE GROWTH OF TUITION AND FEES – CONSTANT 2011 ~ 2012 DOLLARS
SOURCES: NCES, DIGEST OF EDUCATION STATISTICS

	1975	1987	2011	%Change from 1975	%Change from 1987
All Institutions	3,402	4,829	10,111	197%	109%
4-year Institutions	4,403	6,288	13,608	209%	116%
2-year Institutions	1,220	1,590	3,258	167%	105%

Figure 4
TREND OF TUITION AND FEES – CONSTANT 2011 ~ 2012 DOLLARS



Source: NCES, Digest of Education Statistics

CONCLUSION

The higher education sector appears to experience a very significant shift in its managerial structure leaning toward their counterparts in the corporate sector. Most of the managerial tasks are no longer drawn from the faculty. Instead, more and more top administrative positions are filled by professional managers recruited from outside. While some midlevel administrators are drawn and directed by the faculty, unfortunately, they tend to view management as an end in and of itself. Most hope to make management their life's work and have no plan of returning to faculty.

Our empirical evidence reveals that while full-time faculty employment from 1987 to 2011 grew at a rate comparable to the student enrollment growth, the number of administrators and staff seems to increase at a significantly disproportionate rate. The percentage growth of the employments is even more substantial while using 1975 as the base year.

Those sizeable employment increases in the categories of administrators and professional staff, we believe, also translate costs onto students. At constant 2011 ~ 2012 dollars, from 1987 to 2011, the average tuition and fees for undergraduate education nearly doubled. While from 1975, it tripled.

This structural change, we argue, intensifies the separation of ownership and control. We further believe that the agency problems/costs are becoming more pronounced in higher education institutions. They exist with different forms. The one we observe in our data is the trend the administrators trying to enlarge their domain. The escalating size of professional staff is clear evidence. Perhaps in a few years, the total employment of professional staffers would exceed those of full-time faculty since the gap is quickly narrowing. Further, in an effort to mitigate the rising tuition and fees, administrators seem to substitute part-timers for full-time faculty. Indeed, as the data shows, the year of 2011 marked the first year in the history of higher education that full-time faculties are outnumbered by part-timers.

Collectively, this study documents the managerial structural changes in higher education institutions. Those shifts are very substantial and can have long-term impact on the quality of higher education. We believe our study suggests at least two avenues that warrant future research. First, while universities adopt similar compensation practices for their top administrators from the corporate world, a systematic study on the compensation contracts seems to be timely. In particular, an understanding of the incentive mechanisms embedded in those professional administrators' employment contracts is valuable. Second, the governance structure is the other aspect demanding much research attention. This is true while universities seem to converge structurally toward a corporate firm. How to determine the most efficient governance structure in a university remains the question to be answered.

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TAXONOMY OF THE DETERMINANTS OF ENTREPRENEURIAL ACTIVITY

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ABSTRACT

Researchers from many fields of study have found a positive relationship between entrepreneurial activity and economic growth, wealth creation, job creation, and innovation. The dynamic and multidisciplinary nature of entrepreneurship research, however, presents a research environment that often appears confusing and disorganized. This paper offers a multidisciplinary perspective on factors deemed most important in affecting entrepreneurship. While the extensive nature of entrepreneurship research prevents discussion of all entrepreneurship determinants previously examined by researchers, the study objective is to identify classes and subclasses of determinants to be used be used as a starting point toward a more organized approach to entrepreneurship research. In formulating this taxonomy of entrepreneurship determinants, it is hoped that a contribution is made to the entrepreneurship research literature by assisting both scholars and the general public to better understand various factors impacting entrepreneurship and the relationships among those factors. This structuring of entrepreneurial determinants may also help researchers to engage in more focused or specialized research efforts and thereby improve research efficiency. The paper first defines entrepreneurship and presents entrepreneurial activity as a field of study. Factors affecting entrepreneurial activity and an approach toward organizing these factors into classes of entrepreneurship determinants are then offered. The paper concludes with a brief summary of this approach to structuring entrepreneurial determinants and proposals for further research.

INTRODUCTION

A strong positive relationship has been found to exist between entrepreneurial activity and economic growth (Kirzner, 2009; van Stel, Storey, & Thurik, 2007). Indeed, all major theories of entrepreneurship view entrepreneurs as creators of new economic activity, which leads to wealth creation[1]. Moreover, while creating new economic activity, entrepreneurs also create jobs and bring about innovation[2] (Amoros, 2009; Dennis, 2011; Dyck & Ovaska, 2011; Ramos-Rodriguez, Medina-Garrido, Lorenzo-Gomez, & Ruiz-Navarro, 2010). As policy makers are often required to show economic growth and job creation, most see entrepreneurship as a key issue (N. Ahmad & R. G. Seymour, 2008; Macerinskiene & Aleknaviciute, 2011). In addressing this issue, however, policy makers are faced with entrepreneurship research which is dynamic, vast, and multidisciplinary (Klein, 2010). The result is a research environment that appears disorganized

This paper contributes to entrepreneurship research literature by formulating a taxonomy allowing both scholars and the general public to better understand various factors impacting entrepreneurship. The taxonomy may also help researchers to engage in more focused or specialized efforts and thereby become more efficient.The paper offers a multidisciplinary, but not necessarily comprehensive, perspective on factors deemed most important in affecting entrepreneurship. Importance of a particular factor is based on either the test of time or current degree of research effort. Due to the extensive nature of entrepreneurship literature, this study cannot discuss nor even mention all entrepreneurship determinants previously examined by researchers. What it does do is identify classes and subclasses of determinants that may be used as a starting point toward a more organized approach to entrepreneurship research. Entrepreneurship is first defined and presented as a field of study. A discussion of factors affecting entrepreneurship and entrepreneurial activity, as well as an approach toward organizing these factors into classes of entrepreneurship determinants, follows and comprises the major portion of the paper. Finally, the paper concludes with a brief summary and proposals for further research.

ENTREPRENEURSHIP

Entrepreneurs and Entrepreneurial Activity

The definition of entrepreneurship is still a matter of debate (Ahmad & Hoffman, 2008; N. Ahmad & R. Seymour, 2008; Anderson & Marzena, 2008; Bygrave & Hofer, 1991; Freytag & Thurik, 2007; Klapper & Love, 2010; Long, 1983; McKenzie, Ugbah, & Smothers, 2007; Spencer, Kirchhoff, & White, 2008). Despite this debate, entrepreneurs tend to be viewed in similar (but by no means identical) ways by researchers. Three common components of entrepreneurial activity have emerged to dominate the entrepreneurship literature: opportunities, uncertainty, and innovation. For example, Kirzner's (2009) entrepreneur (or "arbitrageur") lives in a state of uncertainty and constantly changes this uncertain environment by finding opportunities (Douhan, Eliasson, & Henrekson, 2007). Some authors believe that entrepreneurs simply identify these opportunities, while others believe that at least some entrepreneurs also create opportunities (Venkataraman et al., 2012). Not surprisingly[3], Kirzner's entrepreneur is similar to von Mises's "speculator." Emerging from the Austrian school of economics, the emphasis here is on individuals being able to identify opportunities and who, by doing so, change the status quo and move the economy forward. This link between entrepreneurial activity, uncertainty, and opportunities can also be found in the writings of scholars such as Cantillon and Knight (Ahmad & Seymour, 2008). Given that all people face uncertainty (even bureaucrats), this approach to entrepreneurship recognizes that the degree of uncertainty may be more important than the fact of uncertainty in distinguishing between entrepreneurs and other decision makers. Uncertainty alone is clearly not sufficient to distinguish between entrepreneurs and others. If it were, one would observe that casinos are full of entrepreneurs. In addition to opportunities and uncertainty, many scholars consider innovation to be a critical factor in examining entrepreneurship and entrepreneurial activity.

Schumpeter's entrepreneur, for example, is an "innovator" and his measure of entrepreneurship relates to innovation. By this approach, patent and trademark activity is used as a proxy measure of entrepreneurship activity (Ovaska & Sobel, 2005).

While many researchers associate entrepreneurial activity with new firm creation (Acs, Braunerhjelm, Audretsch, & Carlsson, 2009; Fauchart & Gruber, 2011; Scott Shane, 2012), others believe that entrepreneurial activity continues after firm formation and within existing organizations (Scott Shane, 2012; Scott Shane & Venkataraman, 2000) or even regardless of firm creation by the sale of entrepreneurship opportunities (Scott Shane and Venkataraman, 2000). From this broader perspective, entrepreneurship may be defined as "the recombination of resources in the expectation of profit" without the requirement of new venture creation (Phelan, Dalgic, & Sethi, 2006). This approach views speculators, those engaged in corporate ventures, small business owners, and direct investors (as opposed to portfolio investors) as entrepreneurs (Phelan, Dalgic, & Sethi, 2006). Another approach to entrepreneurship research, emerging from the Organization for European Economic Cooperation and Development (OECD), echoes this broad definition by examining three components: entrepreneurs, entrepreneurial activity, and entrepreneurship (N. Ahmad & R. Seymour, 2008). The OECD definition distinguishes between entrepreneurial activity and businesses ownership on the supposition that governments and researchers are interested in entrepreneurial activity that leads to economic growth, not merely in the creation of small and medium enterprises as an end in itself (Commission of the European Communities, 2003).

Given the lack of a universally accepted definition, it is not surprising that many researchers do not clearly define "entrepreneur" and simply refer to entrepreneurs descriptively (Montanye, 2003). A comprehensive approach to theory and measurement of entrepreneurial activity (Ahmad & Seymour, 2008) ought to be a good strategy, but such effort is still at an early stage -- another reason for the contributions inherent in this paper. The lack of a widely accepted definition affects not only the measurement of entrepreneurial activity but also the selection of its determinants[4]. Practically all theories of entrepreneurship recognize that, regardless of how they came into existence, two main ingredients of entrepreneurship activity, opportunities[5] and entrepreneurs, exist (Acs et al., 2009; Ramos-Rodriguez et al., 2010; Scott Shane & Venkataraman, 2000). Unfortunately, how opportunities occur is another debated issue. Some authors support the concept of opportunities as exogenous to the entrepreneur while others maintain that opportunities must be endogenous if the entrepreneur is someone who creates opportunities (Acs et al., 2009; Edelman & Yli-Renko, 2010). For the purposes of this paper, we allow that opportunities may be created by the environment in which the entrepreneur operates (for example, by other entrepreneurs who pursue other opportunities, or by research) or by the entrepreneur himself.

Entrepreneurs Create Opportunities versus Entrepreneurs Discover Opportunities

Consider the possibility that there is no market demand for a particular product because potential buyers are unaware such a product exists or even can be created[6]. If entrepreneurs are successful in bringing such a product to market (e.g., stereophonic audio gear, videocassette recorder, Sony Walkman, certain Apple products), one may say that entrepreneurs created the opportunity. At other times, entrepreneurs may identify a need and offer a product to successfully fulfill the need (e.g., a pharmaceutical developed for a different purpose and relabeled as Viagra).

In this case, the opportunity was created exogenously, but entrepreneurship was supplied by an individual. This situation is illustrated by Ray Kroc of McDonald's. Rather than inventing the concept, he bought the rights to a concept which had been created by others. We believe we are dealing with two separate concepts, one being *identifying opportunities* and the other being *taking advantage of opportunities*. Bill Gates did not create MS-DOS; the story one of the authors read is that he bought it for less than $100,000 from the two college professors who had written the software. This purchase came after Gates had already sold a non-exclusive license to IBM for IBM's use (under the name PC-DOS) as the operating system for then-new microcomputers. Perhaps if the two college professors had been able to identify the opportunity and capitalize on it, they would not have thought that they "put one over" on this young kid who was paying them an outrageous sum of money for some computer program they wrote.

Types of Entrepreneurship

Various types of entrepreneurship have been defined in the entrepreneurship literature. Baumol (1990), for example, defines productive, unproductive, and destructive entrepreneurship. Another classification considers entrepreneurial motivation and differentiates entrepreneurs who are motivated by the desire to help others from those motivated by self-interest (Fauchart & Gruber, 2011). The major types of entrepreneurship defined in the literature, however, are nascent versus young entrepreneurship (van Stel et al., 2007) and opportunity versus necessity entrepreneurship (Amoros, 2009; Deli, 2011; McMullen, Bagby, & Palich, 2008).The classification of entrepreneurs between nascent and young consists mostly in the researcher's choice of time frame[7]. Many researchers consider the period after which entrepreneurs leave the nascent phase to become young to be about three years. The difference between opportunity and necessity entrepreneurship is clearer. The primary motivation of necessity entrepreneurship is not the recognition of an opportunity (opportunity entrepreneurship), but rather the lack of other prospects (Deli, 2011). Necessity entrepreneurship may be affected by both job dissatisfaction (Schjoedt & Shaver, 2007) and by the lack of jobs. If an unemployed person wants a job and jobs are not available, he has to create or buy his own. Job creation could be through buying a franchise, buying an existing entity, or starting one completely new entity. This suggests that any empirical model which refers to individual choices should include a variable for job satisfaction or dissatisfaction, and qualitative models should also incorporate it somehow. However, when analyzing aggregate data, this issue is difficult to address unless linked to other factors such as cultural differences[8] and possibly political differences. Necessity entrepreneurship is likely to be lower in a setting in which there is little or no necessity (e.g., multiple years of income support versus limited-duration unemployment benefits).

Some countries exhibit high levels of entrepreneurship that are not associated with significant economic growth. This contradicts the view which identifies entrepreneurship as the key ingredient of economic growth. One explanation of this apparent contradiction is that the high level of entrepreneurship observed in such cases seems to be motivated not by opportunity but by necessity or absence of opportunity (Larroulet & Couyoumdjian, 2009). In these situations, there is little choice but to become an entrepreneur. Some studies have identified necessity as a significant determinant of entrepreneurship even in more developed economies (McMullen et al., 2008; Verheul, Risseeuw, & Bartelse, 2002).

Entrepreneurship as a Field of Study

The nature of entrepreneurship research is "multidisciplinary, multifunctional, and multi-contextual" (Shepherd, 2011). One finds entrepreneurship research in fields as diverse as anthropology, social science, economics, and management (N. Ahmad & R. G. Seymour, 2008). Descriptions may characterize entrepreneurial research to be a relatively unorganized[9] collection of works and wonder if entrepreneurship is evolving as a distinctive scholarly domain[10] orremains a part of established fields such as strategic management (Anderson & Marzena, 2008; Duane Ireland & Webb, 2007; Mitchell, 2011; Moroz & Hindle, 2012; Scott Shane, 2012; Scott Shane & Venkataraman, 2000; Venkataraman, Sarasvathy, Dew, & Forster, 2012; Wiklund, Davidsson, Audretsch, & Karlsson, 2011; Zahra & Wright, 2011).

Some researchers go even further and define yet another scholarship domain, strategic entrepreneurship, as being the common ground between strategic management and entrepreneurship (Hitt, Ireland, Sirmon, & Trahms, 2011). A significant problem faced by entrepreneurship researchers is that the field is not contained within one academic discipline within business, but rather is highly interdisciplinary in settings where authors tend to be rewarded only for work in their own disciplines, and possibly even punished for work which strays beyond the boundaries of their own disciplines. Because at least some authors are so constrained by evaluation and reward systems, they may tend to read and write in their own fields, and sometimes invent their own definitions for concepts that were already researched and defined in other fields of study (Busenitz et al., 2003; Oviatt & McDougall, 2005). One of the authors recalls being confused (while a doctoral student) when he came across a management term, population ecology theory, until he realized that it meant Schumpeter's creative destruction. This lack of appreciation of interdisciplinary work, by at least some reward systems, leads to confusion and to slower progress and convergence than would otherwise be the case.

DETERMINANTS OF ENTREPRENEURSHIP

Analytical Frameworks

Various analytical frameworks have been used in examining determinants of entrepreneurial activity. One prominent framework considers the demand and supply sides of entrepreneurship. The idea behind this approach is to classify factors that influence entrepreneurial activity into two categories: factors influencing the demand for entrepreneurs and factors influencing the supply of entrepreneurs (Klein & Cook, 2006; Verheul, Wennekers, Audretsch, & Thurik, 2003). Some of the factors thought to influence the demand for entrepreneurs are technological development, economic freedom, globalization, customer acceptance of new products, and industrial structure. Factors thought to primarily influence the supply of entrepreneurs are education, age structure of the population, infrastructure, culture, availability of capital, and institutions (Arogyaswamy & Rodsutti, 2007; van Stel et al., 2007). Unfortunately, due to significant overlaps between the two categories, this analytical framework can be very difficult to use. For example, in the case of aggregate data, income might be classified as a demand factor, since people with higher incomes tend to spend more and a higher demand for goods and services in the area translates into more opportunities for entrepreneurs. On the other hand, people with higher incomes might have a higher tolerance for risk (Deli, 2011) since many are not living from paycheck to paycheck, and therefore income also influences the supply of entrepreneurs.

Another analytical framework for entrepreneurial studies rests on identity theory or social identity theory (Fauchart & Gruber, 2011). Authors using this analytical framework develop distinct entrepreneurial role identities that are linked to particular activities (Cardon, Wincent, Singh, & Drnovsek, 2009; Fauchart & Gruber, 2011; Gartner, Starr, & Bhat, 1999). Cardon et al. (2009), for example, identified three role identities for each entrepreneur: an inventor identity, a founder identity, and a developer identity. Here, the inventor has a passion for activities such as exploring new opportunities, the founder has a passion for activities related to opportunity exploitation, and the developer has a passion for activities related to growing a firm.

Finally, differentiation between individual characteristics and the environment as two distinct dimensions seems occur systematically in the study of firm creation and firm success (Fauchart & Gruber, 2011, Gartner et al., 1999). (Fauchart & Gruber also recognized the additional dimensions of entrepreneurial behaviors and strategy.) In this line of research, the focus is on determining what makes entrepreneurs better at recognizing (or creating) and exploiting opportunities (Acs et al., 2009) and how the environment affects this process. One can distinguish between two categories of factors, endogenous factors (individualities) and exogenous factors (the environment) (Shane, 2003). Examples of endogenous factors are knowledge, family and social background (Narayanasamy, Rasiah, & Jacobs, 2011), while examples of exogenous factors are changes in technology and in consumer preferences (Edelman & Yli-Renko, 2010).

Levels of Analysis

Analysis of entrepreneurship may proceed at various levels. Studies have focused on entrepreneurial activity of individual entrepreneurs, institutions, large corporations, new ventures, and established firms of all sizes (Davidsson & Wiklund, 2001). Considering the environment in which entrepreneurs function, analyses have also directed attention to various levels. These environmental levels include neighborhood, city, state, country, group of countries, and the global environment. Many research efforts also distinguish between "micro" and a "macro" levels of analysis (Amoros, 2009). Each level of analysis may capture important types of information, but may be useless at capturing other types. For example, in the case of cross-country studies, macroeconomic variables can be seen as local conditions, while for intra-country regional studies local conditions (such as natural advantages) vary greatly from one location to another. As one example, bogs in Massachusetts are better suited for growing cranberries than are desert acres in Arizona. Similarly, classes of determinants with similar names have different meanings depending on the level of analysis. For example, social capital can be defined at the individual level (Portes, 1998) as well as at the nation level (World Bank, 2011). Likewise, intellectual capital can be assessed at the individual, business, or societal level.

The timing of analysis is also important. If one asks about the indicators of a future entrepreneur at a person's birth, the answer would have less to do with the child (although very loud screams may be one indicator) than with the family background. There is a joke to the effect that, "he started out on a shoestring. It was tied around a whole lot of stocks, bonds, certificates of deposit, and bank accounts that his parents gave him." By contrast, if one looks at an accomplished entrepreneur, family background may be one of the less important factors. For some determinants of entrepreneurship, this issue may be taken into consideration by looking at both their flow and stock. This study examines individual entrepreneurs at the point in time where they are successful in fructifying an opportunity.

Individualities

While there is no universally adopted definition of entrepreneurship, opportunity identification (or creation), selection, and fructification are generally identified as the most important steps in the entrepreneurial process (Ardichvili et al., 2003; Casson & Wadeson, 2007;Cotae, 2011). Whatever the type of opportunity, the context, or the origin of the opportunity, some individuals will end up fructifying opportunities while others will not (Ramos-Rodriguez et al., 2010). Therefore, successful entrepreneurs must be different from those who do not successfully engage in entrepreneurial activity.One popular approach distinguishing entrepreneurs from the rest of the population is to examine individual characteristics (Ardagna & Lusardi, 2008; Fauchart & Gruber, 2011; Gartner et al., 1999) or individual qualities (Kirzner, 2009).

Not only is there a lack of definition for entrepreneurship, there is also no clear definition of many individual characteristics considered relevant to the entrepreneurial process. For example, passion has not been clearly defined in an entrepreneurial context (Cardon et al., 2009). There are, however, some individual characteristics (including demographic characteristics) that have been found to affect entrepreneurial activity (Glaeser & Kerr, 2009; Grilo & Irigoyen, 2006; Schjoedt & Shaver, 2007). Gender (Deli, 2011; Mueller & Dato-On, 2008; Narayanasamy et al., 2011), personal income (Deli, 2011), entrepreneurial alertness, information asymmetry, and prior knowledge (Ardichvili et al., 2003) are examples of such individualities. Since the set of individual characteristics is an extremely broad and heterogeneous class of determinants, it is useful to further classify these characteristics into subclasses such as personal traits, human capital, intellectual capital, and social capital. Although these are logical and relatively homogenous categories, distinctions among these concepts can be rather weak (as they have been defined by different disciplines and research traditions). For example, some scholars view cultural capital as a separate concept from human capital, while others see it as a component of human capital (Tramonte & Willms, 2010).

Personal Traits

The importance of personal traits (Cotae, 2011; Deli, 2011; Mueller & Dato-On, 2008; Phelan et al., 2006) or personality traits (Ardichvili et al., 2003) in entrepreneurship has been frequently examined in the literature. Personal traits are differentiated from skills in that traits cannot be easily changed, while skills can be acquired and continuously improved through education or experience. The most commonly cited personal traits[11] found to be associated with entrepreneurship include boldness, imaginativeness, and creativity (Ardichvili et al., 2003; Deli, 2011; Kirzner, 2009), personal ability (Deli, 2011), optimism, self-efficacy, (Ardichvili et al., 2003), passion (Cardon et al., 2009), motivation (Shepherd, 2011), and the ability to function inside an organization (Deli, 2011; Schjoedt & Shaver, 2007). Other studies have associated being humorous, witty, or amusing (Paunonen & Jackson, 2000), risk-taking (Otani, 1996; Paunonen & Jackson, 2000), thrill-seeking (Paunonen & Jackson, 2000), alertness (Ardichvili et al., 2003) and astuteness (Cotae, 2011) with entrepreneurship.

Two models describing the dimensions by which people differ may serve as a foundation for examining personal traits in entrepreneurship research. The Big Five model and the Five-factor model, though developed using different approaches, overlap in terms of four of five personal characteristics.

Factors found in both models are conscientiousness (which depicts the tendency to control behavior in pursuit of goals), emotional stability (which reflects vulnerability to emotional turmoil), agreeableness (which captures tendencies to maintain social relations by minimizing conflict), and extraversion (which reflects the sensitivity to reward and energy of goal pursuit). A fifth factor (openness in the Five-factor model and intellect in the Big Five model), is linked to one's interest in exploring and understanding the surrounding environment (Chang, Connelly, & Geeza, 2012). Recently, authors have found more dimensions (factors) to be orthogonal to the Big Five or Five-factor models. Examples of such dimensions are sexuality (defined by terms such as coy, chaste, sexy, promiscuous, and prudish)(Saucier & Goldberg, 1998), masculinity-femininity (sly, deceptive, manipulative), and religiosity (Paunonen & Jackson, 2000; Saucier & Goldberg, 1998). Some researchers have also described personal traits using adjectives such as honest, ethical, moral, sexy, sensual, erotic, thrifty, frugal, miserly, egotistical, conceited, and snobbish (Paunonen & Jackson, 2000).

Human Capital

According to Shultz, entrepreneurship is a form of human capital. It is therefore dependent on education, training, experience, and personal health, among others (Klein & Cook, 2006). This concept, dating from at least the time of Adam Smith, defines human capital as composed of the abilities[12] a person possesses (Smith, 2005). The understanding of human capital was later expanded to include components such as health (Becker, 2008). One definition of human capital is, "… the knowledge, skills, competencies and attributes embodied in individuals that facilitate the creation of personal, social and economic well-being" (Keeley, 2007). Some components of human capital may be acquired through experience and education[13] (Becker, 2008; Spengler, 1977).

Intellectual Capital

Researchers have posited that intellectual capital consists of three components (human, structural and relational capitals), two main parts (human and structural capitals), or four elements (market assets, human-centered assets, intellectual property assets and infrastructure assets) (Macerinskiene & Aleknaviciute, 2011). In the context of entrepreneurship, intellectual capital refers to characteristics such as educational level, knowledge and skills (but also the capacity to learn new knowledge and gain new skills), and previous experience (such as managerial and industry experience) as an entrepreneur (Gartner et al., 1999; Ramos-Rodriguez et al., 2010; Shepherd, 2011). In an international context, intellectual capital also includes international competence, whether acquired through school, experience, or by taking advantage of one's social capital (Phelan et al., 2006). Determinants recognized as markets for one's intellectual capital are family background, social background, and education (Narayanasamy, Rasiah, & Jacobs, 2011). Indeed, one's stock of intellectual capital may be higher depending on social and family background (first college graduate in the family versus a long tradition of Ivy League goers who have one or more campus buildings named for family members). Moreover, knowledge and ability in key business functional areas (marketing, finance, operations, technical, management) and "street smarts"[14] may also be a part of the intellectual capital (Gartner et al., 1999).

Two additional aspects of entrepreneurial knowledge and ability have been recently defined in the literature. Tacitness, a form of knowledge unique to each entrepreneur, relates to an individual's expertise about a process. This unique combination of entrepreneurial skills, knowledge, and experience is difficult to copy or imitate (Bourdieu, 1986; Cotae, 2011). Another newly defined entrepreneurial ability is codification, the entrepreneur's skill in transmitting information in a manner that is understood by those who need to understand (Cotae, 2011)

Social Capital

A key subclass of entrepreneurial determinants is often bundled under the individual's social capital, defined as, "access to external knowledge offered by the social network" (Portes, 1998; Ramos-Rodriguez et al., 2010). The basic functions of social capital are a source of social control, a source of family support, and a source of benefits through extra-familial networks (Portes, 1998), while the forms of social capital are obligations and expectations, information channels, and social norms[15] (Coleman, 1988). Social capital offers possibilities for using one's traits and stock of financial and human capital (Portes, 1998). However, social astuteness[16] is required if one is to utilize social capital. This is the "the ability to influence[17] the expectations of potential and existing stakeholders so they will commit resources to a business network on favorable terms" (Phelan et al., 2006). Social astuteness is an entrepreneurial skill, which means it is difficult to delegate or hire (Bourdieu, 1986; Cotae, 2011; Phelan et al., 2006).

The literature is not clear when it comes to the components of social capital (Portes, 1998). Traits that lead to the formation of social capital may be impression management, social perceptiveness, social adaptability, and persuasiveness (Phelan et al., 2006). Other determinants that researchers acknowledge as important, such as family background or social background, may contribute to both intellectual and social capital (Narayanasamy, Rasiah, & Jacobs, 2011). The measure of the stock of social capital seems to be market embeddedness, which reflects the strength of social capital related to a certain market. Embeddedness is instrumental in establishing market presence, in obtaining market information[18], and in establishing business networks[19] (Cotae, 2011). The importance of one's social capital and social competence suggests the importance of enablers, those individuals who, while never becoming entrepreneurs themselves, are able to help entrepreneurs (Thompson, 2010). Interestingly enough, there is stability and consistency in patterns of network development regardless of strong differences in the macro-environment (Jack, Dodd, & Anderson, 2008). This reveals the importance of this factor, as well as its independence from certain local conditions, making it an important determinant. Indeed, since Social capital seems to be unrelated to local conditions, it can be used as a control variable in an empirical setting.

Cultural Capital

Another category of determinants may be bundled as cultural capital. Unfortunately, here again the literature is not clear. Indeed, cultural capital is conceptually similar to human capital and is sometimes seen as a component of human capital (Tramonte & Willms, 2010)[20]. In general, cultural capital is increased by cultural experiences such as participation in literature events, concerts, and entertainment shows (S. Kim & Kim, 2009). Some researchers also see family background as a component of cultural capital (P. Kim, Aldrich, & Keister, 2006). A person raised in a small town or rural area of the southern United States might be less likely to attend a performance at Lincoln Center than the child of a multimillionaire who lives in Manhattan's Upper East Side.

One subclass of cultural capital is cultural intelligence (often presented as CQ). CQ represents one's capacity to work within or with other cultures. This is of particular importance in the case of an entrepreneur who must interact with people from different cultural backgrounds (such as coworkers or customers) (Ng & Earley, 2006; Soon et al., 2007). The stock of CQ comes from substantial international experience and excellent global networks, and may be termed international social competence. This competence has been offered as one explanation for some entrepreneurs' ability to identify and fructify international opportunities (Phelan et al., 2006).

Financial Capital

Lastly, financial capital is another important determinant of entrepreneurship. Not only is financial capital important by itself (as a source of funding for the business venture), it is also important due to the relatively easy conversion of financial capital into other types of capital. It has also been shown to interact strongly with some personal traits[21]. Financial capital may be an endogenous factor (if earned by the entrepreneur) or an exogenous one (if it comes from family, friends, or fools).

Classification of Individualities

Individualities may be classified under different subclasses of entrepreneurship determinants. One means of classification is to consider one's control over these individualities. Indeed, some individualities may be difficult to change (such as imaginativeness or gender)[22] while others may be easier to control (such as through education and experience). Those individualities that are more difficult to control may be classified under personal traits, while those easier to control may be classified as capitals. Similarly, one may distinguish between personal traits and assets. Assets are those individualities that can be accumulated over time (capitals). One's assets then are accumulated (or sometimes transferred or gifted) and they can be further classified into intangible assets (such as the stock of human capital) and tangible assets (such as the stock of financial capital). Of course the capacity for accumulating capital differs from person to person and capitals can be converted from one to another[23] (Bourdieu, 1986).

While the literature as discussed above is far from clear when it comes to the various intangible capitals, one may decide on a classification based on some of the components from each of these capitals. First, there is a clear overlap between intellectual capital and human capital. According to some authors, human capital is a component of intellectual capital, but the issue here is that human capital has components such as health that do not relate directly to one's intellect. However, both human capital and intellectual capital seem to depend on education, experience, and family background. Accordingly, human capital seems to encompass intellectual captital. The other two intangible assets (social capital and cultural capital) seem to each have a place of their own.

The person-side determinants may then be described by considering two main types of factors. First, personal traits (such as gender, race, height, boldness, imaginativeness, and creativity) are measured mostly on nominal and interval scales. Second, capitals, which can be further classified as intangible and tangible, are measured using varying scales (years of school, currency, market embeddedness, etc.).

Intellectual capital is viewed as a subclass of human capital (measured by education, training, experience, and so on) and health is considered a component of human capital. Three other capitals are social capital (measured by market embeddedness), cultural capital (with cultural intelligence, measured by international experience and access to global networks, as a subclass), and financial capital. These main components of individualities are portrayed in Table 1.

Table 1

CLASSIFICATION OF INDIVIDUALITIES

Individualities		Variables
Personal Traits		
	Conscientiousness	risk-taking, imaginativeness, creativity, boldness, optimism, self-efficacy, passion, ability to work in an organization, humorous, witty, amusing, thrill-seeking, alertness, astuteness, honesty, ethical, moral, sexy, sensual, erotic, thrifty, frugal, miserly, egotistical, conceited, snobbish
	Emotional Stability	
	Agreeableness	
	Extraversion	
	Openness/Intellect	
Capitals		
	Human Capital	
	Intellectual	education, training, knowledge, skills and competencies, tacitness, codification, experience, social background, family background
	Health	life expectancy
	Social Capital	impression management, social perceptiveness, social adaptability, persuasiveness, market embeddedness, social astuteness

Cultural Capital	cultural experiences
Cultural Intelligence	international experience
Financial Capital	income

The Environment

Similar to businesses, entrepreneurs operate in certain environments[24]. Of course, some researchers argue that the environment is much less important today than two or three decades ago since inputs such as capital, information, and technology depend less and less on location due to rapid technological advances (Park, 2003; Porter, 1998). While many businesses remain dependent upon a particular location and therefore must either refrain from starting up at all, close, or cope with the environment, others have choices (Cotae, 2011; Dennis, 2011). Therefore, when looking at entrepreneurship, one may first classify the venture as place-bound or not. For example, a brewpub is place-bound while a Web site is not.

As in the case of individualities, the environment[25] in which entrepreneurs operate denotes an extremely broad and heterogeneous class of determinants (including legal, economic, and cultural factors). Although the literature is far from uniform, more or less homogenous categories such as the business environment and human capital (Brown, Earle, & Lup, 2005), and the legal environment (Levine, 1998; Morris & Lewis, 1995) have emerged Other components of the environment are not as homogeneous: economic, political, legal, financial, logistical and social structures (Morris & Lewis, 1995).

Although the importance of understanding the environment has been previously discussed (Busenitz et al., 2003), distinctions among the components of the environment are very weak, as they are defined differently by different disciplines or even by researchers within the same discipline. Fortunately, some of the subclasses of determinants identified in the individualities section have counterparts at the environment level, so one may use these subclasses as anchors for an overall classification. This aids the classification process by allowing for a uniform use of concepts.

Business Environment

A relatively common approach, especially in the literature of business location and economic growth, is to assess the effects of the business environment (also termed business climate or investment climate) on the economic performance of a certain location. This approach also examines the impact of the business environment on the decision of new firms to locate, relocate, or open in an area (Amoros, 2009; Aterido, Hallward-Driemeier, & Pages, 2011; Brown et al., 2005; Dyck & Ovaska, 2011; Lumpkin & Dess, 2001; Perry, 2007). While there is no universally adopted definition of the business environment, some of its main components seem to be the legal, institutional and economic conditions in which firms operate (Commander & Svejnar, 2010; Witkowska, 2007).

These aspects cannot usually be controlled by the firms (Witkowska, 2007). Examples of specific business environment variables are economic freedom (Dyck & Ovaska, 2011) and property rights and corruption (Brown et al., 2005; Dyck & Ovaska,
2011). In general, of the various subclasses of the environment, business environment seems to be the broadest concept.

Economic Environment

One of the most important subclasses of factors that together form the business environment is the economic environment. Some examples of factors that belong to this subclass are access to money (Aterido et al., 2011; Brown et al., 2005; Dyck & Ovaska, 2011; Nystrom, 2008; van Stel et al., 2007), taxes (Djankov, Ganser, McLiesh, Ramalho, & Shleifer, 2010; Fossen & Steiner, 2009), Foreign Direct Investment[26] (FDI) (De Backer & Sleuwaegen, 2003; Zhang et al., 2010), price stability (Bell, 1969), the share of employment in services out of overall employment (van Stel et al., 2007) and the size of different economic sectors (Bell, 1969). The level of economic development also influences entrepreneurship (Freytag & Thurik, 2007). There are many examples of how certain factors affect entrepreneurial activity differently depending on the level of economic development. For example, the number of new small businesses tends to increase at first during recessions, but during prolonged recessions the number of new businesses decreases strongly in developed countries when compared with developing ones (Klapper & Love, 2010)

Technologic Environment

There seems to be little research interest in the effect of the technologic environment on entrepreneurship. Furthermore, if clear definitions of several previously identified subclasses of factors were lacking, the meaning of technologic environment is even more obscure. However, some studies have examined components of the Technologic environment such as transportation (Sahoo & Dash, 2009), energy (Aterido et al., 2011; Sahoo & Dash, 2009), and broadband infrastructure (Czernich, Falck, Kretschmer, & Woessmann, 2011) in the context of economic growth. A particularly interesting technologic factor today is access to Internet. According to recent research, access to Internet has a differing effect on entrepreneurship depending on the level of analysis. Access to Internet may lead to further clustering within regions, and to slower (or even negative) entrepreneurship activity for some areas, but has an overall positive effect for the economy (Cumming & Johan, 2010). Of course, the level of analysis plays an important role for all determinants.

Human Capital

Human capital components such as education (van Stel et al., 2007), experience (Brown et al., 2005; van Stel et al., 2007), and life expectancy (Freytag & Thurik, 2007) have been shown to be important not only in entrepreneurship research, but also in many other research areas. Recent research suggests that entrepreneurship is also influenced by the existence of enablers (Thompson, 2010), people who help entrepreneurs operate. This may be a new component of human capital[27]. Total human capital is, of course, the sum of the human capitals of individuals.

Intellectual Capital

Applied at the organization level of analysis (and above), the intellectual capital may be defined as a component of human capital, concerning both knowledge and knowledge capability (Nahapiet & Ghoshal, 1998). Knowledge includes "local knowledge" (Audretsch, Dohse, & Niebuhr, 2008; Audretsch & Keilbach, 2007). Similar to human capital (of which intellectual capital is a component), total intellectual capital is the sum of the intellectual capitals of individuals.

Social Capital

"Social capital refers to the institutions, relationships, and norms that shape the quality and quantity of a society's social interactions" (World Bank, 2011). According to the World Bank, while the components of social capital are important, social cohesion (the "glue" that holds the institutions together) is the critical factor for economic development. The World Bank identifies five proxies for social capital: groups and networks, trust[28], collective action, social inclusion, and information and communication. Governments can contribute to the creation or existence of such networks (Casson & Giusta, 2007). As discussed above, new research suggests that entrepreneurship is also influenced by the existence of enablers who may be seen as a component of Social capital. Similar to the other capitals, total social capital as a component of the business environment is the sum of individual social capitals.

Cultural Capital

Factors such as culture, tradition, trust (Arogyaswamy & Rodsutti, 2007; Engelen, Heinemann, & Brettel, 2009; Grilo & Thurik, 2008; Kreiser, Marino, Dickson, & Weaver, 2010; Shepherd, 2011), and cultural diversity (Audretsch et al., 2008) have been extensively discussed in the literature. These factors are important not only by themselves, but also in their interactions with personal traits such as risk aversion and culture (Dyck & Ovaska, 2011; Hofstede, Hofstede, & Minkov, 2010). Unfortunately, depending on the researcher, trust may be viewed as a component of either social capital or cultural capital. This confusion may be an effect of cross-cultural entrepreneurial research (the combination of entrepreneurial research with research on local culture) being in its early stages (Engelen, Heinemann, & Brettel, 2009). It could also result from researcher biases which the researchers do not themselves recognize. One of the authors recalls reading a statement to the effect that if fish were researchers, it would take them a long time to discover water.

Entrepreneurship Capital

The entrepreneurial culture (Glaeser & Kerr, 2009), or the existence of entrepreneurial values and the degree of moral approval of entrepreneurship within a culture (Freytag & Thurik, 2007), seems to influence entrepreneurial activity. Indeed, it is relatively easy to understand the possible effect of some cultural aspects on one's decision to become an entrepreneur. If, for some reason, a local culture perceives entrepreneurs in a negative way, there will be less incentive for people to involve themselves in such activities.

Some researchers move further to define Entrepreneurship capital as a region's capacity to create new start-ups (Audretsch & Keilbach, 2007). As one example, if privately owned businesses were outlawed in a society, and the government then changed its position to "to get rich is glorious," then the level of entrepreneurial activity may increase.

Institutions and the Legal Environment

A relatively new approach to analyzing the determinants of entrepreneurship is through the lenses of institutional theory or institutional economics (Aterido et al., 2011; Cangiani, 2011; Davis, Marino, Aaron, & Tolbert, 2011; Dennis, 2011; Escobar & Vredenburg, 2011; Sawyer, 2010; Shepherd, 2011; Tonoyan, Strohmeyer, Habib, & Perlitz, 2010; Tracey & Phillips, 2011). A possible definition of institutions is, "…the humanly devised constraints that structure political, economic and social interaction" (Amoros, 2009; North, 1990). The importance that scholars attribute to institutions in entrepreneurship and other fields of research is apparent from the large number of studies addressing this issue.

While there may be no generally accepted definition of institutions, according to some authors the concept involves much more than just the formal structures (such as government structures). It also includes cultural norms, or "…the informal 'rules of the game" (Dennis, 2011). Studies have identified employment (labor) regulation, and entry regulation (Aterido et al., 2011), as well as red tape, contract enforcement, and property rights (Brown et al., 2005), to be important factors. Other studies have examined institutions and policies in general (Arogyaswamy & Rodsutti, 2007; Engelen et al., 2009; Grilo & Thurik, 2008; Kreiser et al., 2010), or more precisely, the legal structure and the degree to which laws such as property rights are enforced (Nystrom, 2008). Finally, economic freedom in general[29] also influences entrepreneurship (Bjørnskov & Foss, 2006; McMullen et al., 2008).

When it comes to the legal environment, researchers have suggested that it is characterized by reliability, impartiality and efficiency of the judiciary, recognition of private property, and enforcement of contract rights (Silverstein & Hohler, 2010). Similarly, quality of institutions (both formal and informal) is another important dimension of the institutions variable (Amoros, 2009; Minniti, 2008; Sawyer, 2010; Sobel, 2008; Tonoyan et al., 2010). Indeed, both classical and Baumol's theories of entrepreneurship predict that institutions influence entrepreneurship. For reasons easy to understand, better institutions can lead to more (productive) entrepreneurs. Unfortunately, Institutional quality is a broad and poorly defined term. Researchers have addressed the issue by designing broad proxies for it such as the inflation rate (Sawyer, 2010) and indicators such as corruption (Anokhin & Schulze, 2009), rather than using a direct measure. A (positive) relationship between the control of corruption and several standard of living and quality of life components (such as productivity, income and the United Nations' Human Development Index) and between the control of corruption and entrepreneurship has been identified by many studies (Amoros, 2009; Anokhin & Schulze, 2009; Dyck & Ovaska, 2011; Tonoyan et al., 2010). According to the general view, the quality of a country's institutions is reflected in its entrepreneurship intensity, and a country that benefits from a fair structure of incentives is very likely to show evidence of high entrepreneurial activity (Amoros, 2009). Interestingly, some studies went even further and found that the origin of a country's laws (French, Scandinavian, German and English laws) also seems to be a significant factor influencing entrepreneurship (Kreiser et al., 2010; Levine, 1998)[30]. The origin of a country's laws may be a proxy for the main culture that influenced a country's institutions.

An additional aspect of institutional and legal analyses is government policy. Several studies suggest that the allocation of entrepreneurship between productive or unproductive

activities can be influenced by policy (Baumol, 1990; Minniti, 2008). Research has found that regulation (Nystrom, 2008) and other government policies (Da Rin, Nicodano, & Sembenelli, 2006; van Stel et al., 2007; Verheul et al., 2003) influence entrepreneurial activity. Programs intended to support small businesses (small business policy) are also important (Brown et al., 2005; Cotae, 2011; Dennis, 2011).

Competitive Environment

The competitive environment relates the entrepreneur (or the firm) to the competition that it faces in the market. Some possible measures of the competitive environment are market size, market concentration, market growth (Gatignon, Weitz, & Bansal, 1990), and the number and power of competitors (Slater & Narver, 1994). The competitive environment may be characterized by dynamism, hostility and heterogeneity (Zahra, 1996). While the competitive environment is an important concept, it is not well represented in the Entrepreneurship literature. Few studies have directly examined the relationship between entrepreneurship and competition.

Local Conditions

A final important (albeit very broad) subclass of factors that make up the environment is local conditions. While no clear definition of "local conditions" can be found, several studies have examined factors such as the geographical environment, the industrial environment, and natural advantages and have found these factors to be important (Glaeser & Kerr, 2009; Tamasy, 2006). Clustering of economic activity significantly influences manufacturing entrepreneurship activity (Glaeser & Kerr, 2009; Witkowska, 2007). Indeed, clusters of economic activity lead to high economic intensity and many entrepreneurial opportunities (Audretsch & Keilbach, 2007). Moreover, cluster characteristics such as the size of firms within a cluster (Perry, 2007) may also be important. Finally, population density (Bell, 1969) is another example of a local condition that might influence entrepreneurship. For example, in the New York City borough of Manhattan, there are likely to be more sushi restaurants than in the same size geographic area in and around Greenwood or Itta Bena, Mississippi, or in Nunavut, Canada.

Classification of the Environment Factors

The most encompassing class of determinants under the environment is the business environment. In the business and economics literature, some of the most common components of this class are the economic and legal environment, the technological environment, the social environment, and the competitive environment. However, local conditions (sometimes considered to be a subclass of the business environment) seem to also have a unique place. Indeed, very rarely discussed (if ever) in the context of entrepreneurship, but possibly important, are the factors which characterize a location. These factors, such as amenities (Gotlieb, 1995) and disamenities, as well as geographic conditions (such as the local climate), seem to interact with the business environment, For example, there are more tech start-ups in Silicon Valley than in remote Alaskan villages. While these factors have been ignored by most entrepreneurship studies, an effort to understand how local conditions (such as beautiful surroundings), active cultural environments, and crime influence entrepreneurship has recently appeared in the business location literature. With globalization on the rise, these factors may become important even in cross-country studies, as more and more entrepreneurs tend to locate in countries that offer attractive conditions.

Several difficulties arise in developing a logically consistent taxonomy. Of the environmental determinants, the concept of institutions is the most difficult factor to classify. The concept is closely linked with governmental institutions, laws, societal norms (ethics), and culture in general. Given the breadth of the concept, it could encompass the legal environment as well as all or part of the social and cultural capital. The concept could be even broader. Since institutions is such a novel and broad concept, one could argue that keeping the economic and legal environments separate from the social and cultural environments might help to better distinguish between these subclasses of factors. Effort is also made to ensure the consistency of the subclasses of determinants between individualities and the environment. However, in an effort to unify the designations of the different components of the economic environment, all of the capitals (with the exception of entrepreneurship capital) are classified under the social environment concept. Entrepreneurship capital is a very broad and novel concept, and while itcould have a separate place in this taxonomy, it is classified as a component of cultural capital. The main components of the environment are portrayed in Table 2.

Table 2

CLASSIFICATION OF THE ENVIRONMENT

	Environments		Variables
Business Environment			
Institutions			
Economic and Legal			
	Economic		inflation, taxes, access to money, property rights, corruption, economic freedom, foreign direct investment (FDI), level of economic development, size of economic sectors
	Legal		regulation, quality of institutions
Capitals			
	Human Capital		
		Intellectual	education, knowledge, experience
		Health	life expectancy, age structure
	Social Capital		networks, social inclusion, social cohesion, information and communication
	Cultural Capital		culture, trust, cultural diversity
	Financial Capital		entrepreneurship capital, availability of funding
Competitive			number of competitors, strength of competitors, type of competition (atomistic, oligopolistic)
Technological			communication infrastructure, transportation infrastructure

Geographic Environment				
Industrial			clusters, cluster competition	
Physical			climate, natural resources	

CONCLUSION

The analytical framework formulated in this paper focuses on individuals and their environment. Starting with the observation that entrepreneurs are able to fructify opportunities by involving themselves in productive entrepreneurial activities, the approach of this study is to observe that individuals differ by their individualities (personal traits and the stock of capitals they possess at the time of becoming an entrepreneur), and that they operate in a particular environment (business and geographic environment). This analytical framework helps the researcher to take a uniform approach that then can be extrapolated to aggregated data. However, as with any other topic, working with aggregate data tends to blur the (already unclear) distinctions between different classes and subclasses of factors. This is why the supply and demand analytical framework is prone to misunderstanding of the aggregation effects, since it tends to redirect the focus away from the individual and the environment, and leads to supply and demand variables being amalgamated.

Several aspects of the taxonomy are deserving of additional research emphasis. One key issue is to distinguish between the stock of capital and the ability to acquire new capital (for example, earning new knowledge or gaining new skills). A person's stocks of capitals at the moment when becoming an entrepreneur are clearly important. However, the ability to accumulate capital (for example, the speed of accumulating capital) might or might not influence the process (apart from the age of the entrepreneur). Indeed, an individual who has a superior ability to accumulate capital might be able to become an entrepreneur in less time than an individual with an inferior ability. Nonetheless, both become entrepreneurs when they have acquired the necessary capitals. When considering entrepreneurship in one geographical area, one might need to first classify the ventures in the area as place-bound or not. Moreover, one might look at the origins of the entrepreneurs in that area. Many entrepreneurs in Silicon Valley (a cluster) are "imported" from outside. That means some of the individualities of those entrepreneurs are linked to other areas, or in other words, some of the "capitals" of the area, such as human and cultural capital, are also "imported." Finally, the competitive, technological and geographical environments are important concepts, but they are not well represented in the entrepreneurship literature. Investigating the importance of competition, technology (as an environment, not an industry) and variables such as climate and natural resources could bring new insights into the literature. In addition, considering the influence of variables such as crime rate, found to impact these environments in other fields of study, could also prove fruitful.

ENDNOTES

1 An alternative view holds that entrepreneurship is a necessary but not sufficient condition for overall wealth creation, since necessity entrepreneurship has been shown to be unrelated to economic growth (van Stel et al., 2007).

2 According to Schumpeter, entrepreneurs are responsible for capitalism never becoming stationary, since, through their entrepreneurial activity, they contribute to the "creative destruction" needed to assure sustained economic growth (Larroulet & Couyoumdjian, 2009).

3 After all, Mises was Kirzner's teacher (Kirzner, 2009).

4 For example, if entrepreneurship activity is to exist a long time after the creation of a firm, then factors such as firm performance should be considered also when studying entrepreneurship.

5 This leads to even more problems. No clear definition of the term opportunity exists either (Casson & Wadeson, 2007), which complicates the study of entrepreneurship even further. For a discussion about opportunities, see Ardichvili, Cardozo, & Ray (2003).

6 In an interview, a Microsoft manager mentioned "print preview" being invented by a Microsoft engineer for personal reasons. While no customer ever asked for such a feature, simply because customers did not know it could be designed, it became a feature in most software. On the other hand, some creation may be useful to some but annoying to others. Internet pop-up ads pop into mind as one example.

7 There is no commonly accepted threshold for this classification (Grilo & Thurik, 2008).

8 Schjoedt & Shaver (2007) found strong evidence of push effects in the U.S. while almost no evidence of pull effects. The study looked at a sample of 845 respondents from the Panel Study of Entrepreneurial Dynamics data.

9 Some call it a "hodgepodge" (Scott Shane & Venkataraman, 2000) or "intellectual onion" (Anderson & Marzena, 2008).

10 The terms distinctive field and domain of scholarship also appear in the literature.

11 Some authors refer to these characteristics as personal qualities, while others see them as components of the entrepreneurial capacity (Otani, 1996).

12 Some other terms used by researchers are dexterity, skills, and talents.

13 As written by the best known promoter of the Human capital concept itself, "Examples of activities that may lead to increases in human capital are expenditures on medical care, and lectures on the virtues of punctuality and honesty" and "Education, training, and health are the most important investments in human capital" (Becker, 2008).

14 Gartner et al. describe venture survival, and therefore some variables might not be relevant for new firms. Nevertheless, other researchers also see entrepreneurial capacity as similar to managerial ability (Otani, 1996).

15 Social capital is "less tangible" than Human capital (Coleman, 1988).

16 Or social competence, which is the means by which entrepreneurs take advantage of their social capital (Phelan et al., 2006).

17 Social astuteness may be perceived as the ability to manipulate others or to be charming and a natural leader (Cotae, 2011; Phelan et al., 2006).

18 Indeed, social capital may lead to information asymmetry (Ardichvili et al., 2003).

19 Social networks are based on different type of ties compared to business networks, which are based on instrumental ties (relationships concerned with financial gain), but they sometimes overlap (Phelan et al., 2006).

20 A "parallel" form of capital, Symbolic capital, has also been introduced (De Clercq & Voronov, 2009).

21 For example, individual characteristics such as "risk-bearing ability" may be in part determined by initial wealth (Otani, 1996) or financial capital (Portes, 1998).

22 However, some of these individualities may also be affected by other factors. For example, according to Otani (1996), risk-bearing ability "is an innate character of individuals, though it is in part determined by initial wealth." Similarly, entrepreneurial passion may be a trait or may be exogenously stimulated (Cardon et al., 2009). Moreover, the gap between those individualities that can be controlled easily and those that cannot narrows continuously. Modern medicine, new training techniques, and diversity are examples of factors contributing to the narrowing of this gap.

23 For example, Social capital may help to acquire Intellectual capital (Nahapiet & Ghoshal, 1998).

24 In this context, the term Environment denotes the conditions by which entrepreneurs are surrounded. However, equally important here is the entrepreneur's perception about the Environment (Edelman & Yli-Renko, 2010).

25 Or "Contextual aspects" (Tamasy, 2006).

26 Previous research also considered FDI diversity (Zhang, Li, Li, & Zhou, 2010).

27 On the other hand, they could also be seen as a component of social capital.
28 Also see Boulila, Bousrih and Trabelsi (2008).
29 Measured by the Heritage Foundation/Wall Street Journal Index of Economic Freedom.
30 The "Legal Origins Theory" has become a field of research in itself (Porta, Lopez-de-Silanes, & Shleifer, 2008).

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DOES TEXTBOOK CHOICE AFFECT LEARNING IN MACROECONOMIC COURSES ?

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ABSTRACT

This paper deals with the choice of textbooks for a sequence of macroeconomics courses. More specifically, it investigates whether the use of textbooks written by the same author for both principles and intermediate macroeconomics courses is beneficial for students. In a standard sequence of principles and intermediate level textbooks, similar concepts and ideas are explored with progressively higher rigor and technical detail. Among macroeconomics textbooks, there is less consistency in terminology and varying emphasis is placed on particular ideas than it is the case with microeconomics. Therefore, it is plausible to think that if textbooks used for both levels – principles and intermediate macroeconomics courses - share similar organization, terminology and a general approach, ceteris paribus, students' grades in intermediate macroeconomics course might be positively affected. However, regression results show that, after controlling for individual differences among students, using textbooks by the same author in a sequence of macroeconomics courses does not affect students' learning as measured by course grades.

INTRODUCTION

In general, introductory and intermediate level economics courses explore similar concepts and models with a goal to explain human behavior "in the ordinary business of life" (Marshall, 1890). Intermediate level courses and textbooks explore concepts more deeply and with a higher mathematical rigor. In microeconomic theory there is more agreement on the approach and content in economic textbooks for both levels. Macroeconomic theory is, however, often presented with more emphasis on either Keynesian or classical approach, with differences in presentation and the depth with which specific models are presented. This is why one can expect that if textbooks for both levels of macroeconomics have similar organization and approach, students might experience learning benefits. Consequently, this study explored the effect on students' grades when students used textbooks written by the same author for both principles and intermediate macroeconomics courses versus when students used textbooks written by different authors. All students in this study used G. Mankiw's *Macroeconomics* in intermediate macroeconomics course. On principles level some of them used Mankiw's textbook and some Stiglitz, Joseph and Carl Walsh's *Principles of Macroeconomics*.

LITERATURE REVIEW

To the best knowledge of the author, there were no similar studies performed in the past. The only indirectly related work was done by D. Pyne (Pyne, 2007). He explored the effect of different textbooks in Principles of Microeconomics on student performance in subsequent

economics courses – Intermediate Microeconomics and Money and Banking. He did not report on the textbook used in Intermediate Microeconomics courses and his findings can't be directly Compared with the finding in the paper. Pyne has found that different variable affect performance in subsequent economics courses (in addition to principles textbooks in some cases), such as taking first year microeconomics through on-line or distance courses, math background or having taken other economics courses, and the time elapsed between when a student takes an introductory course and when they take follow-up courses. These variables are not relevant for this paper because of the characteristics of the student population used. Students in this sample have all taken the principles course on-site, their math background is controlled for by their SAT scores, and great majority of students at Oxford take the intermediate economics course in the semester immediately following their introductory course.

DATA AND THE METHODOLOGY

In this paper, course grades were used to measure how much learning had occurred during a semester. Although grades are an imperfect measure of learning, keeping all the other factors constant in the analysis can offer an insight into the effect of textbook choice on grades. Data from two intermediate macroeconomics sections with a total of 58 students were collected. Several students dropped the course or withdrew from it, and the analysis was ultimately performed with 50 observations. Grades for students using Mankiw's textbooks for both levels of macroeconomics were compared with students' grades when using different authors' textbooks for principles and intermediate macroeconomics courses. The two sections of intermediate macroeconomics were taught in spring 2010 and fall 2010 by the same instructor, using the same pedagogies, tests and other choices that might affect students' grades. 29 of these students used Mankiw's textbooks for both course levels and 21 used textbooks for principles level written by a different author with differences in organization, terminology and emphasis on particular ideas. To estimate the effect of the same authors' textbook on student grades, dummy variable was created taking value 1 when Mankiw's textbooks were used for both levels and 0 otherwise. I control for individual differences among students by including measures for instructor in principles of macroeconomics class, gender differences, educational background, students' ability, year in college and cumulative collegiate performance as measured by GPA. The following equation is estimated by OLS:

(1)

Where:

Y_i	vector of course grades
a_{0i}	constant
β_{1i}	dummy variable coefficient for book used
$\Sigma_j \beta_{ji} X_{ij}$	control variables
ε_i	error term

To control for a possibility that students who had the same instructor in both courses could benefit from having more information about the instructor's style and pedagogies I included an "Instructor" variable as a dummy variable that takes value 1 if students had the same instructor and 0 otherwise. A dummy variable for gender takes value 1 for male and 0 otherwise. A "citizengroup" variable is a proxy for students' educational background. Data on citizenship status were available as "native", "naturalized", "temporary alien", and "permanent alien". Students who were "native" or "naturalized" in the dataset were grouped together and a dummy

variable was assigned value 1, while those in the "temporary alien" or "permanent alien" categories were assigned the value of 0. The assumption for this grouping is that native or naturalized citizens have spent a longer time in the U.S. and have been exposed to a different educational system compared to the students who have arrived to the U.S. relatively recently[1]. SAT scores were included in estimation as a sum of verbal and math scores to measure for individual differences in ability. SAT scores are generally known not to be good predictors of college performance. This is further supported by the data used in this paper. For example, simple correlation between SAT and term GPA in this data set is only 0.31 (table 2A). Years in college in the data set come as "freshman", "sophomore" and "junior" (Year 1, Year 2, Year 3) reflecting credit hours previously taken by students[2]. The "GPAnoEcon" variable was included in the estimation to control for students' performance at the college and was computed from the information on current term GPA excluding the economics grade(s). Original data included grade for intermediate macroeconomics class in the term GPA. If the economics grade were not excluded, there would be a potential for endogeneity in the estimation and biased coefficient estimates (Wooldridge,2011). I assumed that all students took 16 credit hours in a given semester which is true for the majority of students at Oxford College to derive GPAnoEcon variable[3].

RESULTS AND THE ANALYSIS

Table 1
DETERMINANTS OF THE COURSE GRADE IN INTERMEDIATE MACROECONOMICS COURSE

Variable	Coefficient	Standard Error	t-test	P>t
Book	0.040	0.208	0.19	0.849
Instructor	0.154	0.194	0.79	0.432
Gender	-0.318	0.204	-1.55	0.128
Citizengroup	-0.033	0.220	-0.15	0.881
SAT	-9.14E-05	0.000	-0.11	0.911
Year 1	0.620	0.482	1.29	0.206
Year 2	0.159	0.265	0.6	0.552
GPA noEcon	0.940	0.157	5.97***	0.000
Constant	0.096	1.047	0.09	0.927

Number of observations = 50
F (8, 41) = 7.15
Adjusted R^2 = 0.50

F-statistics indicates that the model fits data well (F-statistic is significant at 0.05 confidence level). The coefficient for the variable of interest, "book" is positive and not statistically significant. The insignificant coefficient demonstrates that students who used Mankiw's textbooks for both courses in the sequence of economics classes did not perform better in the intermediate macroeconomics class compared to those who used books of different authors. Furthermore, the other coefficients are of predicted signs. The coefficient for the "instructor" variable is positive reflecting that having the same instructor in the past might have a positive effect on students' grades in the course, but this coefficient is not statistically significant, either. The gender variable has a negative coefficient indicating that female students might perform more poorly then male students, but again, it is not statistically significant. The coefficients for "citizengroup" reflecting differences in the educational background as well as for SAT scores are not statistically significant either. The previous number of credit hours taken expressed through the year in college does not affect course performance in the intermediate macroeconomics

Course. The only variable that is highly significant is current GPA (excluding the economics grade). A 1 point increase in current GPA results, on average, in a 1.25-point higher grade in the intermediate macroeconomics course. In other words, higher performing students perform even better in intermediate macroeconomics than on average. If this variable reflects general adjustment to college, then it can be said that students who are better able to adjust to college (and perform better in other courses) will on average perform better in intermediate macroeconomics courses, too, no matter their gender, educational background, year in college, SAT, or instructor.

CONCLUSION

The primary goal of this paper was to establish whether the usage of textbooks written by the same author(s) for the sequence of macroeconomics courses – principles and intermediate – affects students' learning as measured by course grades. When individual differences among students were controlled for, grades of students who used corresponding textbooks written by the same author were not significantly different than grades of students who used textbooks written by different authors for principles and intermediate course levels. The only variable that resulted in a statistically significant coefficient, reflecting its importance for success in intermediate macroeconomics courses, was a variable that measured general performance/adjustment to college – current GPA. Students who manage to perform well in other courses, regardless of gender, instructor, educational background or SAT scores, will on average perform even better in intermediate macroeconomics courses.

ENDNOTES

1 There is a possibility, however, that there are students with the U.S. citizenship who did not grow up in the United States and "permanent aliens" who have spent relatively long time in the U.S. I did not have available information on these cases. Credit for this comment goes to Dr. Satu Riutta, Director of Institutional Research at the Oxford College.

2 Oxford College is a specialized division of Emory University offering a liberal arts intensive curriculum for the first two years of the Emory baccalaureate degree. There are nine junior students in the dataset. This follows from the fact that some students come with credit hours in their first year and accumulate enough credit hours in their second year to be considered "juniors". There were also two "freshmen" students in the dataset who came to the Oxford College with prerequisites for intermediate macroeconomics.

3 Approximately 95% students take 16 credit hours on a regular basis

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APPENDIX

Table A1
SUMMARY

Variable	No of observ.	Mean	Stand. Dev.	Min	Max
Grades	51	3.03	0.87	1	4
Book	50	0.54	0.50	0	1
Instructor	51	0.55	0.50	0	1
Citizengroup	51	0.76	0.43	0	1
Gender	51	0.60	0.49	0	1
SAT	51	1290	120	995	1530
Year 1	51	0.03	0.18	0	1
Year 2	51	0.16	0.37	0	1
GPA noecon	51	3.33	0.63	1.37	4.01

Table A2
SIMPLE CORRELATION

	Grade	Book	Instructor	Citizengroup	Gender	SAT	Year1	Year2	GPA noec.
Grade	1								
Book	0.1039	1							
Instructor	0.0273	0.2253	1						
Citizengr.	-0.1392	0.1423	0.1176	1					
Gender	-0.2750	-0.1490	0.2557	0.0821	1				
SAT	0.1830	-0.086	-0.0052	-0.1690	0.0935	1			
Year1	0.1895	-0.033	-0.0247	-0.3444	-0.0788	0.0758	1		
Year2	0.1454	-0.340	0.1007	-0.0783	0.0982	-0.1194	-0.0956	1	
GPAnoec.	0.7258	0.0965	-0.0353	-0.1035	-01714	0.3070	0.0601	0.1486	1

ADVERSE SELECTION AND MORAL HAZARD PROBLEMS WITH RESPECT TO OCCUPATIONAL CHOICE

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1. INTRODUCTION

A pivotal issue in the disciplines of Economics, Strategy, and Entrepreneurship is the relation between firm size and the propensity to innovate (Cohen and Klepper 1996a). Scherer (1984) first asked why small firms should be more innovative considering that much of the fixed costs of innovation could be more easily borne by large firms (Holmstrom 1989). This notion was epitomized in Schumpeter's 1950 work where he argued that large firms were the drivers of innovation, viewing patent counts as a proxy for innovativeness. However, and in light of Schumpeter's thesis, the exact opposite has been found empirically. Studies concerning firm size and market entry (Agarwal and Audretsch 2001; Brown 2012) suggest that market niches are filled by small firms especially in relation to the stage of the product life cycles of these markets.

Within industries, the number of innovations per dollar of Research and Development (R&D) decreases with firm size with smaller firms accounting for a disproportionately large percentage of innovative measures (Cohen and Klepper 1996a, Bound et al. 1984, Acs and Audretsch 1988, 1991a, Pavitt et al. 1987). A follow up question with respect to innovativeness is what constitutes an innovation? This question has primarily been dealt with by using patent data (Kerr and Fu 2008), which measures direct evidence of a firm's ability to innovate. However, patent data measures only quantity, and not quality, which has led others to measure patent citations (Trajtenberg (1990), Hall, Jaffe and Trajtenberg 2000). Citations may be more indicative of a patent's relative importance in the marketplace for products and ideas.

This work will present a model with three agent-level variations based on occupational choice. The choices that will be borne out are that of (i) a salaried production worker, (ii) an entrepreneur who starts a small firm by teaming up with a venture capitalist in a pure equity contract and (iii) a scientist who runs a corporate-sponsored research venture at a large firm for a fixed wage. By introducing heterogeneity in the research sector, and diversity in the types of employers, we create a framework in which both efficient and relatively inefficient research organizations may be simultaneously active in equilibrium. The desired outcome is attained because large firms, by their nature, pool research efforts while entrepreneurial firms attract individuality.

As a prelude to the model developed here, consider a distribution of risk-averse agents indexed by a skill factor that determines one's average productivity at performing research.

Agents have three occupational choices. They may become salaried production workers, entrepreneurs that start-up an independent research venture (i.e. a "small" firm) by entering into an equity contract with a venture capitalist, or scientists running a corporate-sponsored research venture at a large firm in exchange for a fixed wage. Individuals that choose a research-based occupation incur a disutility that is decreasing in their skill factor. In the process of innovating, agents are subject to an uninsurable idiosyncratic shock. Employers observe the aggregate output of their operations, but not the individual ability of a researcher. As such, scientists are paid on the basis of their *average* product at the large firm, which pools the risk of all corporate-sponsored ventures while providing full insurance to its employees. Despite the fact that venture capitalists are unable to observe ability, the income of an entrepreneur is increasing in skill under reasonable assumptions. That is, large firms pay based on average productivity, whereas small firms pay based on individual productivity. In equilibrium, low-skilled agents become production workers; those of intermediate ability become scientists since the disutility of performing research is *decreasing* in skill; and high-skilled agents launch independent ventures because they obtain a sufficiently high expected income as entrepreneurs that warrant foregoing full insurance at the large firm.

In the presence of both uninsurable idiosyncratic risk and unobservable skill, scientists and entrepreneurs coexist in equilibrium. In the full information case, agents are paid their marginal product at the large research firm. If an agent starts up a firm, he also earns an amount commensurate with his productivity.Yet, an entrepreneur must bear a fraction of the risk associated with running a venture by virtue of the equity contract established with a venture capitalist. Consequently, due to risk aversion, no agents become entrepreneurs since they prefer to be fully insured by the large firm. If the innovation technology is deterministic and skills are unobservable, no agents become scientists because of Akerlof's "lemons" problem. Any scientist with a skill level above the average at the large firm would prefer starting up his own venture since, without idiosyncratic risk, insurance is not needed.

Suppose employers observe a noisy signal of ability, such as education, termed a test score [section 3]. In equilibrium, *high-skilled* agents sort as follows: those with fairly accurate test scores become scientists; those that are underrated by the test launch independent ventures; and those that performed poorly overall in the test become production workers. In a sense, entrepreneurs are "disgruntled": they are highly capable, but undervalued by traditionally large employers. Scientists have strong, verifiable qualifications that are handsomely rewarded by large firms. Production workers have little or no education, though they may in fact be very skilled. If the signal is not sufficiently noisy, no agent becomes an entrepreneur since in that case the wage offer from a large firm is close enough to his true marginal product. The higher is the test score of an agent, the more likely he is to become a scientist; the higher is the ability of an agent, the more likely he is to become an entrepreneur. Finally, a decrease in risk aversion leads to a rise in the mass of entrepreneurs, and a fall in the mass of scientists, causing a fall in average firm employment.

If both the large firm and venture capitalists offer a risk-sharing and salary-based contract, the sorting outcome remains unchanged, with one caveat. In this situation, the full insurance contract of a large firm is indistinguishable from that of a venture capitalist offering the same, so agents would be indifferent between running a corporate-sponsored venture or initiating an independent venture in exchange for a fixed wage. However, no agent would choose employment at the large firm offering an equity contract because of the "lemons" problem. A scientist at a large firm with a skill level above the average is clearly better off on

his own by accepting the equity contract of a venture capitalist, since equity contracts in large firms are based on average productivity, whereas it is based on own productivity in a small firm.

This intuition is formalized in the model by introducing unobservable effort in the innovation technology [section 4]. As above, in equilibrium, the venture capitalist offers an incentive-based contract, while the large firm offers a fixed-wage contract, implementing high effort in small firms, and low effort in large firms. High-skilled agents become entrepreneurs paired with a venture capitalist implementing high effort. Low-skilled agents become production workers because the disutility of performing research is decreasing in skill. Agents of intermediate ability are fully insured by the large firm or venture capitalists offering a salary-based contract, and thus exert low effort. In other words, combining moral hazard with adverse selection serves to amplify the difference in research productivity between small and large firms.

Our predictions regarding the sorting of individuals across occupations sharply contrast those in the literature. Typically, if agents are heterogeneous in their ability at either manufacturing a good or coordinating production, then high (low) ability agents become managers (employees, respectively). In Murphy, Shleifer, and Vishny (1991), the output of a firm depends on the skill of its manager and the combined ability of its employees (a measurement of firm size). Due to the assumed supermodularity between firm size and managerial ability, firm size is increasing in the manager's ability. Murphy, Braguinsky, and Ohyama (2004), Oi (1983), Rosen (1981), and Lucas (1978) obtained similar results. Another approach is based on the assignment of tasks. In Kremer (1993), firms with a greater number of tasks (another measure of size) employ agents of higher quality. When skilled workers are used in the production process, these models imply the most skilled are hired by large firms, contradicting the observation that small firms are more innovative.

The construct presented here tells a different story by separating R&D and production activities, and transferring the role of skill to the research sector. Having individuals differ in management and/or production skills cannot explain the observation of interest since the issue at hand is effectiveness at performing R&D. Moreover, if one re-interprets these models as relating to R&D, the wrong conclusion is reached. By introducing heterogeneity in the research sector, and diversity in the types of employers, we created a framework in which both efficient and relatively inefficient research organizations may be simultaneously active in equilibrium. The desired outcome is attained because large firms by their very nature pool their research efforts, while individuality can only be achieved by being entrepreneurial.

Blanchflower and Meyer (1991) pointed out that research concerning entry into an entrepreneurial (or managerial) occupation has focused on the following assumptions [Kanbur (1982), Kihlstrom and Laffont (1979), Grossman (1984)]. First, profitable business opportunities are feasible for all individuals, yet most simply choose not to exploit them. Second, entrepreneurs receive the same expected utility as they would as workers. Third, the entrepreneur is likely to be someone with unusually low risk-aversion (as in Kihlstrom and Laffont). On the other hand, we follow along the lines of classical writings by Kirzner (1973), Knight (1921), and Schumpeter (1939), who argue heuristically the opposite. First, attitude to risk is not the central characteristic that determines who becomes an entrepreneur. In that vein, we propose innate ability is the primary source of heterogeneity. Second, most individuals are not sufficiently skilled to pursue innovative opportunities. We obtain this outcome if the distribution of skill in the population is somewhat skewed. Finally, an entrepreneur chooses that occupation since he receives a higher expected utility than he would as a regular salaried worker.

Indeed, that is the premise of our model, yielding the result that high-skilled individuals become entrepreneurs.

The paper is organized as follows. Section 2 presents the model. In section 3, employers observe a noisy signal of ability. Moral hazard is introduced in section 4. Finally, section 5 concludes. An appendix contains the proofs of all propositions.

2. THE MODEL

There is a continuum of mass one of risk-averse agents, whereby an agent is indexed by entrepreneurial ability a that is drawn from a distribution F with support $[0,\infty)$. Entrepreneurial ability is private information, though we shall also consider the full information case. Agents live for one period and become an *entrepreneur*, *scientist*, or *production worker*. Entrepreneurs create and run independent ventures ("small" firms) financed by risk-neutral venture capitalists via the establishment of an equity contract. Venture capitalists (VC) are endowed with the know-how and investment technology to start-up a small firm, so entrepreneurs cannot initiate an independent venture on their own.[i] Scientists run corporate projects at a large research firm, which offers its employees a fixed wage.

Both the large firm and venture capitalists are restricted to offer the same menu of linear contracts. In equilibrium, however, only the fixed-wage contract of the large firm is accepted, while only the equity-based contracts of venture capitalists are accepted. We shall find that no agent accepts an equity-based contract from the large firm due to the lemons problem. Moreover, an agent will be indifferent between accepting a salary-based contract at a large versus small firm.

The contract structure we consider replicates empirical patterns. Stafford (1980, p. 334) pointed out that "a larger establishment can provide insurance functions … if the different jobs (occupations) or individuals within the plant are subject to earnings uncertainty." Medoff and Abraham (1980) find only a weak link between pay and performance in large firms. In accordance with these observations, the large research firm provides full insurance to its employees in the form of a fixed wage, as in Holmstrom (1983). Gompers (1999), Bullock (1983), and Kozmetsky et al (1985) showed that research-intensive start-ups are typically funded by venture capitalists; moreover, they usually hold an equity stake instead of using debt. The model parallels this practice: in equilibrium, an entrepreneur launches a firm by entering into an equity contract with a venture capitalist.

Independent ventures and corporate projects develop schematics for new goods. The firm employing the inventor of a schematic obtains an infinitely lived patent, the rights to which are then sold to a monopolist that produces the good at constant marginal cost. It is assumed the firm employing the inventor is the full residual claimant to the rent generated by the innovation. The actual inventor receives either a wage (as a scientist) or a share of the returns (as an entrepreneur). Let π denote the payoff per schematic and w the wage of a salaried worker.

Each agent is endowed with an innovation technology. When x units of capital are invested in an agent of entrepreneurial ability a, he invents $n(a)x^{1-\delta}$ new goods, where $n(a)$ is an idiosyncratic innovation shock ("innovation shock") whose distribution depends on a. The timing is such that the innovation shock is realized after the investment has been made. The

productivity of an agent with skill a has the support $[0,\infty)$ and expectation $\bar{n}(a)$. Let $\bar{n}(S) \equiv \int_S \bar{n}(a)dF(a)\left[\int_S dF(a)\right]^{-1}$ denote the average productivity of agents in the set $S \subset [0,\infty)$.

An individual with entrepreneurial ability a that chooses a research-based occupation (i.e. by becoming a scientist or entrepreneur) incurs the disutility $u(d(a))$. For convenience, the disutility has the same functional form u as that over consumption, and it enters preferences in an additive fashion; that is, the utility of a scientist or entrepreneur with entrepreneurial ability a consuming c is equal to $u(c)-u(d(a))$. The disutility of performing research is decreasing in, entrepreneurial ability such that $d'(a)<0$.

Preferences, technology, and the skill distribution satisfy the following throughout the paper:

(A1) The utility function of an agent is $u(c)=\frac{c^{1-\sigma}}{1-\sigma}$, where c is consumption and $\sigma>0$.

(A2) The average productivity of an agent $\bar{\varepsilon}(s)$ is strictly increasing in skill a, and $\bar{n}(0)\equiv 0$.

(A3) The cumulative distribution function of skill F is strictly increasing.

(A4) $\frac{E\{n(a)^{1-\sigma}\}}{1-\sigma}$ is strictly increasing in skill s.

Assumption (A2) states that, holding the level of investment and state of technology constant, a highly skilled individual invents a greater number of schematics for new goods on average. Moreover, note that (A4) follows directly from (A2), since the expected value of a monotone transform of a variable is a monotone transform of the expected value.

2.1 The Corporate-Sponsored Venture

The large research firm operates a collection of ventures, each of which is run independently by a scientist. Let Γ denote the set of skills of the agents who choose to become scientists. Being unable to observe skill, the large firm has no control over the characteristics of its employees, so it takes Γ as given. To construct the equilibrium, it is assumed the firm is endowed with rational expectations (perfect foresight); that is, it accurately predicts the set Γ in equilibrium. Because the firm cannot distinguish its employees, it invests the same amount x in each corporate-sponsored venture. Let v denote the wage paid scientists, which is taken as given by the firm in a competitive equilibrium. Being risk neutral, the firm maximizes its expected profits: $\max_{\{x\geq 0\}} P_A x^{1-\delta}\int_\Gamma \bar{n}(a)dF(a)-(x+v)\int_\Gamma dF(a)$. The first-order condition (FOC) with respect to x leads to

(1) $x(\Gamma)=[(1-\delta)\pi\bar{n}(\Gamma)]^{\delta^{-1}}$.

There is free entry into the research sector, so the large firm makes zero expected profits in equilibrium yielding an expression for the wage v as a function of the average skill of scientists:

(2) $v(\Gamma)=\delta(1-\delta)^{(1-\delta)\delta^{-1}}[\pi\bar{n}(\Gamma)]^{\delta^{-1}}$.

2.2 The Independent Venture

Consider a venture capitalist that is paired with an entrepreneur of skill a to form an equity contract. Let Ω denote the set of entrepreneurs, which is taken as given by venture capitalists. As was assumed for the large research firm, venture capitalists are endowed with rational expectations; that is, they accurately predict the set Ω in equilibrium. A venture capitalist makes an investment I in exchange for a share α of the revenues. There are many venture capitalists bidding for each equity contract, so the entrepreneur decides the values of α and I. Letting u denote an agent's utility function, an entrepreneur of skill a solves $\max_{\{\alpha\in[0,1],I\geq 0\}} E\{u[(1-\alpha)\lambda n(a)I^{1-\delta}]\}-u(d(a))$, subject to the condition that the venture capitalist is willing to enter into the equity contract. Since the venture capitalist must make this decision prior to the realization of the shock without knowing the identity of the entrepreneur, and he is risk neutral, the participation constraint (PC) is $\alpha\lambda\bar{m}(\Omega)I^{1-\delta}-I\geq 0$. The following lemma describes the solution to this problem.

LEMMA 1: Suppose the utility function is strictly increasing. Then the share of revenues that accrues to the venture capitalist is $\alpha=1-\delta$. Moreover, for any given set $S\subset[0,\infty)$, an independent venture utilizes the same investment policy as a large firm, $I(S)=x(S)$.

The lemma states that the entrepreneur chooses a share of revenues that accrue to the venture capitalist equal to $\alpha=1-\delta$. Recall that if the venture capitalist invests x in the venture, then the entrepreneur invents $n(a)x^{1-\delta}$ new goods. Hence, the coefficient $1-\delta$ represents the (percentage) contribution towards the innovative process made by the investment. As δ converges to zero, the venture capitalist must become the full residual claimant of the investment to ensure his participation.

2.2 The Occupational Choice Decision

In equilibrium, a positive mass of agents sorts into each occupation in the following fashion. High-skilled agents become entrepreneurs, those of intermediate ability become scientists, and the lowest skilled segment of the population chooses the occupation of production worker. The intuition of this outcome is straightforward. Because ability is private information, scientists are paid on the basis of their *average* product. Therefore, agents with sufficiently high skill levels are drawn away from the large research firm since they are not compensated an amount commensurate with their productivity. Only such agents can earn a high expected income as entrepreneurs, so they are willing to bear a fraction of the risk associated with running an independent venture. Because the large research firm provides its employees with full insurance, there is a positive mass of agents who choose to become scientists since agents are risk averse, which leads us to the next point.

The presence of the idiosyncratic shock is crucial to the existence of the separating equilibrium. If the innovation technology is deterministic, then no agents become scientists because of the "lemons" problem. The large firm would no longer provide insurance functions, so there is no incentive for a researcher to remain with the large firm when skill is unobservable and there is no idiosyncratic risk.

If both the large firm and venture capitalists offer equity-based and fixed wage contracts, the equilibrium remains unchanged assuming the large firm cannot decentralize into independent subsidiaries and thus is constrained to provide an equity contract on average productivity.[ii] No agents would accept the equity contract offered by a large firm, preferring instead to launch an

independent venture, because of the "lemons" problem. Moreover, agents would be indifferent between employments at a large firm offering full insurance versus being paired with a venture capitalist offering the same.

PROPOSITION 1 (The Separating Equilibrium): Assume skill is private information. Define $\hat{a}_{UN}$ and $\bar{a}_{UN}$ according to

(3) $[\delta(1-\delta)^{(1-\delta)\delta^{-1}}[\pi\bar{n}([\hat{a}_{UN},\bar{a}_{UN}))]^{\delta^{-1}}]^{1-\sigma} - d(\hat{a}_{UN})^{1-\sigma} \equiv w^{1-\sigma}$;

(4) $\dfrac{E\{n(\bar{a}_{UN})^{1-\sigma}\}}{\bar{n}([\bar{a}_{UN},\infty))^{1-\sigma}} \equiv \left[\dfrac{\bar{n}([\hat{a}_{UN},\bar{a}_{UN}))}{\bar{n}([\bar{a}_{UN},\infty))}\right]^{(1-\sigma)\delta^{-1}}$.

In equilibrium, agents choose the following occupations: those in the skill range $[0,\hat{a}_{UN})$ become production workers; those in $[\hat{a}_{UN},\bar{a}_{UN})$ become scientists; and those in $[\bar{a}_{UN},\infty)$ become entrepreneurs.

It is by virtue of the assumption that the disutility of performing research is *decreasing* in skill that we obtain the result that *low*-skilled agents choose to become production workers, or similarly that those of *intermediate* ability become scientists. Nevertheless, without such an assumption, we would still obtain the (unique) outcome that high-skilled agents become entrepreneurs.

2.4 The Full Information Case

Suppose skill is observable to employers, in which case agents are paid their marginal product at the large research firm while receiving the benefits of full insurance. It follows that, due to risk aversion, no agent has an incentive to become an entrepreneur.[iii] The following proposition formalizes this notion. Because the marginal product of a researcher is strictly increasing in skill by definition, and scientists incur a disutility of performing research that is strictly decreasing in skill, the equilibrium consists of a unique cutoff skill level below (above) which agents become production workers (scientists, respectively).

PROPOSITION 2 (The Pooling Equilibrium): Assume skill is public information, and agents are risk averse. Define $\hat{a}$ according to

(5) $[\delta(1-\delta)^{(1-\delta)\delta^{-1}}[\pi\bar{n}(\hat{s})]^{\delta^{-1}}]^{1-\sigma} - d(\hat{a})^{1-\sigma} \equiv w^{1-\sigma}$.

In equilibrium, agents choose the following occupations: those in the skill range $[0,\hat{a})$ become production workers, and those in $[\hat{a},\infty)$ become scientists. There are no entrepreneurs.

Combining this result with Proposition 1, we infer information asymmetries between innovators and their investors are required to generate a positive mass of entrepreneurs. We previously found that, in the absence of idiosyncratic risk, no agents become scientists when skill is private information. Hence, in the presence of both unobservable skill and uninsurable idiosyncratic risk, scientists and entrepreneurs can coexist.[iv]

The following corollary establishes that $\hat{a}_{UN} < \hat{a} < \bar{a}_{UN}$, implying fewer agents become employed by the research sector when skill is observable.

COROLLARY OF PROPOSITION 2: The separating equilibrium relates to the pooling equilibrium as follows: $\hat{a}_{UN} < \hat{a} < \bar{a}_{UN}$.

So far, we have analyzed the bipolar cases in which skill is either public or private information. In the former case, no individuals choose to become entrepreneurs since they are paid their marginal product at a large firm. In the latter case, highly skilled individuals are paired with venture capitalists offering equity contracts, while individuals of intermediate ability become scientists, earning a fixed wage which proxies for full insurance. Small firms are thus more effective at performing R&D on average than large firms. In both cases, low-skilled agents become production workers since choosing a research-based occupation entails a loss of utility that is decreasing in skill. In the next section we consider the intermediate case of imperfect information, wherein individuals know their true skill level, but employers observe a noisy signal of skill. For example, education, work experience, and standardized examinations are typically observable, but these are not a perfect indicator of ability.

3. THE MODEL WITH IMPERFECT INFORMATION

Suppose employers observe a test score s instead of the actual skill a of an agent. All agents are required to take the test prior to employment, and they know their own skill level. An agent's test score is believed to be his actual skill level. That is, if x is invested in an agent with test score s, he is expected to invent $\bar{n}(s)x^{1-\delta}$ new intermediate goods. Because employers are not endowed with perfect foresight, we may not compare the signaling equilibrium derived here with the separating equilibrium. The test score takes on the functional form $s = \eta a$, where η is a random variable with support $[0,\infty)$ and a distribution T that does not depend on skill and is i.i.d. across agents.

Previously, we had assumed that engaging in a research-based occupation entails a loss of utility that is decreasing in skill. This assumption was required to ensure low-skilled agents become production workers, thereby making the equilibrium unique. When employers observe a noisy signal of skill, individuals in research-based occupations are compensated on the basis of their test score. We illustrate below that this implies agents with low test scores choose to become production workers. That is, the disutility of performing research is no longer needed to obtain a unique sorting outcome, so the feature is omitted in this section to simplify the construct.

In equilibrium, high-skilled agents may choose any of the three occupations, while low-skilled agents become scientists or production workers. There is a positive mass of entrepreneurs if the signal is sufficiently noisy. When the signal is an appropriate measure of skill, such that it lies within an acceptable margin of error, the model closely resembles the situation with observable skill. When this is so, employees of the large firm are paid an amount that is reasonably close to their marginal product. If it is close enough, then no agents have an incentive to bear a fraction of their venture's risk as entrepreneurs. When the distribution of the noise in the signal is sufficiently dispersed such that there is a positive mass of entrepreneurs, their average skill exceeds that of scientists.

3.1 The Research Ventures

Consider a corporate-sponsored venture run by a scientist who obtained the test score *s*. Let $v(s)$ denote the wage schedule of scientists mapped according to their test score, which is taken as given by the large research firm in the competitive equilibrium. The firm maximizes its expected profits: $\max_{\{x\geq 0\}} \pi\bar{n}(s)x^{1-\delta} - v(s) - x$. The FOC with respect to *x* leads to the investment policy

(6) $x(s) = [(1-\delta)\pi\bar{n}(s)]^{\delta^{-1}}$.

The wage schedule must be such that no scientist can earn a higher salary at another large firm, yielding the relation $v(s) = \max_{\{x\geq 0\}} \pi\bar{n}(s)x^{1-\delta} - x$. Due to constant returns, this condition is equivalent to requiring that the typical large firm make zero expected profits in equilibrium. Hence, we equate the marginal cost of hiring a scientist who obtained the test score *s* with his expected marginal product: $v'(s) = \pi\bar{n}'(s)x(s)^{1-\delta}$. Applying the investment policy function, we obtain the expression $v'(s) = \pi^{\delta}\bar{n}'(s)[(1-\delta)\bar{n}(s)]^{(1-\delta)\delta^{-1}}$. Integrating this from zero to *s*, and using the fact that $v(0) = 0$ since $\bar{n}(0) \equiv 0$, the competitive wage schedule equals

(7) $v(s) = \delta(1-\delta)^{(1-\delta)\delta^{-1}}[\pi\bar{n}(s)]^{\delta^{-1}}$.

Consider an agent with test score *s* and skill *a* who becomes an entrepreneur by entering into an equity contract with a venture capitalist. Because an agent knows his own skill level, the objective remains the same, except for having removed the disutility of performing research: $\max_{\{\alpha\in[0,1], I\geq 0\}} E\{u[(1-\alpha)\pi n(a)I^{1-\delta}]\}$. The participation constraint (PC) of the venture capitalist must reflect the fact that he only observes the test score of the entrepreneur. Hence, the PC is given by $\alpha\pi\bar{n}(s)I^{1-\delta} - I \geq 0$. The first-order conditions are identical to those derived in Lemma 1, whereby $\bar{n}(\Omega)$ is replaced by $\bar{n}(s)$, yielding $\alpha = 1-\delta$ and $I(s) = x(s)$.

3.2 The Occupational Choice Decision

The following proposition states the equilibrium. Subsequent corollaries describe the sorting of agents according to their skill level and test score.

PROPOSITION 3 (The Signaling Equilibrium): Assume employers observe a test score $s = \eta a$, the idiosyncratic innovation shock is $n(a) = na^{\delta}$, with $\bar{n} \equiv E\{n\}$ and $n \in [0,\infty)$, and the distribution *T* of η is strictly increasing with support $[0,\infty)$. Define the cutoff $\bar{\eta}$ according to

(8) $\bar{\eta} \equiv \left[\frac{E\{n^{1-\sigma}\}}{\bar{n}^{1-\sigma}}\right]^{[\delta(1-\sigma)]^{-1}}$.

Furthermore, define $\hat{s}$ according to

(9) $\bar{n}(\hat{s}) \equiv \frac{w^{\delta}}{\delta^{\delta}(1-\delta)^{1-\delta}\pi}$.

In equilibrium, agents choose the following occupations: those in the set $\{(\eta,a): \eta a \leq \hat{s}\min\{(\eta\bar{\eta}^{-1})^{\delta}, 1\}\}$ become production workers; those in $\{(\eta,a): \eta a > \max\{\bar{\eta}a, \hat{t}\}\}$ become scientists; and those in $\{(\eta,a): \hat{t}(\eta\bar{\eta}^{-1})^{\delta} < \eta a \leq \bar{\eta}s\}$ become entrepreneurs.

FIGURE 1
THE SIGNALING EQUILIBRIUM

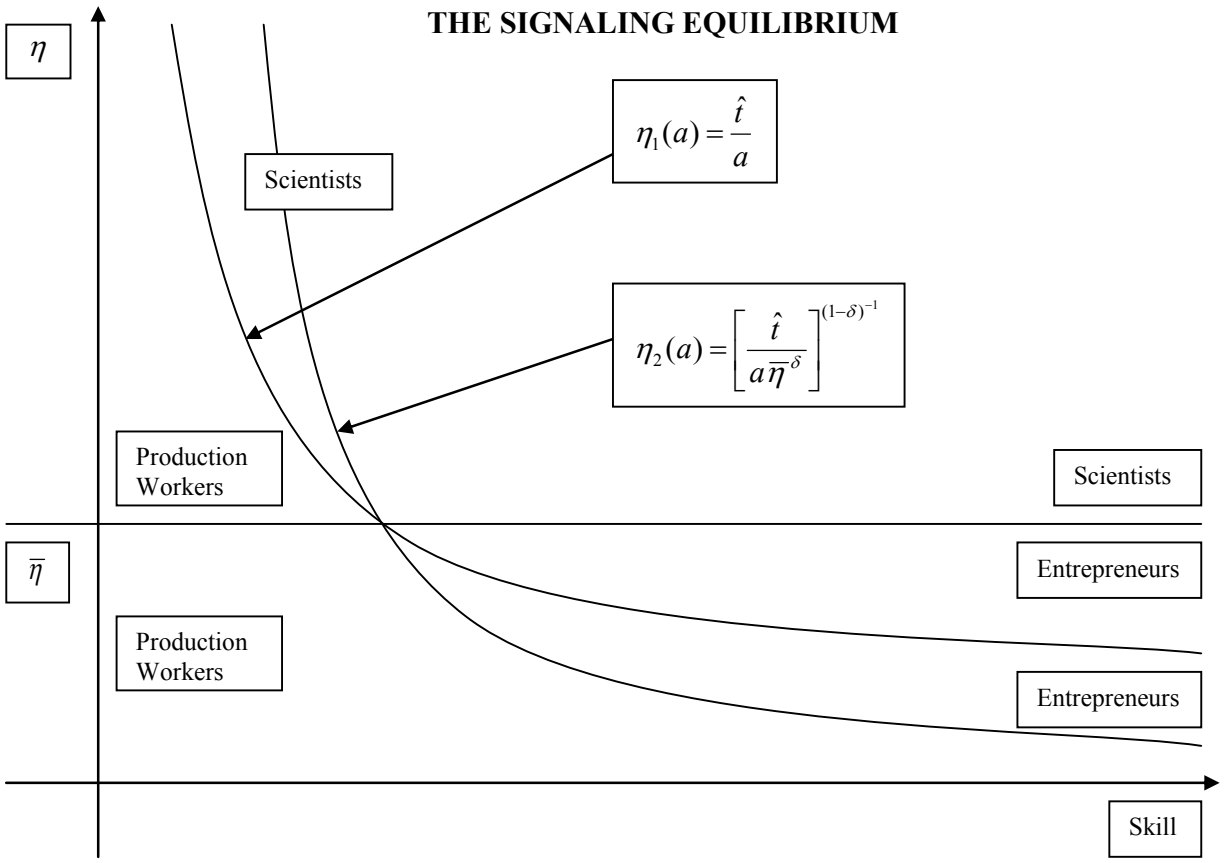

Figure 1 is a graphical depiction of the equilibrium in (η, a) space. The line $\eta = \overline{\eta}$ describes the point of indifference between an entrepreneur and scientist.[v] The function $\eta_1(a)$ describes the point of indifference between a production worker and scientist. Finally, the function $\eta_2(a)$ describes the point of indifference between a production worker and entrepreneur. Figure 1 is read as follows: all agents to the left and below both curves $\eta_1(a)$ and $\eta_2(a)$ become production workers; all agents above the line $\eta = \overline{\eta}$ and to the right of $\eta_1(a)$ become scientists; and all agents below the line $\eta = \overline{\eta}$ and to the right of $\eta_2(a)$ become entrepreneurs. Define a *high-skilled* agent as one with a skill level above $\hat{s}\overline{\eta}^{-1}$. Agents with $\eta \leq \overline{\eta}$ are referred to as *underrated* because $\overline{\eta} < 1$ by Jensen's inequality; that is, employers undervalue their true worth.

The proposition demonstrates that, depending on their realized value of η, high-skilled agents may choose any of the three occupations, while low-skilled agents become production workers or scientists. A low-skilled agent that did not test well, having obtained a test score below $\hat{s}$, becomes a production worker, while a low-skilled agent with a test score above $\hat{s}$ becomes a scientist. A high-skilled agent with $\eta > \overline{\eta}$ becomes a scientist, while an underrated high-skilled agent becomes a production worker or entrepreneur. An extremely underrated high-skilled agent, having obtained $a\eta^{1-\delta} \leq \hat{s}\overline{\eta}^{-\delta}$, becomes a production worker. An underrated high-skilled agent that did not perform so poorly, having obtained $a\eta^{1-\delta} > \hat{s}\overline{\eta}^{-\delta}$, becomes an entrepreneur. We may think of $\overline{\eta}$ as an allowable margin of error in the signal to *not* choose the occupation of entrepreneur. If the distribution *T* is truncated such that no realizations of η are below $\overline{\eta}$, then no agents become entrepreneurs, so the signal must be sufficiently noisy to have a positive mass of entrepreneurs.

Large firms compensate their employees on the basis of verifiable qualifications, which corresponds with the test score in our model. The higher is an individual's test score, the more productive he is expected to be, so the wage schedule of a scientist is increasing in his test score, according to (7). If a high-skilled agent performed well on the test, then the market, and in particular the large research firm, values highly his (expected) innovative contribution. Hence, if his test score is sufficiently close to his skill level, or exceeds it, then he strictly prefers to become a scientist instead of an entrepreneur since agents are risk averse. A high-skilled agent that performed terribly on the test will get a low wage offer from the large research firm, so he rules out the occupation of scientist. Indeed, if he was unlucky, the wage offer is so low that he is better off as a production worker instead of a scientist. Furthermore, because venture capitalists undervalue the contribution of an unlucky high-skilled agent, they would invest a low amount in his independent venture. The occupation of entrepreneur is thus also unattractive, so such an agent becomes a production worker. An unlucky high-skilled agent that did not perform so poorly on the test becomes an entrepreneur as long as the venture capitalist invests a sufficient amount in his venture.

Corollary 1 of Proposition 3 outlines the sorting of agents across occupations on the basis of their skill level.

COROLLARY 1 OF PROPOSITION 3: Suppose the assumptions stated in Proposition 3 hold. Consider an agent with skill level $a > \hat{s}\overline{\eta}^{-1}$. The higher is his skill level, the more (less) likely he is to become an entrepreneur (production worker, respectively), while the probability that he becomes a scientist remains unchanged and positive (since ηs and $\overline{\eta} s$ both grow). Consider an agent with skill level $s \leq \hat{s}\overline{\eta}^{-1}$. The higher is his skill level, the more (less) likely he is to become a scientist (production worker, respectively), while no agents in that range become entrepreneurs.

A direct implication of the corollary is that the average skill of entrepreneurs (averaged over the noise in the signal) exceeds that of scientists, which in turn exceeds that of production workers, as occurred in the separating equilibrium. Corollary 2 of Proposition 3 describes the sorting process in terms of the test score. Overall, agents with high skill levels are more likely to become entrepreneurs, while those with high test scores are more likely to become scientists.

COROLLARY 2 OF PROPOSITION 3: Suppose the assumptions stated in Proposition 3 hold. Consider an agent with test score $s > \hat{s}$. The higher is his test score, the more (less) likely he is to become a scientist (entrepreneur, respectively), while no agents in that range become production workers. Consider an agent with test score $s \leq \hat{s}$. The higher is his test score, the more (less) likely he is to become an entrepreneur (production worker, respectively), while no agents in that range become scientists.

The cutoff $\hat{s}$ has numerous interpretations. For example, suppose attaining the test score $\hat{s}$ is equivalent to having an MBA, such that individuals with test scores below $\hat{s}$ do not have an MBA. Suppose the higher is an individual's test score in excess of $\hat{s}$, the more famous (or reputable) is the graduate program he attended. According to Figure 1, no production worker has an MBA. Some individuals without an MBA become entrepreneurs, but they must be highly skilled (specifically having a skill level in excess of $\hat{s}\overline{\eta}^{-1}$). Among individuals with an MBA, the more reputable is the granting institution, the more likely they are to be hired by a large firm [Corollary 2 of Proposition 3]. However, a select group of *highly* skilled individuals with an MBA become entrepreneurs. They tend to be individuals that attended slightly less reputable institutions, or those that went to top graduate programs, but have exceptionally high skill levels.

To summarize, we have thus shown that introducing imperfect information does not change the qualitative results of the model with unobservable skill. Whereas before we had that *all* high-skilled agents become entrepreneurs, and *all* agents of intermediate ability become scientists, we obtain the same results *on average* when employers observe a noisy signal of skill [Corollary 1 of Proposition 3]. Large firms succeed in hiring individuals with high test scores because they are expected to be highly innovative. However, a high test score can be obtained if an individual is lucky, including those of low ability, decreasing the average skill of scientists.

3.3 Comparative Statics

The following corollary predicts the impact changes in $\overline{\eta}$ have on the signaling equilibrium when n is distributed uniformly. The cutoff $\overline{\eta}$ in Proposition 3 solely depends on the fundamental parameters of the model, including the idiosyncratic shock distribution and the coefficient of relative risk aversion. The following corollary establishes that a decrease in the variance of the idiosyncratic shock, such that performing research is less risky, leads to a rise (fall) in the mass of entrepreneurs (scientists, respectively), as does a decrease in risk aversion. When agents are not very risk averse, or the idiosyncratic shock is not highly volatile, the entrepreneurial occupation is not as risky as that of a scientist, so it becomes relatively more attractive if one has a sufficiently high skill level.

COROLLARY 3 OF PROPOSITION 3: Suppose the assumptions stated in Proposition 3 hold. An increase in $\overline{\eta}$ raises the mass of entrepreneurs, while lowering that of scientists and production workers. If the idiosyncratic shock n is distributed uniformly over $[n_0, 2-n_0]$, where $0 \leq n_0 < 1$, then $\overline{\eta}$ rises in response to either of the following: a decrease in the variance of the idiosyncratic shock (i.e. a rise in n_0), or a decrease in the coefficient of relative risk aversion σ.

It is not possible to predict how the mass of entrepreneurs versus scientists varies with the signal to noise ratio. When the signal becomes less noisy, the large research firm pays its employees an amount that is more highly correlated with their true skill level, which we call the "income effect." As such, the occupation of scientist becomes more attractive, implying more agents should choose that occupation instead of pursuing a more risky, entrepreneurial venture. Venture capitalists are also endowed with imperfect information, investing in entrepreneurs on the basis of their test score. Hence, as the signal becomes less noisy, venture capitalists invest an amount that is more aligned with an entrepreneur's true marginal product, which we call the "investment effect." Whether the investment effect supersedes the income effect depends on the parameters of the model.

The next section introduces moral hazard in the research sector. The question of interest is whether doing so changes the sorting outcome, or rather enhances the difference in research productivity between small and large firms. Common wisdom suggests individuals engaged in an entrepreneurial occupation have a greater incentive to work hard. Indeed, we find entrepreneurs are not only more skilled than scientists at large firms, but also exert a higher level of effort.

THE MODEL WITH MORAL HAZARD

The framework with moral hazard parallels Holmstrom (1982), wherein team members exert unobservable effort in a production process, and only the aggregate output of the team is observable to the principal. In that context, Rasmusen and Zenger (1990) analyzed which contractual structure will be utilized depending on the size of the team. The authors found that large firms offer fixed-wage contracts, while small firms link pay and performance more closely. In a similar model, McLaughlin (1994) predicts the link between individual compensation and firm performance is stronger the smaller is the firm. Moreover, adverse selection is generated when workers are heterogeneous: the best workers sort into firms that offer performance pay, while a firm offering team incentives attracts only those of low ability. This separation parallels the one we obtain, though the technology is different: here there is no "team production" since the output of an agent is not correlated with that of another.

An agent exerts unobservable effort when innovating. Specifically, each researcher chooses between exerting a high level of effort at some positive cost, versus low effort at zero cost. If an agent with skill s exerts high effort, and x is invested in his venture, then he invents $n(a)x^{1-\delta}$ new intermediate goods. If he exerts low effort, then he invents $en(a)x^{1-\delta}$ schematics, where $e \in (0,1)$. For ease of exposition, the cost of exerting high effort parallels the functional form of preferences: $\frac{c^{1-\sigma}}{1-\sigma}$.

Employment contracts take one of two forms depending on the level of effort an employer wishes to implement. For an agent to exert high effort, he must be offered a share of the revenues. If a firm wishes to implement low effort, then a fixed wage contract achieves the desired result, replicating full insurance. An entrepreneur exerting low effort is equivalent to a corporate-sponsored venture run by a scientist exerting low effort, so an employee of a firm implementing low effort will simply be referred to as a *low-effort researcher*. Agents are faced with two other occupational choices: *high-effort entrepreneur* (paired with a venture capitalist implementing high effort), and *high-effort scientist* (running a corporate-sponsored venture at a large firm implementing high effort).

4.1 The High-Effort Independent Venture

Let Ω denote the set of skills at which an agent becomes an entrepreneur paired with a venture capitalist that wishes to implement high effort. Venture capitalists are endowed with perfect foresight, thereby predicting the set Ω in equilibrium. So as to induce high effort, a venture capitalist offers the entrepreneur a share $1-\alpha$ of revenues. There are many venture capitalists bidding for each equity contract, so the equilibrium share will be determined by a zero-profit condition, contingent on the set of entrepreneurs. Taking the share $1-\alpha$ and set Ω as given, the typical venture capitalist maximizes his expected profits by choosing a level of investment: $\max_{\{I\geq 0\}} \alpha\pi\bar{n}(\Omega)I^{1-\delta} - I$. The maximization is subject to a collection of incentive compatibility (IC) constraints. These ensure the entrepreneur does not shirk by exerting low effort. The IC constraint of a high-effort entrepreneur with skill *s* is given by

(10) $E\{u[(1-\alpha)\pi n(a)I^{1-\delta}]\} - \dfrac{c^{1-\sigma}}{1-\sigma} \geq E\{u[(1-\alpha)e\pi n(a)I^{1-\delta}]\}$.

Since skill is private information, the venture capitalist carries out the maximization subject to the condition that the IC constraint (10) holds for all $a \in \Omega$. The entrepreneur can observe his resulting productivity *ex post*, so (10) depends on $n(a)$ and not $\bar{n}(a)$.

Suppose preferences are given by (A1), such that (10) becomes

$\dfrac{E\{n(a)^{1-\sigma}\}}{1-\sigma}(1-e^{1-\sigma})[(1-\alpha)\pi I^{1-\delta}]^{1-\sigma} \geq \dfrac{c^{1-\sigma}}{1-\sigma}$ for all $a \in \Omega$.

Define $\bar{a}_{MH} \equiv \min\{a : a \in \Omega\}$; that is, $\bar{a}_{MH}$ is the lowest skill level at which an agent chooses to become a high-effort entrepreneur. Recall that assumption (A4) requires $\dfrac{E\{n(a)^{1-\sigma}\}}{1-\sigma}$ is strictly increasing in skill *a*. Because skill does not enter anywhere else in the above equation, it follows that, under assumption (A4), (10) holds for all $a \in \Omega$ if and only if it holds for agents at the skill level $\bar{a}_{MH}$. We therefore reduced a set of inequalities into a single IC constraint given by

(11) $\dfrac{E\{n(\bar{a}_{MH})^{1-\sigma}\}}{1-\sigma}(1-e^{1-\sigma})[(1-\alpha)\pi I^{1-\delta}]^{1-\sigma} \geq \dfrac{c^{1-\sigma}}{1-\sigma}$.

Let λ denote the multiplier associated with (11). The FOC with respect to investment *I* is

$1-\alpha(1-\delta)\pi\bar{n}(\Omega)I^{-\delta} = \lambda(1-\delta)E\{n(\bar{a}_{MH})^{1-\sigma}\}(1-e^{1-\sigma})[(1-\alpha)\pi]^{1-\sigma} I^{(1-\delta)(1-\sigma)-1}$.

Suppose $\lambda = 0$. Then the FOC becomes $I = \alpha(1-\delta)\pi\bar{n}(\Omega)I^{1-\delta}$, such that the expected profits of the typical venture capitalist are positive irrespective of the level of investment: $\alpha\pi\bar{n}(\Omega)I^{1-\delta} - I = \alpha\delta\pi\bar{n}(\Omega)I^{1-\delta} > 0$. Since this cannot hold in equilibrium (by virtue of the competitive venture capitalist sector), it must be the case that $\lambda > 0$, implying the IC constraint (11) binds. The zero-profit condition yields:

(12) $I(\Omega) = [\alpha(\Omega)\pi\bar{n}(\Omega)]^{\delta^{-1}}$.

Plugging (12) into the binding IC constraint, we obtain an implicit equation for the equilibrium share as a function of the set of high-effort entrepreneurs:

(13) $[E\{n(\bar{a}_{MH})^{1-\sigma}\}(1-e^{1-\sigma})]^{(1-\sigma)^{-1}}[1-\alpha(\Omega)]\pi^{\delta}[\alpha(\Omega)\bar{n}(\Omega)]^{(1-\delta)\delta^{-1}} = \frac{c^{1-\sigma}}{1-\sigma}$.

The expected utility of a high-effort entrepreneur with skill *s* is given by

$$U_E(a) = \frac{E\{n(a)^{1-\sigma}\}}{1-\sigma}[[1-\alpha(\Omega)]\pi I(\Omega)^{1-\delta}]^{1-\sigma} - \frac{c^{1-\sigma}}{1-\sigma} - \frac{d(a)^{1-\sigma}}{1-\sigma}.$$

Using (12) and (13), we find

(14) $U_E(a) = \frac{1}{1-\sigma}\left[c^{1-\sigma}(1-e^{1-\sigma})^{-1}\frac{E\{n(a)^{1-\sigma}\}}{E\{n(\bar{a}_{MH})^{1-\sigma}\}} - c^{1-\sigma} - d(a)\right]$.

It follows that the expected utility of the lowest-skilled entrepreneur is given by

$$U_E(\bar{a}_{MH}) = \frac{1}{1-\sigma}\left[\frac{(ce)^{1-\sigma}}{1-e^{1-\sigma}} - d(\bar{a}_{MH})\right].$$

The incentive-compatible contract defined by (13) implements high effort among all entrepreneurs. Moreover, the contract is such that the expected utility of an entrepreneur is increasing in skill, ensuring that *high*-skilled agents become high-effort entrepreneurs. We now describe low-effort researchers, and derive the unique equilibrium.

4.2 Low-Effort Researchers and the Occupational Choice Decision

Consider a large research firm that wishes to implement low effort among its employees, given by the skill set Γ, which it accurately predicts in equilibrium. Let *v* denote the competitive wage paid such agents, to be determined by a zero-profit condition. Taking *v* as given, the firm's investment problem is $\max_{\{x\geq 0\}} e\pi x^{1-\delta}\int_{\Gamma}\bar{n}(a)dF(a) - (x+v)\int_{\Gamma}dF(a)$, or equivalently $\max_{\{x\geq 0\}} e\pi\bar{n}(\Gamma)x^{1-\delta} - x - v$. The latter formulation is identical to the problem of a venture capitalist paired with an entrepreneur implementing low effort. Hence, as argued earlier, we do not distinguish between these two types of ventures, and simply refer to agents choosing that occupation as low-effort researchers. Agents take as given the competitive wage *v*. Because exerting high effort is costly, they exert low effort as expected. The FOC yields the investment policy

(15) $x(\Gamma) = [(1-\delta)e\pi\bar{n}(\Gamma)]^{\delta^{-1}}$.

Free entry into the research sector leads to zero expected profits for the typical low-effort firm, such that the equilibrium wage is a function of the average skill of low-effort researchers:

(16) $v(\Gamma) = \delta(1-\delta)^{(1-\delta)\delta^{-1}}[e\pi\bar{n}(\Gamma)]^{\delta^{-1}}$.

The following proposition describes the separating equilibrium. Low-skilled agents become production workers because the disutility of performing research is decreasing in skill. Agents of intermediate skill become low-effort researchers, who may reside at small or large firms, and high-skilled agents become high-effort entrepreneurs. Risk aversion ensures there is a positive mass of low-effort researchers enjoying the benefits of full insurance. No agents become high-effort scientists because of the "lemons" problem.

PROPOSITION 4 (The Separating Equilibrium with Moral Hazard): Assume skill is private information, and agents exert unobservable effort. Define $\hat{a}_{MH}$ and $\bar{a}_{MH}$ according to

(17) $\bar{n}([\hat{a}_{MH}, \bar{a}_{MH})) \equiv [\pi(c\delta)^{\delta}[e(1-\delta)]^{1-\delta}(1-e^{1-\sigma})^{\delta(1-\sigma)^{-1}}]^{-1}$;

(18) $[\delta(1-\delta)^{(1-\delta)\delta^{-1}}[e\pi\bar{n}([\hat{a}_{MH}, \bar{a}_{MH}))]^{\delta^{-1}}]^{1-\sigma} - d(\hat{a}_{MH})^{1-\sigma} \equiv w^{1-\sigma}$.

In equilibrium, agents choose the following occupations: those in the skill range $[0, \hat{a}_{MH})$ become production workers; those in $[\hat{a}_{MH}, \bar{a}_{MH})$ become low-effort researchers; and those in $[\bar{a}_{MH}, \infty)$ become high-effort entrepreneurs.

The following corollary compares this equilibrium to the one obtained in the absence of moral hazard (Proposition 1). Four cases arise depending on parameter values. In three of the four cases (denoted Cases II, III, and IV in the corollary), we find $e\bar{n}(\Gamma_{MH}) < \bar{n}(\Gamma_{UN})$, implying the average productivity of scientists is *lower* in the equilibrium with moral hazard in comparison to the equilibrium without moral hazard. Furthermore, in three of the four cases (denoted Cases I, II, and III in the corollary), we find $\bar{n}(\Omega_{MH}) > \bar{n}(\Omega_{UN})$, implying the average productivity of entrepreneurs is *higher* in the equilibrium with moral hazard in comparison to the equilibrium without moral hazard. Therefore, overall, in two of the four cases (denoted Cases II and III in the corollary), we find $\bar{n}(\Omega_{MH}) - e\bar{n}(\Gamma_{MH}) > \bar{n}(\Omega_{UN}) = (\Gamma_{UN})$, implying the difference in average productivity between small versus large firms was magnified after having introduced moral hazard. It is possible, though not certain, that the same result holds in the other two cases.

COROLLARY OF PROPOSITION 4: The separating equilibrium with moral hazard relates to the separating equilibrium without moral hazard according to one of the following four cases:

Case I: $\hat{a}_{MH} < \hat{a}_{UN} < \bar{a}_{UN} < \bar{a}_{MH}$, $e\bar{n}(\Gamma_{MH}) > \bar{n}(\Gamma_{UN})$, and $\bar{n}(\Omega_{MH}) > \bar{n}(\Omega_{UN})$;

Case II: $\hat{a}_{UN} < \hat{a}_{MH} < \bar{a}_{UN} < \bar{a}_{MH}$, $e\bar{n}(\Gamma_{MH}) < \bar{n}(\Gamma_{UN})$, and $\bar{n}(\Omega_{MH}) > \bar{n}(\Omega_{UN})$;

Case III: $\hat{a}_{UN} < \bar{a}_{UN} < \hat{a}_{MH} < \bar{a}_{MH}$, $e\bar{n}(\Gamma_{MH}) < \bar{n}(\Gamma_{UN})$, and $\bar{n}(\Omega_{MH}) > \bar{n}(\Omega_{UN})$;

Case IV: $\hat{a}_{UN} < \hat{a}_{MH} < \bar{a}_{MH} < \bar{a}_{UN}$, $e\bar{n}(\Gamma_{MH}) < \bar{n}(\Gamma_{UN})$, and $\bar{n}(\Omega_{MH}) < \bar{n}(\Omega_{UN})$.

CONCLUSION

Many studies have shown empirically that small firms are more innovative as they obtain a greater number of innovations per dollar of R&D (or per researcher) in comparison to large firms. The literature predicts the opposite, so new theory was called for. In the context of an occupational choice framework, our approach emphasized the role of two features: researchers face uninsurable idiosyncratic risk, and their ability is private information. In equilibrium, the most able researchers sort into an entrepreneurial, risky occupation, while those of intermediate ability prefer the benefits of full insurance at a large firm. When employers observe a noisy signal of ability, such as education, large firms employ individuals with a greater educational attainment, while small firms hire highly skilled individuals, as has been documented empirically. Finally, when moral hazard is introduced, entrepreneurs are not only highly skilled, but also exert high effort, while researchers at large firms exert low effort, magnifying the difference in research productivity between small and large firms.

Contributions

Our findings make several contributions. First, from a policy perspective, small firms and start-ups have greater difficulty in obtaining funding for R&D-based projects from financial

institutions such as banks due to capital market imperfections. For this reason, many entrepreneurs turn to the venture capital market. Large firms tend to fund R&D projects with in-house funds. When these do not suffice, they may rely upon the capital markets to raise capital. Yet, the contribution to growth by small firms is great relative to their size. As such, a role for the government would be to lessen the impact of capital market imperfections by aiding start-ups and small R&D ventures obtain funding on more favorable terms.

Secondly, in the model, we specify which type of agent selects which type of occupation. While cases are made for circumstances with no information problems and with unobservable effort (i.e. Moral Hazard), our most interesting contribution is in the case with Adverse Selection. In this model, a noisy signal of ability is observed and high-skilled agents sort according to the test score which they receive. Those with fairly accurate test scores become scientists while those that are underrated by the test launch independent ventures. In a sense, these entrepreneurs are disgruntled in that they are highly capable but undervalued. However, the noisiness of the signal plays a role in the sorting. If the signal is not sufficiently noisy, then no agent becomes an entrepreneur since the wage offer from the large firm is close to his true marginal product. Finally, the higher the agent's test score, the more likely he becomes a scientist while the higher ability of the agent, the more likely he is to become an entrepreneur.

Managerial Implications

This paper consists of several renditions of a model concerning occupational choice of agents. However, there are several managerial implications at the firm level. First, considering the finding with respect to the signal observed by the firm, one managerial implication is in the construction of work-related tests. Retaining talented employees who have high ability is, perhaps, a manager's most daunting task. According to the model presented in this paper, agents whose test scores are underrated leave the insured position which they have at large firms in order to launch an independent venture. Therefore, controlling the accuracy of the test which is implemented is an important implication for existing managers, especially at high-tech companies which have property rights policies.

Secondly, and following Cases II, III, and IV of the moral hazard model, it is important for managers in high-tech firms to implement incentive structures for researchers which are consistent with the researchers' effort policies. Additionally, managers who monitor scientists who operate as part of a team must implement mechanisms to avoid free-riding. Since these researchers at large firms tend to have low-effort policies, the free-rider problem must be contained in order to preserve collective productivity for the firm. Therefore, the following two points act as constraints on the manager. First, the fact that scientists employ low-effort policies must be taken into account in order not to overcompensate. Secondly, the fact that the propensity to free-ride in a group of agents which have low-effort policies may be increasing must be taken into account in order not to undercompensate.

Empirical Implications and Future Research

We argue that the most interesting contribution of this work appears in Section 3 in the model with imperfect information. Empirically, finding and testing a reliable proxy of the signal t would be an important extension of our theory. While the example of t used in this paper is that of an advanced degree, such as an MBA, other proxies may suffice. For example, if managers observed a signal relating to the agent's relative optimism (Landier and Thesmar 2008) or wealth (Anton and Yao 1995; Hellmann 2007), then this could be used as a proxy for the value of the parameter t. Hypothesizing on the propensity for employees to remain employees, therefore, would require that the information gleaned from this signal have the following properties. With

respect to optimism, agents who are employees should have optimism levels below that of entrepreneurs. Additionally, one might predict that agents who are wealth-constrained are more likely to remain or become salaried research scientists instead of entrepreneurs.

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ENDNOTES

[i] In a dynamic context, in which an independent venture operates over multiple periods, this is akin to imposing that only venture capitalists have access to the capital markets, thus being able to borrow sufficient funds to launch a firm.

[ii] In a sense, if a large firm were to decentralize as such, then we would no longer consider it a "large" firm, but rather a collection of "small" firms. As Cohen, Levin, and Mowery (1987) noted, the empirical pattern that small firms are more innovative in fact applies to the business unit, which in this case would be the subsidiary of the "large" firm.

[iii] In fact, if agents are risk neutral, they are precisely indifferent between becoming an entrepreneur versus scientist.

[iv] If there is no risk and skill is observable, then individuals are indifferent between becoming scientists versus entrepreneurs.

[v] The cutoff $\overline{\eta}$ should not be confused with the mean of η, which we have not explicitly defined.

THE ROLE OF STATIONARITY IN BUSINESS AND ECONOMIC RESEARCH[1]

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ABSTRACT

Unit root or nonstationarity is inherent in time series data. Hence, a mandatory econometric task before performing time series analysis is to determine whether the data is nonstationary. This is to avoid spurious results. Non-stationarity can be detected through the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests. I exposit the size and power of these tests in detecting stationarity given the statistical properties of the data. Findings revealed that the ADF is more efficient in detecting that a random walk, random walk with drift, and random walk with drift along a deterministic trend is non-stationary while the PP test is more efficient in detecting stationarity among the family of AR(1) data generating processes (DGPs).

INTRODUCTION

Creating decision models for analysis is a critical requirement of many business and economic applications – forecasting, budgeting, causality, and organizational control systems. According to Arsham (1994), "existing formalisms and methods of inference have not been effective in real-time applications where tradeoffs between decision quality and computational tractability are essential." That is, to effectively perform time series analysis, it is essential to realize the fundamental structure and function of the data generating process (DGP) that generates the observations. Understanding time series would permit for the development of an econometric model that can best represent the data to employ forecasting, monitoring, and/or control (Senter, n.d.).

However, time series data (such as asset and stock prices, unemployment rate, exchange rates, inflation, gross domestic product) are often non-stationary, has unit root, or have means, variances, and covariances that are time variant. The data can possess trends, cycles, and/or random walks (Iordanova, 2007). Consequently, it becomes difficult to identify the systematic patterns within the data (Senter, n.d.). Fortunately, there are time series analysis techniques that can filter the data to reduce the errors.

In this study, I lay emphasis on on the inherent random process, trending behavior, or nonstationarity in the mean of most time series data. Meanwhile, a stationary process reverts around a constant long-term mean and has a constant variance independent of time (Iordanova, 2007). Hence, a mandatory econometric task before performing time series analysis is to establish whether the series is non-stationary, that is, there is a need to determine the most appropriate form of the trend in the time series data (Enders, 2004). To generate

consistent and reliable results, the non-stationary data must be stationarized or de-trended prior to analysis.

A crucial characteristic of a high-performing manager is the aptitude to employ a strategic approach in making long-term managerial decisions that will achieve organizational goals. A fundamental quality of long-term managerial decision is its strong dependence on forecasts. According to Arsham (1994), "every decision becomes operational at some point in the future, so it should be based on forecasts of future conditions." Forecasts are critical in any business organization because the impact of the forecasts on actual performance is linked. Variances in forecasts and actual can compel decision to be revised. As such, this warrants the use of a reliable time series data. An organization cannot make a good decision nor create a correct planning strategy without a suitable time series data. A sophisticated time series analysis technique will not be enough given poor data.

Nonstationarity can be detected through various testing procedures. The most popular of which are (1) the Augmented Dickey-Fuller (ADF) and (2) the Phillips-Perron (PP) Unit Root Test. Likewise, non-stationary time series can be stationarized via available de-trending procedures such as first differencing and time-trend regression (Enders, 2004). Furthermore, suitable alternative estimation procedure involves checking for cointegration and specifying an error correction model (ECM) (Elder & Kennedy, 2001). However, these alternative procedures are beyond the scope of this study. This study exposit this mandatory initial step in time-series analysis – detect for nonstationarity. This is key because in business and economic research, a well-organized time series data is vital to generating reliable results for analysis, decision-making, and long term planning. Highlighting both the importance and conviction of stationarity tests would assure researchers that they generate results that are not spurious.

Given such limitations and disagreements of various unit root tests to detect non-stationary time series, it is imperative to know their respective powers and shortcomings given the kind of non-stationary properties present. Under which conditions will a unit root test be able to detect non-stationary? Hence, this study aims to establish a preliminary basic set of operational principles in model specification based on unit root testing procedures.

As a limitation, the methodology of this study will only focus on the ADF and the PP unit root tests – the widely used tests in the literature and commonly available in most statistical software, although it is recognized that there are other methodologies that can detect non-stationary.

THE NATURE OF UNIT ROOT TESTING[2]

Empirical work employing time series data must warrant that the time series is stationary. Non-stationary time series data are characterized to be unpredictable. Hence, it cannot be used for time series modeling and forecasting (Iordanova, 2007). According to Gujarati and Porter (2009), "a stochastic process is said to be stationary if its mean and variance are time invariant and the value of the covariance between the two time periods depends only on the lag between the two time periods and not the actual time at which the covariance is computed." Moreover, Gujarati and Porter (2009) claimed that stationarity is required in order to guard against spurious regressions – nonsensical relationship when one

non-stationary time series variable is regressed against one or more exogenous non-stationary time series variables. Operating on spurious analysis may result to errors in economic planning and decision-making; hence, spurious regressions must be perceived and avoided.

As such, unit root testing is the preliminary and mandatory step in time series model building. However, there have been a number of questions to the value of unit root testing to detect for nonstationarity. Restrictions based on theory are at least as effective and that there is a need for a set of principles that limit and define the role of the implicit knowledge of model builders (Allen & Fildes, 2005). Detecting nonstationarity among time series data will have a bearing on how to select the most appropriate DGP among the family of time series models for the purposes of forecasting, vulnerability, volatility, and other time series analyses.

Moreover, if nonstationary variables are regressed with each other, spurious results are obtained wherein one obtains a very high coefficient of determination (R^2) even though there is no meaningful relationship among variables. Also, there is spurious regression when the R^2 is greater than the Durbin-Watson (DW) statistic (Gujarati & Porter, 2009). Hence, to guard against spurious regression, it is important to test for whether the variables being used contain unit roots. If unit roots are present, the time series is non-stationary and must be stationarized.

STATIONARY AND NON-STATIONARY TIME SERIES

Most business and economic time series are characterized by trending behavior that generates critical inquiries statistically modeling long-run components. Two different methods are frequently employed: (1) the trend stationary model – assumes that the long-run component follows a time polynomial often assumed to be linear and added to an otherwise stationary ARMA process (Wolters & Hassler, 2005); and (2) the difference stationary model – assumes that differencing is required to obtain stationarity wherein the first difference of a time series follows a stationary and invertible ARMA process (Wolters & Hassler, 2005). As such, the level of the time series has unit root in its AR. Hence, unit root processes are also called order of integration denoted by $I(d)$ where d is the order of integration (Gujarati & Porter, 2009).

Note that first differencing is appropriate for $I(1)$ time series and time-trend regression is appropriate for trend stationary $I(0)$ time series (Zivot & Wang, 2006). Moreover, business and economic theories often suggest cointegration – the existence of long-run relationships among non-stationary time series variables (Tsay, 2005). If these variables are $I(1)$, then cointegration techniques can be used to model these long-run relations. Hence, pre-testing for unit roots is deemed to be the first step in cointegration modeling.

However, econometricians are not always following such stationary requirement. For instance, in an n-variable time series model such as a Vector Autoregression (VAR) model, all the n variables must be jointly stationary. If the n variables are non-stationary there is a need to transform the time series data appropriately through differentiation depending on the order of integration. However, according to Harvey (1990) as cited in Gujarati and Porter (2009), the results derived from the transformed data

may be unsatisfactory. Furthermore, Harvey (1990) noted that the usual approach by VAR aficionados is to work in level values even if the series is non-stationary. However, Mulligan (2003) claimed that although the regression can be estimated in first-differences, any long-term information carried by the levels of the variables is lost. Hence, conventional inference is valid even when the structural variables are non-stationary, provided that the residuals are white-noise processes. Adding a sufficient number of lagged difference terms in the disequilibrium adjustment process is always sufficient to guarantee white-noise errors (Mulligan, 2003; Gujarati & Porter, 2009).

In applied research, time series analysis is generally used for forecasting and planning. Thus, unit root tests become expedient as it aids in choosing forecasting models. Difference stationary and trend stationary models of time series often imply very different predictions, so deciding which model to use is tremendously important for applied forecasters (Diebold & Kilian, 2000). The following options can be undertaken: (1) always difference the data, (2) never difference, or (3) use a unit-root pretest. Each option has its respective advantages and disadvantages (Diebold & Kilian, 2000).

METHODS TO DETECT NONSTATIONARITY OF TIME SERIES

This section presents the theoretical features of the ADF and PP culled from Davidson and MacKinnon (1993); Hamilton (1994); and Hayashi (2000). Consider a simple AR(1) process: $y_t = \rho y_{t-1} + x_t'\delta + \varepsilon_t$ **(1)**

where x_t are exogenous regressors which may comprise of constant, or a constant and trend, ρ and δ are parameters to be estimated, and the ε_t is the stochastic disturbance term, assumed to be white noise. If $|\rho| \geq 1$, y is a non-stationary series and the variance of y increases with time and approaches infinity. If $|\rho| < 1$, y is stationary. Thus, the hypothesis of stationarity can be evaluated by testing whether the absolute value of ρ is strictly less than one.

Unit root tests generally test the null hypothesis H_0: $\rho = 1$, which implies that the time series is non-stationary against the one-tailed alternative hypothesis H_1: $\rho < 1$, which implies that the time series is stationary. In some cases, the null hypothesis is tested against a point alternative. For instance, the KPSS test evaluates the null hypothesis of H_0: $\rho < 1$ against the alternative hypothesis of H_1: $\rho = 1$.

AUGMENTED DICKEY-FULLER UNIT ROOT TEST

The standard Dickey-Fuller (DF) test is carried out by estimating Equation 1 after subtracting y_{t-1} from both sides of the equation: $\Delta y_t = \alpha y_{t-1} + x_t'\delta + \varepsilon_t$ (2)

where $\alpha = \rho - 1$. The null hypothesis is stated as $H_0 : \alpha = 0$ and the alternative hypothesis is stated as $H_1 : \alpha < 0$ and evaluated using the conventional t-ratio for α:

$$t_\alpha = \frac{\hat{\alpha}}{se(\hat{\alpha})} \quad (3)$$

where is $\hat{\alpha}$ the estimate of α, and $se(\hat{\alpha})$ is the coefficient standard error. Note that the possibility of $\alpha > 0$ is ruled out because in that case $\rho > 1$, which implies that the underlying time series will be explosive. If the null hypothesis is rejected, it simply shows that y_t is a stationary time series.

Dickey and Fuller (1979), as cited by Bordoloi (2009), showed that under the null hypothesis of a unit root, t_α does not follow the conventional student's *t*-distribution, and they derive asymptotic results and simulate critical values for various test and sample sizes. Moreover, MacKinnon (1996) implemented a larger set of simulations than those by Dickey and Fuller (1979). Additionally, MacKinnon (1993) estimated response surfaces for the simulation results, permitting the calculation of DF critical values and *p*-values for arbitrary sample sizes.

However, as exposited by Emidio (2007), note that the DF test is valid only if the series is an AR(1) process. If the series is correlated at higher order lags, then the assumption of white noise disturbance, ε_t, is violated. Hence, the Augmented Dickey-Fuller (ADF) test constructs a parametric correction for higher order correlation by assuming that the y_t series follows an AR(*p*) process and adding lagged difference terms of the dependent variable y_t to the right hand side of the test regression is yielding:

$$\Delta y_t = \alpha y_{t-1} + x_t' \delta + \beta_1 \Delta y_{t-1} + \beta_2 \Delta y_{t-2} + ... + \beta_p \Delta y_{t-p} + \upsilon_t \quad (4)$$

This augmented specification is then used to test $H_0 : \alpha = 0$ and $H_1 : \alpha < 0$ using the t-ratio shown by Equation 3. An important result generated by the ADF is that the asymptotic distribution of the *t*-ratio for α is independent of the number of lagged first difference included in the ADF regression. Moreover, while the assumption that y_t follows an AR process may seem restrictive, Said and Dickey (1984) demonstrated that the ADF test is asymptotically valid in the presence of an MA component, provided that sufficient lagged difference terms are included in the test regression.

Hamilton (1994) mentioned two practical issues in performing the ADF test. First, there is a need to decide whether to include exogenous variables in the test regression. There is a choice of including a constant, a constant and linear time trend, or neither in the test regression as shown by the succeeding equations:

$\Delta y_t = \delta y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta y_{t-1} + \varepsilon_t$	(5)
$\Delta y_t = \beta_1 + \delta y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta y_{t-1} + \varepsilon_t$	(6)
$\Delta y_t = \beta_1 + \beta_2 t + \delta y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta y_{t-1} + \varepsilon_t$	(7)

where t is the time trend and ε_t is a pure white noise error term and where $\Delta y_{t-1} = (y_{t-1} - y_{t-2})$, $\Delta y_{t-2} = (y_{t-2} - y_{t-3})$, etc. One way is to implement the test with both a constant and a linear time trend. However, including irrelevant regressors in the regression

will reduce the power of the test to reject the null hypothesis of a unit root. The standard recommendation of Hamilton (1994) is to choose a specification that is a plausible description of the data under both the null and alternative hypotheses.

Second, there is a need to specify the number of lagged difference terms of the optimal lag length to be added to the regression. The number of lagged difference terms to include is often determined empirically; the idea is to include enough terms so that the error term in Equations 5 to 7 is serially uncorrelated.

According to Gujarati and Porter (2009), it is extremely important to note that the critical values of the τ test to test the null hypothesis that $\delta = 0$, are different for each of Equations 5 to 7, which can be seen from the 1 percent and 5 percent critical Dickey-Fuller t ($= \tau$) and F values for unit root tests. In addition, suppose Equation 6 is true but Equation 5 was estimated, a specification error is committed whose consequences include under fitting a model wherein a relevant variable was included (Gujarati & Porter, 2009). However, there is really no way of knowing which specification is true to begin with. Hence, some trial and error procedures are inevitable, data mining notwithstanding.

The ADF test suffers from some problems. It has low statistical power to reject a unit root and power is reduced with the addition of the lagged differences (Wang & Tomek, 2004). According to Stewart (2005), too few lags in the ADF regression introduces size distortion so that the actual size may be quite different from the nominal one. Consequently, test decisions are unreliable. On the other hand, too many lags weaken the power of the test so that it has a relatively low probability of rejecting the null of a unit root when it is appropriate to do so. Therefore, a trend stationary variable that is strongly autocorrelated such as an AR(1) process may be easily be mistaken as having a unit root.

Furthermore, the ADF test is also plagued by size distortions that occur when a large firs-order moving average component exists in the time series. Diebold and Rudebusch (1991) showed that the ADF test has low power against the alternative of fractionally integrated series. Likewise, Perron (1991) revealed that when a process that is stationary about a broken trend generates a time series, standard DF tests of an $I(1)$ null hypothesis may have very low power. On the other hand, Leybourne, Mills and Newbold (1998) demonstrated that when a process generates a time series that is $I(1)$, but with an abrupt break, routine application of the DF test could lead to a severe problem of spurious rejection of the null when the break is early in the sample period.

PHILLIPS-PERRON UNIT ROOT TEST

A critical assumption of the DF test is that the error terms u_t are independently and identically distributed. The ADF test adjusts the DF test to take care of the possible serial correlation in the error terms by adding the lagged difference terms of the regressand. On the other hand, Phillips and Perron (1988) used nonparametric statistical methods to take care of the serial correlation in the error term without adding lagged difference terms. Moreover, the asymptotic distribution of the PP test is the same as the ADF test statistic. The intent of the PP test is to improve the finite sample properties of the ADF test (Wang & Tomek, 2004). The test regression for the PP test is the AR(1) process:

$$\Delta Y_t = \alpha + \beta Y_{t-1} + \varepsilon_t \quad (8)$$

while the ADF test corrects for higher order serial correlation by adding lagged differenced terms on the right-hand side, the PP test makes a correction on the t-statistic of the γ coefficient from the AR(1) regression to account for the serial correlation in ε. The correction is nonparametric since an estimate of the spectrum at frequency zero that is robust to heteroscedasticity and autocorrelation of unknown form was used. The Newey-West heteroscedasticity autocorrelation consistent estimates.

$$\omega^2 = \gamma_0 + 2\sum_{v=1}^{q}(1 - \frac{v}{q+1})\gamma_j \quad (9)$$

where

$$\gamma_j = \frac{(\sum_{t=j+1}^{T} \varepsilon_t \varepsilon_{t-j})}{T} \quad (10)$$

and q is the truncation lag. The PP t-statistic is computed as

$$t_{pp} = \frac{\gamma_0^{\frac{1}{2}}}{\omega} - \frac{\omega^2 - \gamma_0 T s_b}{2\omega s} \quad (11)$$

where t_b and s_b are the t-statistic and standard error of β respectively and s is the standard error of the test regression.

The asymptotic distribution of the PP t-statistic is the same as ADF t-statistic and uses the MacKinnon critical values. As with the ADF test, there is a need to specify whether to include a constant, a constant and linear trend, or neither in the test regression. For the PP test, there is also a need to specify the truncation lag q for the Newey-West correction, that is, the number of periods of serial correlation to include. The dialog initially contains the Newey-West automatic truncation lag selection wherein the floor function, denoted by F, returns the largest integer not exceeding the argument.

$$q = F[4(T/100)^{\frac{2}{9}}] \quad (12)$$

The strengths of the PP test include the following. First, the PP test can be seen as an alternative to the ADF test. It responds to the ADFs assumption that errors are statistically independent and have a constant variance by generalizing the ADF test itself. This is also due to the fact that it requires little attention to be paid to the assumptions of the error terms (Ang, 2008). Second, the PP test is a more comprehensive theory of unit root non-stationarity. It is similar to the ADF tests but incorporates an automatic correction to the DF procedure, which is a feature, which accommodates autocorrelated residuals. However, it must be noted that the PP test often produces similar results and suffers from the same notable limitations of ADF tests (Brooks, 2008). Although the ADF and PP tests suffer from a variety of limitations, they still provide significant and crucial information on the nature of the persistence of the time series under investigation (Garratt, 2006).

On the other hand, the weaknesses of the PP test include the following:

- Perron (1988) claimed that the ADF as well as the PP tests perform poorly when there is a break in the deterministic trend function. Zivot and Andrews (1992), as cited in Halkos and Kevork (2005), devised methods to endogenously search for a break point and testing for a unit root when the process has a broken trend.
- According to Halkos and Kevork (2005), the PP test has a very low power against slow mean reversion alternatives in relatively small samples implying that failure to reject the null hypothesis may not be considered as strong evidence against mean reversion.
- According to Breitung and Gourieroux (1997), the PP test has been observed to be extremely biased if the errors generated by an MA process have a root close to one. Specifically, the tests proposed by Phillips and Perron (1988) do not come close to their asymptotic distribution for samples as large as 10,000 observations (Schwert, 2002).
- According to Kim and Maddala (1998), the PP test suffers from size distortions when the MA parameter is large, a deficiency common in most time series. Monte Carlo experiments revealed that the PP test suffers from serious size distortions with plausibly correlated AR or MA error structures. It was also argued that the PP test has very low power, less the 0.10, against trend-stationary alternatives. In fact, the ADF is likely to be more useful in actual practice (Kim & Maddala, 1998).
- According to Brooks (2008), one of the most criticized characteristics of the PP test is its low power for processes that are stationary but with a root close to the non-stationary boundary.

METHODOLOGY

The Monte Carlo Simulation

To determine which conditions unit root tests will be able to detect nonstationary and identify the most appropriate order of integration, there is a need to generate a purely stationary time series free from any contamination. The generation of a clean time series will be done by performing the Monte Carlo simulation experiment – a simulation method that makes use of pseudo-random draws from an error distribution and performs multiple replications over a set of known parameters. This is relevant in situation where the only analytical finding involve asymptotic, large-sample results (Baum, 2007).

According to Baum (2007), although the Monte Carlo simulation experiment does not generalize to cases beyond those performed in the experiment, this is still useful in modeling quantities for which no analytical results have yet been derived. In the absence of closed-form expression for the sampling distributions of the statistics, the critical values for many unit-root test statistics have been derived by simulation experiments.

The Monte Carlo simulation does not rely on the assumptions underlying any econometric model. Under the Monte Carlo simulation, The DGP can be altered to allow for different misspecification types. For instance, to simulate the effect of autocorrelated errors on inference procedures, an error term can be simulated as:

$\varepsilon_t = \beta_1 \varepsilon_{t-1} + u_t$	(23)

Having done this, the normal regression coefficients $\hat{\alpha}_0$ and $\hat{\alpha}_1$ for a DGP such $Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \varepsilon_t$ where $\varepsilon \sim N(0, \sigma^2)$, or any other statistic related to the model, can generate the distribution, and learn whether the existence of autocorrelated errors is particularly detrimental to statistical inference. The same thing can be done for heteroscedasticity, non-normality, wrong functional form, and combinations of all of these. Note that this study will only focus on a particular misspecification or contamination procedure since this would allow better comprehension of a particular misspecification as it will be isolated.

Thus, culling from Reade (2008), Monte Carlo experiment is advantageous because it allows analysis of:

- the types of econometric models that could have generated the observed data;
- bias and efficiency outcomes from estimating our regression coefficients in different settings;
- test outcomes from all the different types of tests we have considered; and
- effects of failures of particular assumptions of an econometric model.

The Monte Carlo simulation approach also assumes awareness of the appropriate model for estimation. Although this is a strong assumption, it is not necessary because nothing stops an econometrician from estimating a wrongly specified model and act as if the true model unknown.

Structure Of The Monte Carlo Simulation

To test for the power of the ADF and PP unit root tests given various circumstances and contamination procedures, an algorithm or program that will perform the Monte Carlo experiment will be done. Generally, the initial program will include the following procedures:

- set a finite sample of 50 observations with 1,000 replications;
- simulate an error term with mean 0 and standard deviation 1;
- utilize an initial arbitrary stationary AR(1) DGP;

Stationary AR(1) Process	$Y_t = 0.7Y_{t-1} + \varepsilon_t$	(24)
Stationary AR(1) Process with Mean Parameter	$Y_t = 1 + 0.7Y_{t-1} + \varepsilon_t$	(25)
AR(1) Process with Trend	$Y_t = 1 + 0.1t + 0.7Y_{t-1} + \varepsilon_t$	(26)
Random Walk	$Y_t = Y_{t-1} + \varepsilon_t$	(27)
Random Walk with Drift	$Y_t = 0.1 + Y_{t-1} + \varepsilon_t$	(28)
Random Walk with Drift along a Deterministic Trend	$Y_t = 0.1 + 0.01t + Y_{t-1} + \varepsilon_t$	(29)

- implement the DF and PP tests;
- retrieve the probability values of both tests under the 5 percent and 1 percent significance level;
- count the number of rejection of the null hypothesis for both significance level, which will represent the power of the test to reject the null hypothesis of non-stationarity for both ADF and PP.

Contamination Procedures

The Monte Carlo simulation will begin testing the power of the ADF and PP under a stationary AR(1) process, where all succeeding results will be benchmarked. The contamination procedures that will be included in this study are the following:

- modifying time frequency from 50 to 60, 70, 80, 90 and 100
- expressing time series in elasticities or natural logarithm
- modifying the distribution of the stochastic disturbance term

RESULTS AND DISCUSSION

This section presents the results of the Monte Carlo simulations in scrutinizing the capacity of unit root tests in detecting non-stationary time series. Note that Equation 24 to Equation 29 will be used as the basis of the contamination process.

The figures that can be seen in the succeeding tables represent the rejection rate of the ADF and PP to reject the null hypothesis of nonstationarity under different cases and under the 1 percent and 5 percent significance level. The figures were computed by dividing the number of probability values less than or equal to 0.01 and 0.05 respectively with the total number of replications. Note that probability values less than or equal to 0.01 or 0.05 imply statistical significance thus, possessing the evidence to reject the null hypothesis.

Modifying Time Frequency

To scrutinize the power of the ADF and PP unit root tests given different number of time periods, the same specification for the DGP from Equation 24 to Equation 29 will be used. Results in Table 5.1 show that as the number of observations increases, the efficiency of the ADF and PP tests in detecting whether a series is stationary or non-stationary increases.

Expressing Time Series in Elasticities

To scrutinize the power of the ADF and PP unit root tests given a monotonic linear transformation across different number of time periods, the same specification for the DGP in Equation 24 to Equation 29 will be used. Results in Table 5.2 show that when a time series is expressed in natural logarithms or elasticities, the efficiency of the ADF and PP unit root tests in detecting whether a stationary AR(1), stationary AR(1) with mean parameter, and AR(1) with trend increases with the increase in the number of observations. Peculiarities arise when a series is random walk, random walk with drift, and random walk with drift along a deterministic trend. The ADF and PP tests reject the null hypothesis of nonstationarity in these cases and the rejection rate increases as the number of observations increases.

Table 5.1
REJECTION RATE FOR DIFFERENT NUMBER OF TIME PERIODS

Number of Observations	Significance Level	Stationary AR(1) Process		Stationary AR(1) with Mean Parameter		AR(1) with Trend		Random Walk		Random Walk with Drift		Random Walk with Drift Along a Deterministic Trend	
Unit Root Test		ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP	ADF	PP
50	1%	0.343	0.347	0.494	0.512	0.402	0.399	0.013	0.017	0.012	0.010	0.001	0.001

	5%	0.686	0.732	0.822	0.831	0.726	0.715	0.064	0.067	0.045	0.050	0.002	0.003
60	**1%**	0.489	0.510	0.647	0.657	0.477	0.472	0.014	0.015	0.009	0.013	0.000	0.000
	5%	0.810	0.829	0.916	0.914	0.807	0.788	0.051	0.057	0.052	0.055	0.001	0.001
70	**1%**	0.648	0.668	0.771	0.779	0.562	0.539	0.021	0.021	0.010	0.012	0.000	0.000
	5%	0.914	0.931	0.970	0.978	0.866	0.834	0.063	0.069	0.048	0.051	0.000	0.000
80	**1%**	0.774	0.786	0.865	0.872	0.605	0.569	0.014	0.013	0.007	0.010	0.000	0.000
	5%	0.964	0.969	0.986	0.990	0.907	0.868	0.061	0.067	0.045	0.049	0.000	0.000
90	**1%**	0.867	0.887	0.939	0.940	0.639	0.587	0.018	0.017	0.007	0.009	0.000	0.000
	5%	0.987	0.989	0.999	0.998	0.927	0.900	0.060	0.060	0.044	0.051	0.000	0.000
100	**1%**	0.939	0.941	0.973	0.974	0.704	0.646	0.012	0.014	0.008	0.011	0.000	0.000
	5%	0.998	0.999	1.000	1.000	0.948	0.917	0.050	0.053	0.036	0.040	0.000	0.000

Table 5.2
REJECTION RATE FOR TIME SERIES EXPRESSED IN ELASTICITY

Number of Observations	**Significance Level**	**Stationary AR(1) Process**		**Stationary AR(1) with Mean Parameter**		**AR(1) with Trend**		**Random Walk**		**Random Walk with Drift**		**Random Walk with Drift Along a Deterministic Trend**	
Unit Root Test		**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**	**ADF**	**PP**
50	**1%**	0.423	0.425	0.710	0.715	0.650	0.643	0.271	0.276	0.362	0.373	0.347	0.381
	5%	0.584	0.589	0.876	0.880	0.847	0.835	0.377	0.391	0.459	0.466	0.456	0.479
60	**1%**	0.512	0.512	0.816	0.821	0.748	0.725	0.299	0.304	0.380	0.393	0.369	0.397
	5%	0.662	0.666	0.924	0.925	0.926	0.907	0.418	0.426	0.502	0.506	0.469	0.486
70	**1%**	0.575	0.582	0.902	0.900	0.825	0.785	0.322	0.332	0.387	0.393	0.387	0.418
	5%	0.719	0.716	0.959	0.962	0.952	0.935	0.443	0.447	0.517	0.511	0.483	0.511
80	**1%**	0.638	0.640	0.921	0.925	0.849	0.821	0.333	0.335	0.423	0.427	0.413	0.451
	5%	0.777	0.781	0.967	0.968	0.960	0.946	0.447	0.444	0.557	0.549	0.520	0.550
90	**1%**	0.709	0.715	0.937	0.941	0.886	0.852	0.336	0.344	0.433	0.441	0.447	0.476
	5%	0.820	0.827	0.972	0.973	0.975	0.966	0.464	0.467	0.565	0.563	0.545	0.579
100	**1%**	0.754	0.762	0.949	0.951	0.910	0.876	0.370	0.369	0.471	0.472	0.478	0.506
	5%	0.848	0.859	0.975	0.973	0.984	0.974	0.483	0.482	0.598	0.589	0.587	0.609

MODIFYING THE MEAN AND VARIANCE OF THE STOCHASTIC DISTURBANCE TERM

To scrutinize the power of the ADF and PP unit root tests given different combinatory values of mean and variance for the stochastic disturbance term ranging from 0 to 3 for 50 time periods, the same specification for the DGP in Equation 24 to Equation 29 is used. Results in Table 5.3 imply the following. First, as long as the DGP is in the family of stationary AR(1), stationary AR(1) with mean parameter, and AR(1) with trend, the ADF and PP tests will have a considerable rejection rate for the null hypothesis of nonstationarity regardless of the mean and variance of the stochastic disturbance term. Second, as long as the DGP is in the family of random walk, random walk with drift, and random walk with drift along a deterministic trend, the ADF and PP tests will also have a considerable acceptance rate for the null hypothesis of nonstationarity regardless of the value of the mean and variance of the disturbance term.

Also, the ADF test is more efficient in detecting that a random walk, random walk with drift, and random walk with drift along a deterministic trend is non-stationary while the PP test is more efficient in detecting stationarity among the family AR(1) DGPs.

Table 5.3
REJECTION RATE FOR DGPs WITH DIFFERENT MEANS AND VARIANCE OF THE STOCHASTIC DISTURBANCE TERM

(Mean, Variance)	**Significance Level**	**Stationary AR(1) Process**	**Stationary AR(1) with Mean Parameter**	**AR(1) with Trend**	**Random Walk**	**Random Walk with Drift**	**Random Walk with Drift Along a Deterministic**

												Trend	
Unit Root Test		DF	PP	DF	PP	DF	PP	DF	PP	DF	PP	DF	PP
(0,1)	1%	0.343	0.347	0.494	0.512	0.402	0.399	0.013	0.017	0.012	0.010	0.001	0.001
	5%	0.686	0.732	0.822	0.831	0.726	0.715	0.064	0.067	0.045	0.050	0.002	0.003
(1,1)	1%	0.494	0.512	0.867	0.871	0.794	0.808	0.000	0.003	0.000	0.005	0.000	0.000
	5%	0.822	0.831	0.976	0.981	0.962	0.962	0.004	0.012	0.004	0.013	0.000	0.001
(2,1)	1%	0.867	0.871	0.996	0.998	0.990	0.993	0.000	0.001	0.000	0.001	0.000	0.000
	5%	0.976	0.981	1.000	1.000	1.000	1.000	0.003	0.008	0.003	0.008	0.000	0.001
(3,1)	1%	0.996	0.998	1.000	1.000	1.000	1.000	0.000	0.001	0.000	0.001	0.000	0.000
	5%	1.000	1.000	1.000	1.000	1.000	1.000	0.003	0.008	0.003	0.008	0.000	0.001
(0,2)	1%	0.302	0.347	0.376	0.394	0.358	0.371	0.013	0.017	0.012	0.013	0.004	0.006
	5%	0.637	0.732	0.737	0.753	0.688	0.693	0.064	0.067	0.058	0.064	0.023	0.029
(1,2)	1%	0.376	0.394	0.494	0.512	0.468	0.464	0.001	0.004	0.000	0.004	0.000	0.000
	5%	0.737	0.753	0.822	0.831	0.803	0.789	0.013	0.025	0.010	0.018	0.000	0.003
(2,2)	1%	0.494	0.512	0.686	0.871	0.641	0.646	0.000	0.003	0.000	0.003	0.000	0.001
	5%	0.822	0.831	0.926	0.981	0.905	0.906	0.004	0.012	0.004	0.012	0.000	0.001
(3,2)	1%	0.686	0.693	0.867	0.871	0.851	0.854	0.000	0.001	0.000	0.005	0.000	0.001
	5%	0.926	0.924	0.976	0.981	0.971	0.975	0.003	0.010	0.003	0.010	0.000	0.001
(0,3)	1%	0.343	0.347	0.354	0.376	0.349	0.363	0.013	0.017	0.014	0.015	0.006	0.009
	5%	0.686	0.732	0.709	0.738	0.691	0.703	0.064	0.067	0.058	0.061	0.039	0.047
(1,3)	1%	0.354	0.376	0.401	0.418	0.398	0.408	0.007	0.009	0.004	0.008	0.000	0.002
	5%	0.709	0.738	0.760	0.771	0.741	0.738	0.022	0.027	0.021	0.027	0.006	0.010
(2,3)	1%	0.401	0.418	0.494	0.512	0.480	0.483	0.000	0.004	0.000	0.003	0.000	0.001
	5%	0.760	0.771	0.822	0.831	0.824	0.806	0.007	0.015	0.007	0.015	0.002	0.004
(3,3)	1%	0.494	0.512	0.618	0.871	0.603	0.601	0.000	0.003	0.000	0.003	0.000	0.001
	5%	0.822	0.831	0.895	0.981	0.883	0.878	0.004	0.012	0.004	0.012	0.001	0.004

CONCLUSIONS

I accentuated on the mandatory initial step in time-series analysis – testing for the existence of unit roots in time series variables using the widely used tests – the ADF and PP. I have also laid importance on its crucial role in doing applied research in business and economics. The increasing sophistication of the tools of time series analysis would be rendered ineffectual if the time series data used are plagued with unit root.

I have also underscored that using non-stationary time series data in business and economic models produces spurious results that leads to poor analysis and forecasting. Decisions are no better than the data on which they are based. Other than relevance and completeness of data, its reliability also supports organizational efficiency and is a foundation of sound decision-making. Insisting on using inappropriate data for time series analysis would just lead to bad and/or delayed decisions. Nonstationarity issues now becomes a confidence issue – if a researcher is not confident with the data, what more with the results – a waste of organizational resources.

Assuming data gathered is relevant and complete, a groundwork empirical solution to the problem is to stationarize or de-trend the time series data. If the non-stationary process is a random walk with or without drift, it is stationarized through differencing. If it exhibits a deterministic trend, de-trending is required. If it demonstrates both stochastic and deterministic trends, differencing and de-trending are obligatory. According to Iordanova (2007), "differencing will remove the trend in the variance and de-trending will remove the deterministic trend."

To establish a set of operational principles in model specification based on unit root testing procedures, I was able to empirically verify that generally, the ADF and PP tests perform relatively at par with each other. However, it must be underscored that the ADF test is more efficient in detecting that a random walk, random walk with drift, and random walk with drift along a deterministic trend is non-stationary while the PP test is more efficient in

detecting stationarity among the family AR(1) DGPs. It is also important to note that the ADF and PP tests may not agree whether a time series is stationary or not. Hence, the properties of the DGP as well as the descriptive statistics of a time series must be taken into account in deciding which unit root test to perform and which unit root test must prevail in case counter results exists.

Given the design of this study, I was able to capture only a number of statistical properties that a typical time series dataset can possess; and perform limited number contamination procedures that will reveal how the ADF and PP tests behave under different conditions. Thus, it is still necessary to explore deeper statistical properties and perform more contamination procedures to fully establish a comprehensive set of guidelines in using the various unit root-testing procedures available.

Unit root testing must be taken critically in business and economic research. The accurate detection of nonstationarity will have an impact on how to select the best DGP among the family of time series models for the purposes of accurate forecasting, planning, vulnerability, volatility, and other time series analyses. Compliance with this procedure will enable decision-makers and policymakers relying on empirical research develop sound decisions and policies based on rigorous econometric techniques and procedures.

ENDNOTES

[1] This study was culled from the author's seminar paper for Master of Science in Economics entitled *Scrutinizing the capacity of unit root tests in detecting nonstationary time series*, under the supervision of Dr. Lawrence B. Dacuycuy. This study was also presented the *8th International Conference on Business, Economics, and Information Technology* conference held last 23-24 March 2015 at the Westin Resort Guam, Guam, United States. **For replication purposes:** the program and codes to implement the Monte Carlo simulation is available upon request. **Disclaimer:** (1) The findings, interpretations, and conclusions expressed in this work do not reflect the views of the author's institutional affiliation, its Board of Executive Directors, or the institutions he represents. (2) Likewise, the author's institutional afffiliations make no representation concerning the views in this feature and do not assume any legal liability, responsibility nor guarantee the source, originality, accuracy, completeness, or reliability of any statement, information, data, finding, interpretation, advice, opinion, or view presented. (3) Other usual disclaimers apply.

[2] The main reference for this section is the EViews 3.1 User's Guide (3rd Edition). Copyright © 1994-1999 Quantitative Micro Software, LLC. Retrieved from http://www.personal.ceu.hu/staff/Gabor_Kezdi/Econometrics-1/EViewsUG.pdf?

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IS THE FED PRINTING MONEY?

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ABSTRACT

This article uses monthly production data from the U.S. Bureau of Engraving and Printing (BEP) in conjunction with published data from the Federal Reserve System to affirm that the United States is clearly not on the path to a "cashless society." In addition, BEP data are used to track the production of currency from its origins - in Fort Worth and Washington - to the various Federal Reserve Districts to which the currency was issued. The data show that the increase in the production and distribution of new $100 notes is responsible for the majority of the increase in the value of currency in circulation from 2002 to 2012. Much of this increase was channeled through the Federal Reserve Bank of New York - with ultimate destinations outside of the district and, in many cases, outside the United States. Estimates of the per capita value of currency distributed to each of the 12 Federal Districts as of December 2012 range from $2,228 (Philadelphia) to $21,062 (New York). The per capita currency values far exceed the estimates of average cash holdings found by the annual Survey of Consumer Payment Choice (SCPC) conducted by researchers from the Federal Reserve Bank of Boston for 2008, 2009 and 2010. The degree of uncertainty regarding the percentage of currency held by U.S. residents in the underground economy and the percentage held by residents in foreign currency lend support to those who recommend that policymakers consider excluding U.S. currency from the M1 and M2 definitions of the money supply.

INTRODUCTION

Although M1 and M2 definitions of the money supply include paper money and coins "in the public's hands" (excluding amounts held by banks and the government), a greater percentage of the money supply of the United States is in the form of demand deposits and other checkable deposits at banks, which the Federal Reserve System (Fed) controls through open market operations. Many non-economists assume that changes in the supply of money are the result of printing currency. This misunderstanding is reinforced by frequent references to the Fed "printing money" in newspaper and magazine articles. The title of this paper is taken from one such reference published in *The Wall Street Journal* (Hilsenrath, 2010). Two other examples are Tanous (2013) and Wessel (2013). In his article Wessel wrote: "The Federal Reserve...has printed money - more than $2 trillion - and pumped that into the economy." The authors of such articles refer to the Fed printing money knowing that the phrase should not be taken literally. Time and space are needed to explain the intricacies of monetary policy to those who do not understand them whenever the Fed's actions make headlines. For many readers such explanations are unnecessary. Therefore, figurative references are made to printing money assuming that readers know the truth; but many non-experts do not.

Currency is printed at two locations operated by the Bureau of Engraving and Printing (BEP): Washington, D.C. and Fort Worth, Texas. The BEP is part of the U.S. Department of the

Treasury, not the Fed. In Section 16 of the Federal Reserve Act of 1913 the United States Congress ceded to the Fed the legal authority to issue currency:

> *Any Federal Reserve bank may make application to the local Federal Reserve agent for such amount of the Federal Reserve notes...as it may require…The Federal Reserve agent shall each day notify the Board of Governors of the Federal Reserve System of all issues and withdrawals of Federal Reserve notes to and by the Federal Reserve bank to which he is credited.* (Federal Reserve Act)

Each year, the Fed's Board of Governors submits an order for new currency to the BEP. The print order is "...based on historical payments to and receipts from circulation, destruction rates, and also to build inventories of new-design notes before issuance...most of the notes…replace unfit currency that Reserve Banks receive from circulation." (Federal Reserve Note Print Order, 2014). The currency order is submitted to the BEP approximately 60 days prior to the beginning of the BEP's fiscal year (October 1st).

This article uses data from the BEP to describe the amount and value of U.S. currency printed from 2003 to 2012. Estimates of "currency in circulation" using these data are similar to measures published by the Fed. Because the BEP identifies the origin of the printed currency (Washington or Fort Worth) and the Federal Reserve District to which it is distributed, BEP data can be used to estimate the value of currency - total and per capita - placed into circulation in each District. These amounts far exceed estimates of the amount of currency held by consumers as reported by the Federal Reserve Bank of Boston's Survey of Consumer Payment Choice (SCPC).

THE LEGAL AUTHORITY TO PRINT MONEY

Section 8 of the United States Constitution empowers "The Congress... [to] borrow money on the credit of the United States...To coin money, regulate the value thereof..." and "To provide for the punishment of counterfeiting the securities and current coin of the United States." (Constitution) The Federal Reserve Act of 1913 created a Board of Governors and twelve regional Reserve Banks to "...provide the nation with a safer, more flexible, and more stable monetary and financial system…" (*Purposes and Functions*, 1)

THE MISSING CURRENCY MYSTERY

Consumers have a variety of payment choices - including debit cards, prepaid cards and online banking payments - that reduce the need for currency to conduct transactions. These alternatives have led some analysts to predict an imminent "cashless society" which would have little need for paper money. But measures of the U.S. money supply in recent years belie predictions of currency's demise. An estimate of the amount of currency in circulation in 1996 - $375 billion or $1,400 for every living American (Carlson and Keen, 1996, p. 1) - is dwarfed by a more recent estimate - over $1.1 trillion - in late summer of 2013, or about $3,500 per person. (Williams 2013, p. 6) However, the annual Survey of Consumer Payment Choice (SCPC) conducted by researchers from the Federal Reserve Bank of Boston found that mean cash holdings by survey respondents were less than $500 in 2008, 2009 and 2010. (Foster, et. al. 2013, T-9). The 2012 SCPC had "2,012 respondents whose responses were weighted to represent all U.S. consumers 18 years of age and older." (Foster, et. al, p. 4)

Because the U.S. dollar is formally accepted as a medium of exchange in a number of other countries and territories – including East Timor, Ecuador, El Salvador and Zimbabwe – and is widely used in informal and black markets in other countries, many economists believe that the majority of currency printed is used outside of the United States. Studies have shown that per capita currency holdings for countries with currencies that are not used as extensively in foreign countries are similar to those of the U.S. Sprenkle (1993, p. 177) noted that per capita currency holdings for the U.S. were only 10th highest among 22 industrialized countries. Feige (2012, p. 2) cited 2010 data that show per capita currency holdings in Europe, Hong Kong, Switzerland and Japan were higher than those in the U.S. And estimates of the amount of foreign holdings of U.S. currency vary. Porter and Judson (1996, p. 894), Judson (2012, p. 26) and Anderson and Williams (2007, p. 1) all report estimates well above 50 percent, though these rates have varied over time. Sprenkle (1993, p. 183) estimated foreign holdings of U.S. currency at 83 percent in 1993, but Feige (2012, 22) estimates that less than 25 percent of U.S. currency is held overseas.

Because individual shipments of cash to foreign countries in amounts less than $10,000 do not have to be reported to United States Customs a precise count of cash flows beyond U.S. borders, and how much remains in the U.S., is not possible. An additional explanation for "missing currency" in the United States is that unrecorded amounts are used to conduct transactions in the domestic underground economy. These include illegal, unreported, unrecorded and informal transactions not included in National Income and Product Accounts. (Feige, 1996 and 2012)

WHY PEOPLE USE CASH

There are two primary reasons why people continue to use currency. The first has to do with the role of currency as a medium of exchange – a means of obtaining the goods and services people want. Currency:

> *is easy to carry, it's widely accepted, and it's easy to divide for transactions of different sizes…you can count on cash even when other payment methods might not be working, during power outages and natural disasters…And cash has another advantage…It's anonymous. Using cash keeps transactions away from the eyes of tax collectors, law enforcement agencies, and businesses that track the buying habits of individual Americans.* (Williams, 2012, p. 3)

The second reason to hold currency is related to its use as a store of value. Holding cash, rather than real assets or financial assets, is costly since cash earns no interest and its value decreases with the rate of inflation. And holding cash carries a risk of loss due to theft. But in times of financial uncertainty and low interest rates the opportunity cost of holding cash is relatively low and the threat of loss from war or political uncertainty enhances the value of currency as an asset that can be moved safely and quickly. SCPC surveys have found that, compared to other payment instruments, consumers gave their highest ratings to cash in terms of cost, security and convenience. (Foster, et.al., 2011, p. 3)

PRINTING AND DISTRIBUTION OF U.S. CURRENCY: 2002-2012

The Fed publishes estimates of currency in circulation (Currency and Coin Services). These estimates include paper and coin held by the public and in the vaults of depository

institutions. This differs from the definition the Fed uses to measure the currency component of the U.S. money supply, which excludes currency held in vaults of depository institutions.

Table 1 summarizes the value of currency in circulation reported by the Fed in December of each year from 2002 through 2012. Over this period there was a 72.2 percent increase in currency in circulation.

Table 1
CURRENCY IN CIRCULATION (FED)
2002-2012 ($ BILLION)

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Percent of 2002 Total	Percent of 2012 Total
$1	8.0	8.2	8.3	8.8	9.0	9.3	9.5	9.6	9.7	10.0	10.3	1.2	0.9
$2	1.3	1.3	1.4	1.5	1.5	1.6	1.7	1.7	1.8	1.8	2.0	0.2	0.2
$5	9.4	9.7	9.8	10.3	10.5	10.8	11.0	11.2	11.5	11.8	12.2	1.4	1.1
$10	14.9	15.1	15.1	15.5	16.0	16.2	16.3	16.2	16.6	17.2	17.7	2.3	1.6
$20	103.7	107.8	107.6	115.4	119.2	121.8	125.1	127.5	130.6	141.1	148.9	15.8	13.2
$50	58.5	59.9	60.5	62.1	62.8	63.0	64.7	65.3	66.9	69.5	72.5	8.9	6.4
$100	458.7	487.8	516.7	545.0	564.1	569.3	625.0	656.4	704.6	782.6	863.1	70.1	76.5
Total	654.5	689.8	719.4	758.6	783.1	792.0	853.3	887.9	941.7	1,034.0	1,126.7	100.0	100.0

Currency in circulation includes paper currency held by the public and in the vaults of depository institutions. Currency in circulation differs from the currency component of the money stock, which excludes currency held in vaults of depository institutions.
Source: Federal Reserve System, http://www.federalreserve.gov/paymentsystem/coin_currcirvolume.htm.

The data in Table 1 are posted by the Fed for all denominations and are available monthly but are not broken down by the Federal Reserve District to which new bills are shipped or by the BEP facility - Washington or Fort Worth - where the notes are printed. The BEP posts monthly figures for all U.S. currency printed and distributed from fiscal 2003 (October 2002 through September 2003) on its website. (U.S. Currency) Serial numbers identify each of the Federal Reserve Banks to which currency has been distributed. One can determine, for example, the number of $100 notes printed at the Washington or Fort Worth BEP facility in August 2007 for distribution through the Cleveland or St. Louis District Banks. This article uses BEP data - converted to a calendar basis to make them consistent with the Fed's data - to measure the amount and value of currency in circulation by:

- First, starting with the Fed's value of currency in circulation from the prior December; subtracting from this value an estimate of currency removed from circulation in a given year using the estimated average lives of each note. The Federal Reserve Bank of New York (Currency Processing and Destruction) reports that the lives of notes are: $1 - 5.9 years; $5 - 4.9 years; $10 - 4.2 years; $20 - 7.7 years; $50 - 3.7 years; and (How Currency Gets into Circulation), also from the New York Fed, states that the average life of a $100 note is 15 years.
- Second, estimating the amount of currency removed from circulation in a given year by multiplying the amount in circulation published by the Fed for December of the prior year by 1/years (for $1 bills: 1/5.9, etc.)
- Third, adding the number of notes printed and distributed through the following calendar year.

The estimates made for currency in circulation using BEP data are similar to the corresponding Federal Reserve data. Table 2 summarizes the distribution of new currency denominations from 2003 to 2012 by BEP facility. Although neither the Washington (East) nor

Fort Worth (West) facility was the sole provider of any denomination, there is evidence of a division of labor. For example, nearly all $2 and $5 notes were printed in Fort Worth and over 80 percent of $100 notes were printed in Washington. Currency totals for individual District destinations, not included in this article, show predictable geographic patterns. For example, the Washington facility prints more currency for the New York and Richmond Districts than for the Dallas or San Francisco Districts.

Table 2
QUANTITY AND VALUE OF U.S. CURRENCY PRINTED
FISCAL YEARS 2003-2012 (BILLIONS)

	East	West	Total (East + West)	Percent of Total	Percent of Total
Denomination	**Quantity (Value)**	**Quantity (Value)**	**Quantity (Value)**	**East**	**West**
$1	11.3 ($11.3)	22.0 ($22.0)	33.3 ($33.3)	33.9	66.1
$2	0.0	0.5 ($1.0)	0.5 ($0.9)	0.2	99.8
$5	0.2 ($1.0)	7.0 ($35.0)	7.2 ($36.0)	3.0	97.0
$10	0.7 ($7.0)	4.1 ($41.0)	4.8 ($48.0)	15.3	84.7
$20	10.1 ($202.0)	7.7 ($154.0)	17.8 ($356.0)	56.7	43.3
$50	0.2 ($10.0)	1.7 ($85.0)	1.9 ($95.0)	11.6	88.4
$100	10.5 ($1,050.0)	2.5 ($250.0)	13.0 ($1,300.0)	80.6	19.2
Total	33.0 ($1,281.3)	45.5 ($588.0)	78.5 ($1,869.3)	42.2	57.5

East refers to the BEP facility located in Washington, D.C. West refers to the BEP facility located in Fort Worth, Texas.
Source: Monthly Production Reports. Bureau of Engraving and Printing (BEP). U.S. Department of the Treasury.

Additional insight from the BEP data can be found by stating BEP currency estimates on a per capita basis. Table 3 lists these estimates for each Federal Reserve District for calendar year 2012. The following procedures were used to derive these estimates.

- First, Federal Reserve data were used to represent the value of currency in circulation for December 2012. The fraction of currency in circulation of each denomination for each Federal Reserve District was estimated by averaging BEP data for 2003 to 2012. For example, the fraction of all $10 bills issued by the Kansas City Fed of $10 notes issued by all Fed Districts between 2003 to 2012, was assumed to be the same as the fraction of all $10 notes issued by the Kansas City District in circulation in December 2012.
- Second, the fraction of currency for all denominations for each district was multiplied by the Fed's estimates of currency in circulation for December 2012.
- Third, the fraction of the U.S. population served by each district was taken from a publication of the San Francisco Fed. (Dr. Econ, 2001) This fraction was multiplied by the total civilian non-institutionalized population, 18 years and over, of the United States in 2012 - 234.7 million (U.S. Census Bureau) - to obtain an estimate of the population served by each Federal Reserve District.
- Fourth, the dollar values of currency in circulation for all denominations of notes for each District were added and divided by the estimated population of each Federal Reserve District.

Table 3
ESTIMATES OF CURRENCY PER CAPITA
BY FEDERAL RESERVE DISTRICT

District	Letter	Fraction of Population	Population per District (millions)[a]	Value of Currency Per capita - 2012
Boston	A	.05	15.9	$3,287
New York	B	.07	22.2	21,062
Philadelphia	C	.08	25.4	2,228
Cleveland	D	.04	12.7	5,071
Richmond	E	.10	31.7	3,643
Atlanta	F	.15	47.6	4,227
Chicago	G	.13	41.2	2,740
St. Louis	H	.04	12.7	3,880
Minneapolis	I	.03	9.5	2,587
Kansas City	J	.04	12.7	3,669
Dallas	K	.08	25.4	4,902
San Francisco	L	.19	60.2	3,450

[a]U.S. civilian non-institutionalized population 18 years and over December 2012 = 234.7 million.
Sources: U.S. Census Bureau; Dr. Econ; Monthly Production Reports. Bureau of Engraving and Printing (BEP). U.S. Department of the Treasury.

The per capita currency value for the New York district, $21,062, is much higher than that for any other District, a difference that reflects, in part, the foreign demand for U.S. currency:

> *...the Federal Reserve Cash Office serving the New York City region is the primary supplier of currency to foreign users, especially of $100s...its shipments of $100s are large relative to the size of the District...This Cash Office has accounted for 97 percent of the nationwide net issuance of $100s [between 1988 and 1995]...the basic information we have from surveys and the Federal Reserve Cash Offices about the circulation of $100 notes is consistent with relatively low dollar use domestically and high use abroad. (Porter and Judson,* 1996, pp. 887-888)

Districts other than New York supply currency to foreign countries. The staff of the Federal Reserve Board has identified four Federal Reserve Districts - New York, Atlanta, Dallas and San Francisco - that have historically issued relatively large numbers of $100 notes and shipped many of them to foreign countries. (Porter, p. 14; Porter and Judson, p. 892). The estimated mean per capita value of currency for these four Districts in 2012 was $6,441. The estimated mean per capita currency value for the other eight Fed Districts was $3,226. If one were to assume that: (a) the New York, Atlanta, Dallas and San Francisco Districts were the only sources for currency that was shipped overseas, and (b) the average domestic per capita currency values in all twelve districts equaled $3,226, then 32.8 percent of U.S. currency outstanding in December 2012 would be found in foreign countries.

Currency from Districts other than New York, Atlanta, Dallas and San Francisco ends up overseas, and the SCPC surveys indicate that the average 18 year old holds much less than $3,226 in cash. If, for example, the average currency holding by the civilian non-institutionalized population 18 years and over in 2012 equaled the average cash holding ($340) estimated by the SCPC in 2010, total cash holdings would equal only 7.1 percent of total value of outstanding currency, leaving nearly 93 percent of currency held in foreign countries or in the underground economy. As noted previously, estimates of the percentage of U.S. currency held overseas vary widely, from as low as 25 to over 80 percent. The degree of uncertainty regarding the percentage of currency held by U.S. residents in the underground economy and the percentage held by residents in foreign currency lend support to those who recommend that policymakers consider excluding U.S. currency from the M1 and M2 definitions of the money supply. For example, Sprenkle (1993, p.183) made this recommendation and cited other economists who made the same suggestion.

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STUDENT SATISFACTION AND LEARNING USING APLIA IN PRINCIPLES OF MICROECONOMICS

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ABSTRACT

Students learning outcomes and student satisfaction are popular topics for pedagogical research, especially regarding online learning. This paper examines student performance after the introduction of Aplia as a homework management tool. Data on student performance and sentiment regarding Aplia was gathered from principles of microeconomics. A survey regarding Aplia was administered to students, and the results were correlated to student performance. Overall, student sentiment regarding Aplia was high, and results suggest that student attitudes toward Aplia did affect student performance. Generally speaking, students holding favorable views toward Aplia performed better in the class than students with unfavorable views of Aplia.

INTRODUCTION

Higher education has faced increasing pressure in recent years to document demonstrable student learning outcomes. In their 2011 book *Academically Adrift: Limited Learning on College Campuses*, Richard Arum and Josipa Roksa document the lack of student learning in the modern classroom and call for increasing the rigor of the classroom experience. In conjunction with this pressure to increase and document student learning outcomes has been the explosion of course offering types and corresponding course management solutions. In addition to traditional face-to-face classes, institutions routinely offer hybrid, web only, and other alternative forms of course delivery. Text publishers and other educational companies have scrambled to fill the need for out-of-class material delivery by developing an increasingly sophisticated array of online support tools to augment their texts, all of which claim to increase student learning. Student educational outcomes when using these tools has become the subject of an active body of academic research. A 2010 meta-analysis conducted by the U.S. Department of Education found that students using online learning methods performed modestly better than their peers that received only face-to-face instruction (DOE, 2010). This study examines student performance in principles of microeconomics courses when using one such publisher-provides software solution, Aplia.

Aplia is an online homework and quizzing system designed by Stanford economist Paul Romer. The purpose of the design was to 'develop interactive exercises that students could do in conjunction with the most widely used college economics textbooks' (Pearlstein, 2009). In 2007, Aplia was sold to Cengage publishers and had been refined and developed to augment certain Cengage textbooks. According to the Aplia website (Aplia 2014):

"Aplia's economics students use interactive chapter assignments, tutorials, news analyses, and experiments to make economics relevant and engaging. Students receive immediate, detailed explanations for every answer. Math and graphing tutorials help students overcome deficiencies in these crucial areas. Economics articles from top news sources challenge students to connect current events to course concepts."

Research directed toward the efficacy of Aplia in enhancing economic learning outcomes shows little in the way of substantial learning gains. Kennelly et al. (2011) and Lee et al. (2010) find no significant improvement in test scores when comparing Aplia to traditional homework management systems. Although the previous studies find little benefit in terms of student learning when using Aplia as compared to traditional homework assignments, an equally important corollary is that no harm in student learning outcomes was found when using Aplia in place of traditional homework assignments.

This article analyzes the relationship between student performance in class and student use and satisfaction with Aplia. We hypothesize student satisfaction and student use of Aplia is positively related to final grade in the course. That is, as students indicate increasing levels of satisfaction with Aplia, their academic performance improves. Given the nontrivial purchase cost of Aplia to students, student satisfaction and learning outcomes are an important component of the adoption decision. This approach is somewhat unique in the literature, as most studies regarding online homework management systems use pre/post testing in an attempt to demonstrate that learning outcomes differ after the implementation of the online learning aid.

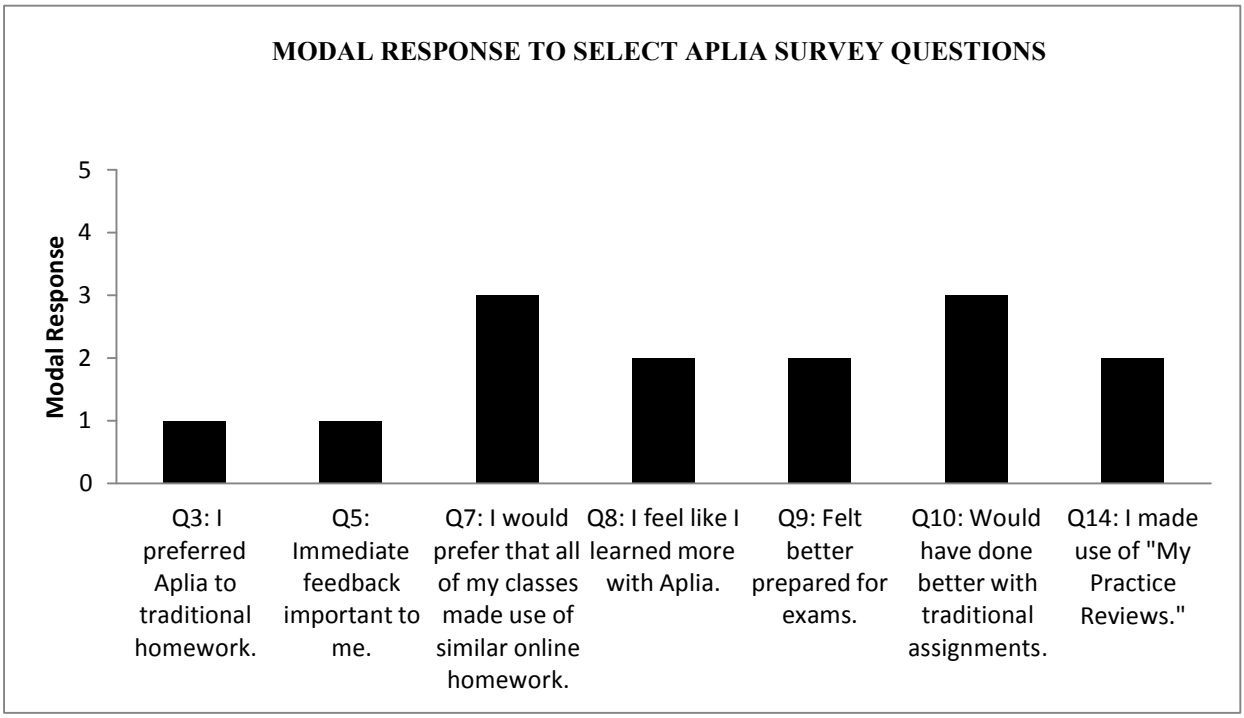
METHODS

The data used in this study come from students enrolled in ten sections of principles of microeconomics taught by two instructors during the fall of 2013 and the spring of 2014 at a mid-sized, regional institution with AACSB accreditation. Each section used Aplia in lieu of traditional homework assignments. Five of the sections were hybrid classes, meeting face-to-face for only 50 percent of the contact hours, while the other five classes were traditional face-to-face classes. At the end of the semester, a 16 question survey utilizing a 5 point Likert scale was administered. Survey questions focused on accessibility, use, and satisfaction with Aplia (Appendix 1). In addition to the student satisfaction survey, student gender, GPA, and total points earned in the class were collected.

RESULTS

After excluding missing observations from the dataset, there were 192 usable observations. Figure 1 shows the modal response to selected questions. The modal responses to all survey questions can be found in Appendix 2.

Figure 1

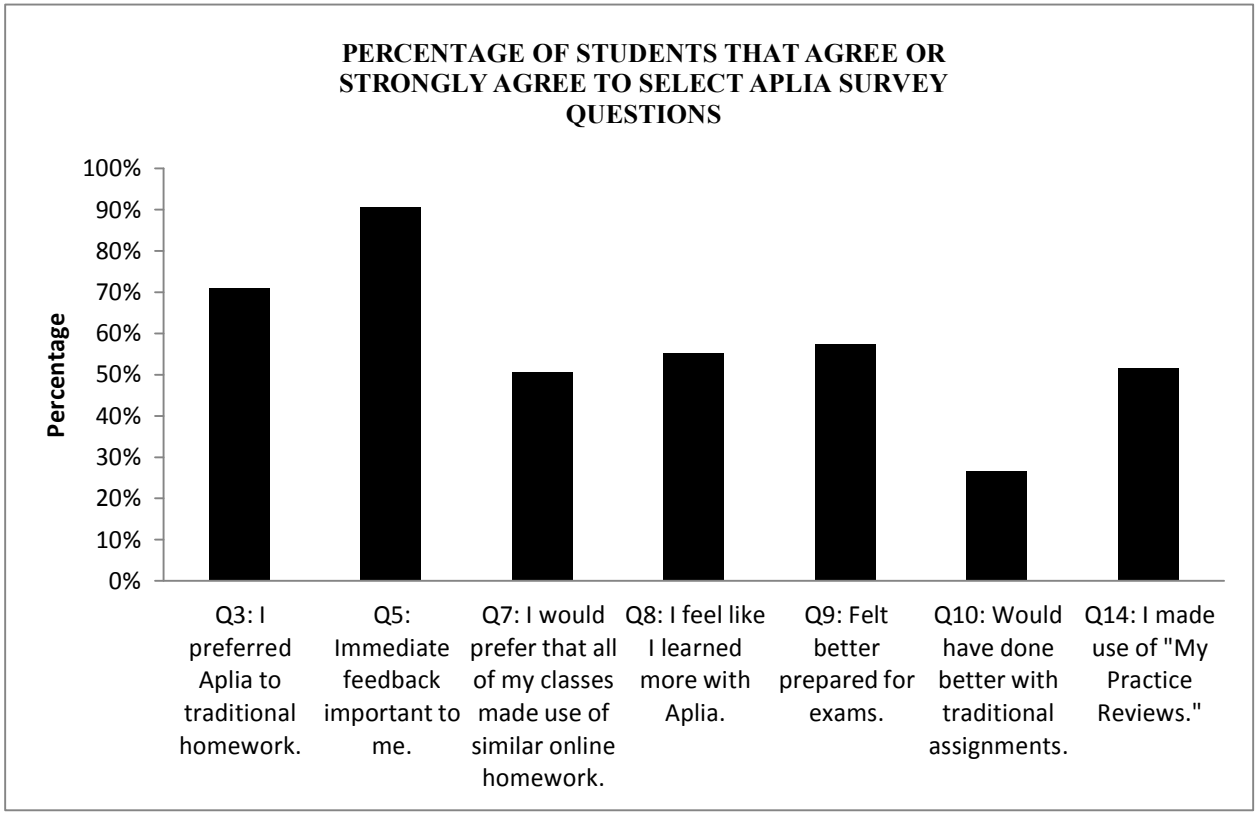


All questions with the exception of Q14 relate to student satisfaction and use the scale of 1 indicating "strongly agree" and 5 indicating "strongly disagree". Questions 14 relates to student use of exam review sheets and uses the scale of 1 indicating "never" and 5 indicating "all of the time". As responses to Question 3 indicate, students generally indicate strong agreement with the statement that "I preferred using Aplia to complete my homework over traditional handwritten assignments". Responses to Question 5 demonstrate strong student agreement to the statement, "The immediate grading and feedback provided in Aplia homework assignments is important to me as a student." Considering the results of these two questions jointly, students seem generally happy with the use and feedback provided by Aplia.

Question 7 deals with a preference that all their classes use Aplia (or a similar online homework management system). Despite the fact that students appear to be happy with Aplia, they are neutral with respect to a wholesale adoption of online homework systems. Questions 8, 9, and 10 all deal with the student's perception that they are doing better with Aplia or that Aplia is better preparing them for the exams than traditional homework assignments. Results indicate that students exhibit mixed feelings about how well Aplia is doing in terms of preparing them for exams. Question 14 asks students to rate the frequency in which they accessed embedded Aplia practice reviews. Most students indicate that they did use the reviews, but not very often.

Figure 2 shows the percentage of students that agree or strongly agree to selected survey questions. Full results can be found in Appendix 2.

Figure 2



The results shown in Figure 2 generally echo the results of Figure 1. Students tend to agree or strongly agree with questions 3 and 5 (use and feedback) while their agreement is less strong for questions 7, 8, 9, 10, and 14. For all questions except Q10, 50 percent or more of the respondents agreed or strongly agreed. Q10 had only 26.6 percent of the students agreeing or strongly agreeing. In contrast to the bulk of the survey, Q10 was phrased in the negative. That is, students agreeing or strongly agreeing with Q10 are indicating that they feel they would have done better on the exams without Aplia. Thus a low percentage agreeing or strongly agreeing to Q10 is actually an expression of the student-held belief that Aplia helped them do better on exams than traditional handwritten homework assignments.

Figure 3 illustrates the percentage of students that agree or strongly agree to select survey questions broken out by final class rank.

Figure 3

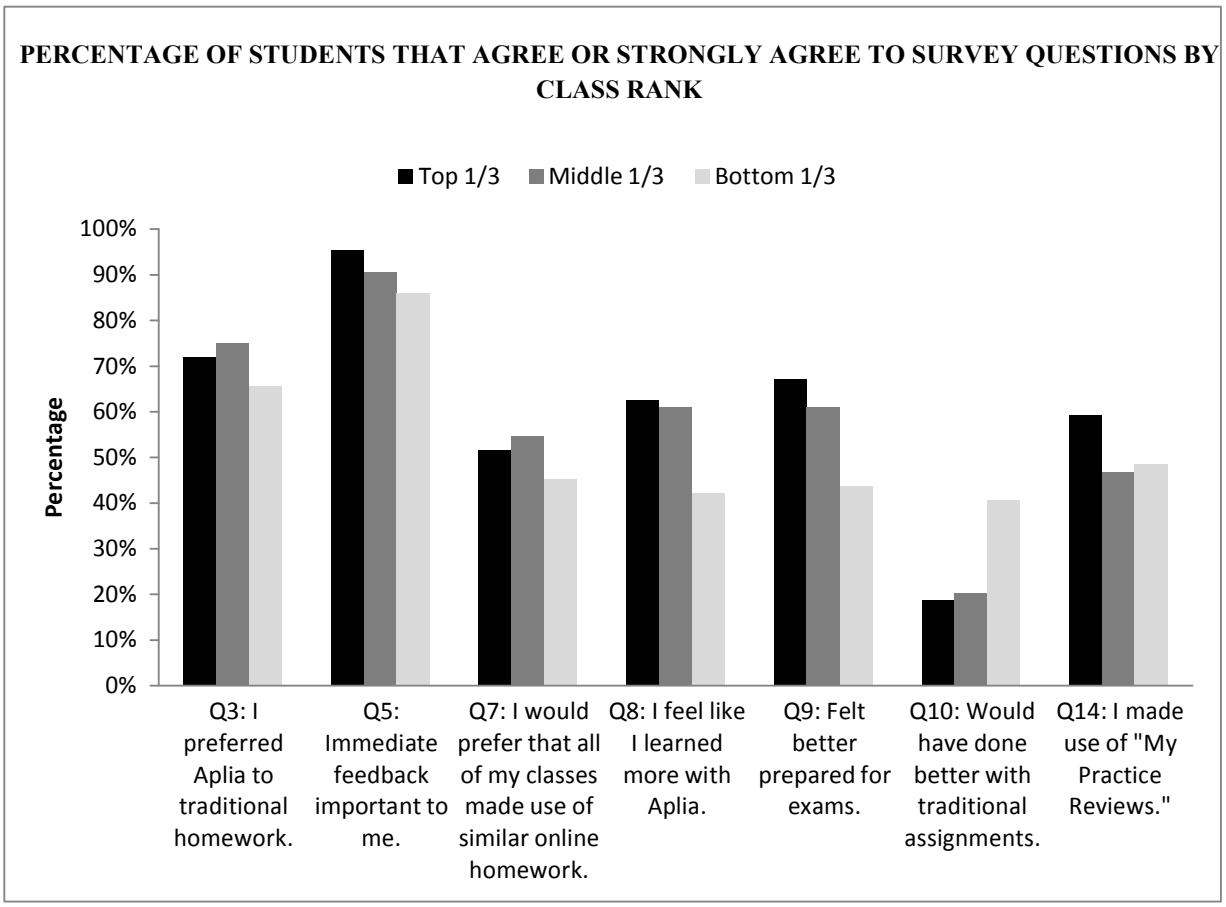


Figure 3 shows the contrast in percent of students agreeing or strongly agreeing to questions that occurs between the top, middle, and bottom third of the class. Generally speaking, the top third of students express a slightly greater satisfaction with Aplia than the middle third, who were generally slightly more satisfied than the bottom third. An exception to this is Q3 and Q7, where the top third of students were slightly less likely to agree or strongly agree that the middle third are. Although the general level of agreement with the survey questions is high, the bottom third of all students are the least likely to be satisfied with their Aplia experience. Recall, Q10 is 'flipped', so the higher percentage of students agreeing or strongly agreeing for the bottom third indicates they felt they would have done better with traditional assignments as opposed to Aplia assignments. Perhaps not surprisingly, Q14 indicates that the top third of the class are more likely to use exam review sheets than the middle or bottom third do.

Figure 4 shows the results of the regression of class points as the dependent variable on GPA, gender, and the 7 survey questions. The dependent variable in the model is total points earned in the class (out of 1000 possible points). GPA is cumulative institutional GPA for the student at the beginning of the semester, and gender is a binary where 1 indicates male and 0 indicates female.

Figure 4
REGRESSION OUTPUT

Regression Statistics	
Multiple R	0.6194
R Square	0.3837
Adjusted R Square	0.3532
Standard Error	84.5107
Observations	192
ANOVA	

	df	*SS*	*MS*	*F*	*Significance F*
Regression	9	809219	89913	12.5893	0.0000
Residual	182	1299855	7142		
Total	191	2109074			

	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	423.6127	60.6043	6.9898	0.0000
Q3	-6.3490	7.5747	-0.8382	0.4030
Q5	-9.6030	9.2394	-1.0394	0.3000
Q7	12.1475	7.5045	1.6187	0.1072
Q8	-5.5285	9.0418	-0.6114	0.5417
Q9	-14.2388	7.2484	-1.9644	0.0510
Q10	16.7216	7.6969	2.1725	0.0311
Q14	-2.3749	5.0925	-0.4663	0.6415
Gender (1=male)	46.0693	12.7226	3.6211	0.0004
GPA	99.9205	11.5451	8.6548	0.0000

For a simple specification, the model fits fairly well, with an R-squared of 0.38, and an overall F statistic that is significant at the 10% level. Both GPA and gender have positive statistically significant coefficients. For each 1 point increase in GPA, the student earns nearly 100 points (one letter grade) better. In addition, male students earn about 46 more points than female students, which equates to almost half a letter grade. These results are consistent with prior studies regarding gender on academic performance in economics courses (Hirschfeld, Moore, and Brown, (1995); Gratton-Lavoie and Stanley (2009); Lopus (1997)).

The coefficient on Q3 is not statistically significant at the 10 percent level. This indicates that student sentiment regarding the ease of use for Aplia does not differentiate performance in the class. The modest and statistically insignificant coefficient on Q5 indicates student's viewpoints on the immediacy of feedback also did not affect their overall point total in the class. Q7 asks if students would prefer all of their classes use Aplia or something similar. The statistically insignificant coefficient on Q7 indicates that student attitudes regarding all classes and online homework have no bearing on their overall class point total. Returning to the breakout

of survey responses by final grade outcome (Figure 3), it was Q3, Q5, and Q7 that had the least differentiation in responses between lowest class performers and highest class performers. Thus, it is not all that surprising to find these variables statistically insignificant factors in determining final class points.

The negative and significant coefficient on Q9 indicates students who agree with the statement that "completing the online homework in Aplia made me feel better prepared for the exams" tend to do better in the class than their counterparts who disagree with the statement. Again, referring back to the ranking of survey responses by class outcome, we find clear separation in level of agreement in this question between top, middle, and low performers. In addition to the separation, the level of agreement corresponds directly to class outcome (i.e., top performers have the highest percentage of strongly agree/agree responses, while low performers have the smallest percentage).

Q10 is essentially an inverted way of writing Q8 which was found to be insignificant. In Q10, students are asked to rate their agreement with the statement "I feel like I would have done better on the exams if the homework has consisted of traditional handwritten assignments as opposed to only Aplia online assignments". The positive and significant coefficient on Q10 demonstrates that students who disagree with the previous statement (thus expressing their support of the Aplia based homework assignments) tend to do better than their students who feel traditional homework assignments were better. Again, referring back to Figure 3, we can see a clear difference between the responses given to this question by final class outcome with top and middle performers responding in about the same proportion with strongly agree/agree answers whereas bottom performers responding the same in a much larger proportion.

DISCUSSION

The above results of the study shed light on several facets of student performance and Aplia. Results from the descriptive analysis suggest that students generally hold a very favorable view of online homework in general and Aplia in particular. Most students agreed that Aplia was easy to use and expressed a preference for using Aplia as opposed to traditional handwritten assignments. Students almost universally liked the immediate feedback that Aplia gave them on their assignments. Students were more mixed in their opinion of the amount of learning that occurred from Aplia. These results are consistent with the findings of most other research which suggests that students typically favorably receive online education (Mayadas, et al., 2009). In addition, the top and middle students are more likely to report higher levels of satisfaction with their experience using Aplia than the bottom students do. In particular, top and middle performers had proportionately greater numbers of strongly agree/agree responses when asked about how prepared they felt for exams after working with Aplia and also proportionately lower numbers of strongly disagree/disagree responses when asked whether they thought traditional homework would have prepared them more for exams.

Regression results show that total points in the class are determined in part by gender, GPA, and student attitudes regarding questions 9 and 10. Students who agreed that "completing the online homework in Aplia made me feel better prepared for exams" tended to do better in the class than students who did not agree. Students who agreed with the sentiment that "I feel like I would have done better on exams if the homework consisted of traditional handwritten assignments as opposed to only Aplia online assignments" tended to do worse than their counterparts who disagreed (and presumably felt that online homework helped them do better).

Male student tended to earn more points than female students, and students with high GPAs tend to earn more points than students with low GPAs.

Students generally felt strongly that completing their online Aplia homework helped them feel better prepared for the exams, and generally disagreed with the sentiment they would have done better on the exams if the homework was traditional handwritten assignments. Despite these student held beliefs, there was not a statistically significant relationship between student sentiment regarding preparation and overall grade. In addition, student use of the exam review sheets was not a significant factor in overall class performance.

CONCLUSIONS

In the face of an ever changing educational landscape, it is important to evaluate new teaching technologies for student satisfaction and efficacy of student learning. Aplia is an online homework and quizzing system initially designed for economics courses. Results of this study indicate that students in sophomore level principles of microeconomics courses generally hold a favorable view of the Aplia online homework management system. The stronger their favorable opinion of Aplia, the better they tended to perform in the class. Directions for future research include incorporating additional student characteristics such as self-reported hours studied, ACT scores, hours of Aplia usage and frequency of Aplia usage to examine the relationship between student attitudes, academic performance, and demographic characteristics.

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Appendix 1
STUDENT APLIA SATISFACTION SURVEY

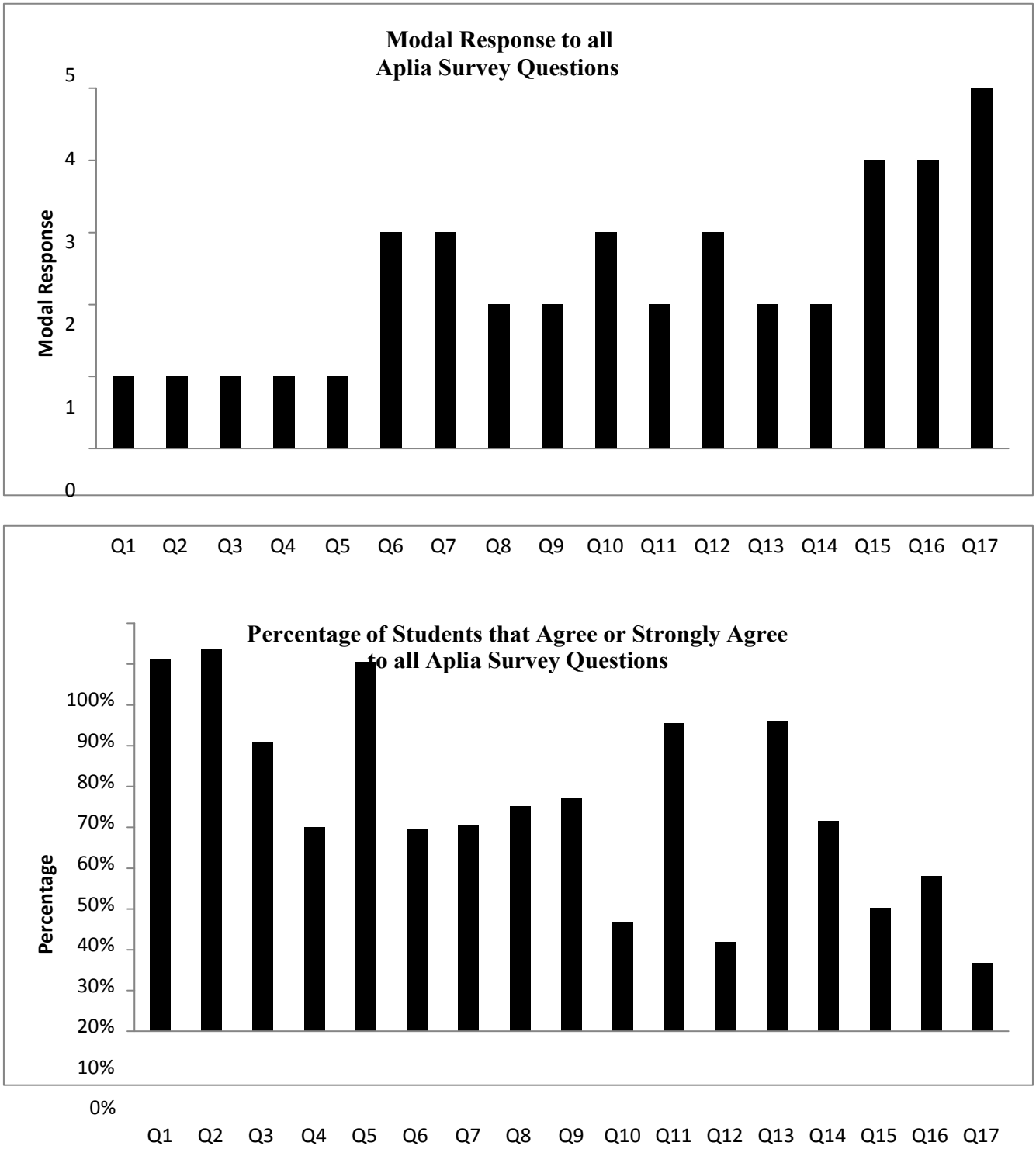
1 is strongly agree, 2 is agree, 3 is neutral, 4 is disagree, 5 is strongly disagree.

_____ 1. Aplia was easy to use.
_____ 2. The Aplia website was always up and running when I needed it.
_____ 3. I preferred using Aplia to complete my homework over traditional handwritten assignments.
_____ 4. I preferred taking my quizzes in Aplia as opposed to traditional quizzing in class.
_____ 5. The immediate grading and feedback provided in Aplia homework assignments is important to me as a student.
_____ 6. I preferred using Aplia to access my course materials (PowerPoint notes, review problems/sheets) as opposed to Blackboard or other electronic access platforms (MyCourses, publisher sites, etc.).
_____ 7. I would prefer that all of my classes made use of Aplia or a similar online homework management system.
_____ 8. I feel like I learned more with the Aplia online homework than I would have with traditional handwritten homework.
_____ 9. Completing the online homework in Aplia made me feel better prepared for exams.
_____ 10. I feel like I would have done better on exams if the homework consisted of traditional handwritten assignments as opposed to only Aplia online assignments.
_____ 11. The graphing tools in Aplia helped me to understand difficult concepts.
_____ 12. I prefer reading the e-book as opposed to a traditional paper text.
_____ 13. I would recommend Aplia to others.

For the last set of questions, please use this new scale which best corresponds to how often you made use of various course resources:
1 is never; 2 is tried at least once; 3 is more than once, but not often; 4 is most of the time; 5 is all of the time
I made use of "My Practice Reviews" in Aplia.
_____ 14. I made use of the exam review sheets available for download in either Aplia or Blackboard.
_____ 15. I made use of the exam review problems available for download in either Aplia or Blackboard.
_____ 16. I made use of the course PowerPoint notes available for download in either Aplia or Blackboard.

Appendix 2

FULL RESULTS OF STUDENT APLIA SATISFACTION SURVEY



EXPLAINING WHY INDIAN TRADE BALANCE DIDN'T IMPROVE WITH ITS CURRENCY DEVALUATION

Harmeet Singh, Texas A&M University-Kingsville
Hans Schumann, Texas A&M University-Kingsville
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ABSTRACT

Since the 2008-2009 Global Financial crisis, world economies have witnessed significant changes. Monetary authorities across many countries actively pursued policies to boost domestic economic outlooks. Currency valuations became more dynamic as the Central Banks' policies directly or indirectly interacted among each other. One of these occurrences has been the dramatic drop in the value of the Indian currency, Rupee (INR), as compared with other currencies such as the US Dollar. This is in sharp contrast with the Chinese currency, Renminbi (RMB) which held its value, even though both economies had been leaders in Gross Domestic Product (GDP) growth and shared similar characteristics in the prior periods. When looking at the sharp decline in the value of the Rupee (at an annualized rate of 6 percent since the global recession), we would expect to see significant changes and growth in exports and foreign investment and a significant reduction in imports. Little of this has happened and the purpose of this paper is to explain potential reasons for this economic anomaly.

Our analysis finds multiple explanations that can explain this phenomenon. In turn, we explore how the different inflationary tendencies of the two countries, differences in the consistency and direction of monetary policy, the effects of importation of Gold and precious metals interacted with or caused the currency fluctuations. We end by exploring why traditional balance of trade accounts may be unsuitable for discussing the trade balance in an economic environment like that of India in which large industrial sectors provide a "value added" services to intermediate goods that are themselves imported. We believe that the results of this analysis are interesting in their own right and also could be used as an interesting case study for readers to use in their Macro-economics and International Economics courses.

INTRODUCTION

The global financial crisis of 2007-09 initiated a round of international monetary system reform. For instance, European Central Bank has been actively engaged in reforming its monetary policy in the face of extended downfall of economic activity that had left some member economies in dismay. China, one of the fastest growing emerging economies, expedited its currency, RMB, appreciation process and even started to internationalize RMB. Another potential leader in global economic growth, India, on the other hand, seems to rely on free exchange rate regime as part of its monetary policy. With China and India being two of the high growth rate economies implementing contrasting monetary policies, the former has witnessed much better economic results as compared to the latter.

In exchange markets, INR, has depreciated drastically since the beginning of global economic downturn. In January 2008, USD-INR exchange rate was approximately 39 and six years later it was almost 62. A sharp devaluation of currency should have had stimulating effects on its economy through expected higher exports and higher capital inflow in the short run, or at least have helped India take some shares of China's exports in the global market. However, contrary to expectations none of this happened and India has a growing negative trade balance that dampens the growth in GDP. These outcomes challenge the basic assumptions of free exchange rate models and its impact on trade balances. In this research we analyze Indian monetary policy in relation to its' international trade, and the mix of the top trade categories of goods and services alongside India's major trading partners to offer a viable rationale for this situation.

REVIEW OF THE LITERATURE

The Indian economy has exhibited promise to be one of the major power-houses of the world economic output. According to the World Development Indicators database, currently Indian Gross Domestic Product (GDP) is tenth largest in the world in nominal value and the third largest in Purchasing Power Parity. India had a real annual GDP growth rate of 6.7 percent in the last two decades and more than 7.5 percent in the last decade which is surpassed only by China among the "BRIC" nations (Brazil, Russia, India, China, an acronym for the four of the fastest developing economies in the world). The Indian economy is becoming more and more de-centralized in the last two decades following its openness to world trade (Krueger, 2002). The increasing foreign trade brought a much needed capital injection from foreign investors to non-farm private sector, making a major force in a traditionally agricultural economy (Iversen et al., 2014).

Comparing the Indian economy to that of the Chinese, one cannot overlook the differing monetary policies of these two global growth engines (Bosworth and Collins, 2008). China has strongly implemented strict controls over its currency RMB exchange value in relation to United States dollar (USD) in the foreign exchange (FX) markets. By doing so, China has been able to provide competitive pricing edge to its export industry in world trade (Cheung, 2012). Chinese monetary policy has been effective in controlling its currency value volatility to the minimum. In contrast, Indian monetary policy has not been effective in keeping its currency value from fluctuating drastically. Despite constant inflation in India, the rupee has witnessed some episodes of increases in nominal value which coupled with domestic high inflation creates an unconducive trade environment for its exports industry.

However, the Chinese policy of maintaining its currency exchange value to a given level has its own downside. The economy must either restrict capital flow to and from the economy – thus also restricting many prospective projects by foreigners in domestic economy and vice versa – or give up its control of internal monetary policy to keep the exchange value from fluctuating (Song et al. 2011). The common term "financial trilemma" states that an economy can effectively manage only two out of the three major variables of its financial policy: free flow of funds with the rest of the world; independent monetary policy to control domestic inflation and interest rates (and unemployment in the short run); and value of its currency's exchange with other nations' currencies.

Indian economic policy makers have not been very clear in terms of their choices out of the "financial trilemma" (Hutchison, 2011). Despite Indian policy of a free exchange rate

regime, the Reserve Bank of India (RBI) intervenes in the FX market frequently thus creating an uncertainty over its policy choice. India has experienced long trade deficit to GDP ratio which has more than doubled and the net capital inflow to GDP ratio has dropped by more than 50% since 2008. The GDP growth rate also declined sharply since global recession (World Bank data). With the Indian economic outlook on the downside, there is possibility that investors react by pulling the assets out of India sooner than the economy actually goes down, a phenomenon referred as "an initial overshooting of exchange rate" (Dornbusch 1976). The monetary expansion fuelled growth may not be sustainable without the reformative core changes in the economic set-up. It seems that the Indian economy, not quite as established as some of the developed economies, has many inherent impediments to growth.

DISCUSSION

The fast depreciation of INR against major currencies may expose Indian economy to some risks, such as investment risk, capital outflow, high inflation, low investment, etc. India being one of the engines of global growth, contributes substantially to global trade. Its economy is also seen as a counter-balance to Chinese economy which has surpassed all but United States in terms of Gross Domestic Product. If the Indian economy has indeed inherited some or all of these risks, the effects of a slow growth rate trajectory may pose challenges to the global economic recovery from the brunt of 2007-09 financial crises.

After joining the World Trade Organization, Indian participation in International Trade has grown consistently. At the same time, the Indian economy has experienced a trade deficit for every single year since it opened up its economy. The magnitude of the deficits in relation to Gross Domestic Product (GDP) has increased in the recent years as compared to all the previous periods. All of this has happened despite the continued nominal devaluation of currency that took place. To finance this consumption of imports, there needs to be net inflow of capital from other economies.

With trade deficits that need external financing, one would expect fundamental structures that support capital investments from abroad. On the contrary, the free flow of capital has been subjected to restrictions by the government at times. Besides, frequent volatility in currency valuations also dampens investor confidence in the economy and its long term prospects.

Understanding the economic rationale for high fluctuations in currency value and increasing trade deficit is critical to policy decision as well as for transactional decisions by the trading partners. In the following sections, we explore Indian trade balance from three different economic lenses in order to explore possible explanation for the current economic situation. Precisely, we look at,

1. Exchange valuation of INR in relation to real value;
2. Indian monetary policy effect on INR valuation and trade; and
3. Top product categories and partners in India's foreign trade

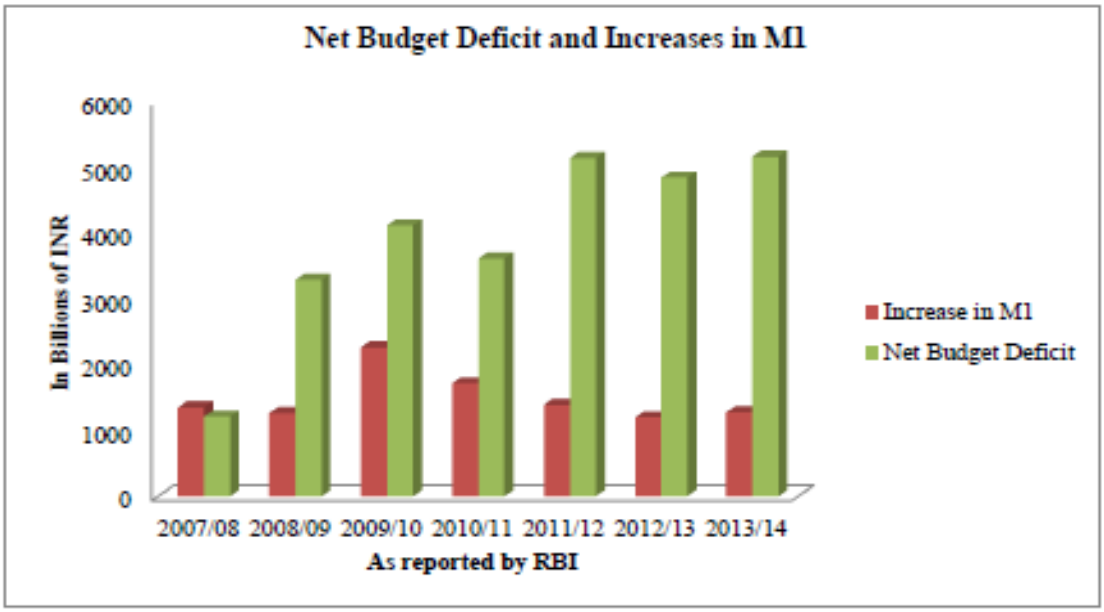
Exchange Valuations of INR in Relation to Real Value

The role of exchange rates in determining the trade balance for an economy has been studied from multiple perspectives. The renowned Dornbusch overshooting hypothesis, Marshall-Lerner model, the J-curve effect, etc. have been studied in different country contexts to

see what effect, if any, currency valuations have on domestic trade balances.

Mundell-Fleming model explains the long-term effects of monetary and fiscal policy on domestic currency valuation. According to the model, expansionary monetary and expansionary fiscal policy with low financial mobility should devalue the domestic currency which in turn should lower imports and boost exports thus improving the trade balance. We witness that the model conditions are mostly held within the context of India. There has been constant increase in money supply by the RBI indicating an expansionary monetary policy. At the same time the central government has had persistence budget deficits during each and every year since India joined the World Trade Organization (WTO) signaling an expansionary fiscal policy. The continuous domestic inflation in India highlights this situation. Following graph (Figure 1) shows the amount of increase in the narrowest category of money supply, M1, at the start of year for the last seven years and the net budget deficits in the central government.

Figure 1
(DEVELOPED BY CALCULATING RAW DATA REPORTED BY RESERVE BANK OF INDIA FOR MONEY SUPPLY AND FISCAL DEFICITS)



The Marshall-Lerner condition explains that import and export elasticities are instrumental in any affect that currency valuations may have on trade balance of an economy (Dornbusch, 1973; Rose, 1991; Ali and Kamal, 2012). For currency valuation to have any positive impact on balance of trade, the absolute value of import and export elasticities must not be less than one when added together. It is important to look at the product mix that an economy imports and exports predominantly to understand whether this condition is met or not. Marshall-Lerner's "J – Curve" further explains that the condition is usually met in the long run and that in the short run the effect is quite the opposite. The trade balance, immediately after the devaluation usually deteriorates due to existing trade contracts that must be fulfilled before the new contracts come into existence.

In India's case, Kumar and Maurya (2012) found that the real long-run depreciation of INR should have a positive impact on the trade balance as it will increase the competitiveness of Indian exports. These findings are consistent with the model of Net Capital Outflow, wherein, real depreciation of currency caused by increased flow of capital out of a domestic economy should increase the amount of exports, *ceteris paribus*.When we look beyond the nominal numbers in Indian economy, we notice that the real value of currency is significantly different.

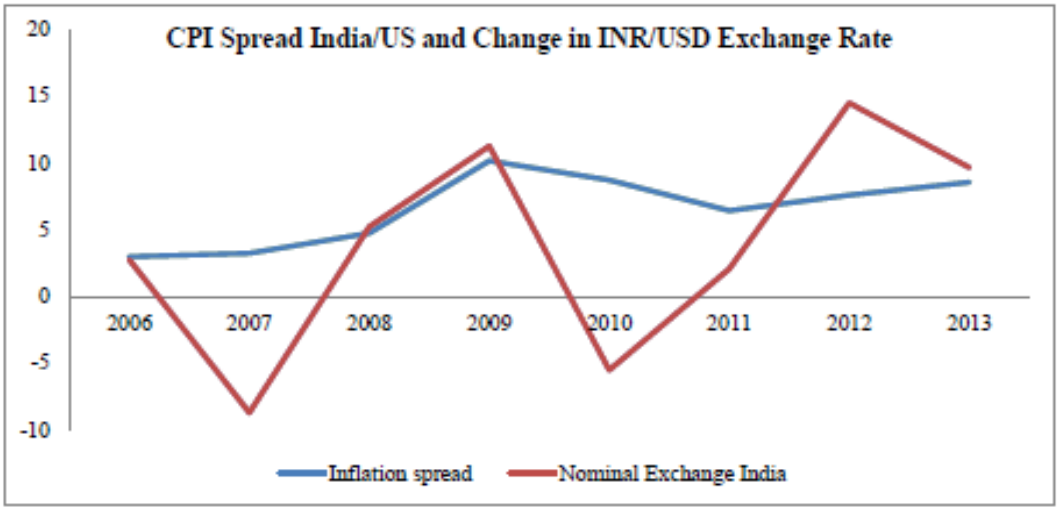
Real Exchange Rate for INR is substantially different and there is strong volatility in valuations.

In India's case, the real exchange rate is materially different than the nominal exchange rate. Comparing the inflation rate in India with that of the United States from 2007-2013, one finds that the annual spread between the two economies' Consumer Price Index (CPI) has been a little over 7 percent. During the same time period, the INR has depreciated at an annualized rate of little less than 6 percent. So the resulting average real decrease in value of rupee in relation to USD has been approximately negative 1 percent. One may term it as a moderate appreciation of currency in contrast to the sharp decrease that the nominal numbers suggest.

The following graph (Figure 2) depicts this data. One would not expect any positive impact to the trade balance with 1 percent constant appreciation of currency. However, the deterioration of trade balance has rather been drastic which is not justifiable with this slight appreciation in the real value. Besides the real exchange rate affects are usually only in the mid-to-long term and most short-term business contracts are fixed at a certain price levels of either the domestic or foreign currency units which makes the short term currency fluctuations a prominent factor in business decisions regarding imports and exports. An interesting inference from the graph is the volatility in nominal currency value that did not move along the inflation spread.

Figure 2

(INFLATION SPREAD DEVELOPED BY CALCULATING RAW DATA FOR INFLATION REPORTED AS CONSUMER PRICE INDEX FOR UNITED STATES BY U.S. BUREAU OF LABOR STATISTICS AND CPI REPORTED FOR INDIA BY ECONOMIC INTELLIGENCE UNIT COUNTRY DATABASES; NOMINAL EXCHANGE RATE CALCULATED BY DATA PROVIDED BY RBI REGARDING INR EXCHANGE RATE FOR USD)



This volatility is a plausible indication of investor confidence, or lack thereof, which leads to fast movement of wealth in and out of the country resulting in exchange values to fluctuate overall leading to an unstable trade environment.

Indian Monetary Policy Effect on Exchange Valuation and Foreign Trade

In nominal terms, INR devalued by almost 60 percent in relation to USD since the global recession of 2008. Even before that time, INR had witnessed several episodes of currency devaluations attributed to internal and external factors. The exchange rate regime for Indian currency has been market based since 1993 when policymakers began liberalizing the economic system. The Reserve Bank of India (RBI), as Indian monetary authority, has an objective of "maintaining price stability and ensuring adequate flow of credit to productive sectors". As the manager of foreign exchange, RBI maintains the objective "to facilitate external trade and payment and promote orderly development and maintenance of foreign exchange market in India"[1].

Since the adoption of a free market currency regime, there have been several instances of extreme currency exchange volatility in India. As the Indian economy started to globalize, the inflow of capital surged to unprecedented levels during the early years (1993-95) causing the exchange rate to increase sharply. With increased international flow of goods and services and unprecedented openness of financial markets, the currency exchange was exposed to the global economic ups and downs. Whether it was the currency crisis in Mexico in 1995 or in the East Asia during 1997-98, INR witnessed sharp depreciation against USD and other major world currencies. The two of the recent episodes of greatest volatility have been, 1.) global financial crisis of 2007-08 and 2.) mid-2013 when United Stated Federal Reserve (Fed) first announced its tapering of extended quantitative easing.

Figure 3
(DEVELOPED BY CALCULATING RAW DATA PROVIDED BY RBI REGARDING INR EXCHANGE RATE FOR USD WITH DATA FROM FINANCE.YAHOO.COM FOR RMB EXCHANGE RATE FOR USD)

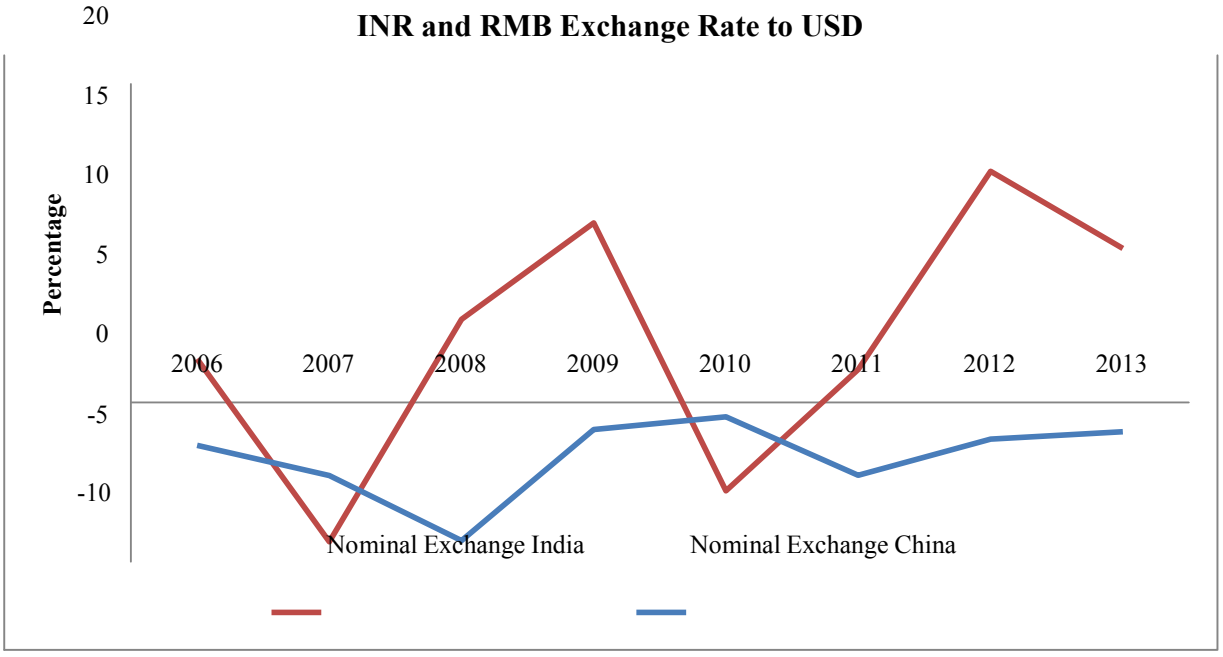


Figure 3 compares the percentage change in INR and RMB nominal exchange rate against USD. A positive change indicates a higher exchange rate and a resulting lower currency value. Looking at this graph, one cannot overlook the stability that the Chinese authorities have provided to its export industry by minimizing the volatility of RMB in relation to USD whereas INR, despite operating in a constant domestic inflationary environment, has witnesses sharp

declines in exchange rate (resulting higher values) at times followed by steep rises (lower value).

During these and other instances of INR exchange rate volatility, the RBI had intervened aggressively in the exchange markets to buy or sell USD in its efforts to stabilize the exchange value of the currency. By maintaining deep account balances of foreign reserves in its balance sheet, RBI has been somewhat effective during these volatile periods[2]. This active participation in the foreign exchange market undermines the free market regime that the INR claims to operate in.

In addition to the market operations of currency transactions, RBI intervenes to influence the interest rates via multiple channels. For credits related to foreign trade, the interest rates have been historically influenced by RBI via surcharges/subsidies and/or by setting rates directly. This also has the potential to influence the value of INR beyond what a free market would dictate. During the recent currency volatility periods, direct communication from RBI via announcements to maintain or implement certain policies has supplemented direct actions. One can conclude that the Indian currency regime is not in a free market float such as that of United States but could be considered a 'managed float' at the best.

Monetary Authority of India through RBI has caused chaos and instability in valuations.

Indian monetary policy exhibits signs of instability over the long run. The annual inflation in India ranged from 4% to 11% in the last decade which is very high and volatile compared to other comparable economies. The monetary policy in India that is dedicated to maintaining price stability has clearly failed to keep prices in check. Although the efforts by RBI have been drastic, often times extra-ordinary as evidenced by some of its actions, such as

- *Change in Cash reserve ratio for 25 times since 2007 to 2013 with a low of 4 percent to 9 percent being the highest.*
- *Constant changes in bank rates for domestic lending*
- *Multiple benchmark rates during a short time period*
- *Imposition of ceilings for foreign investments in domestic government debt securities*
- *Buying and selling of foreign reserves (USD, in particular) to influence INR exchange rates*

A policy involving these kinds of actions would baffle even an introductory student in macroeconomics as to the objective of central bank by creating confusion and inconvenience for the banking system, especially with regards to constant flirting with cash reserve ration. This would likely inhibit banking system's ability to function as a smooth mechanism of monetary flow in the economy.

To keep up with the economic growth aspirations of central governments and to unofficially finance the budget deficits, RBI has grown the money supply (M2) by an average annualized rate of 12% since 2007. A high inflationary economy coupled with frequent interference in the banking system creates an instable environment for investors in the domestic economy. This lack of confidence in the monetary system of an economy would discourage diligent foreign investors from committing their capital. High local inflation also negates any positive effect that nominally devalued currency may have had on trade balances.

Chaotic monetary policy has caused 'wealth flight' from India to 'safe havens'.

An inflationary monetary policy without clear future path also encourages wealth flight away from currency toward "safe" alternatives. Gold and silver are the second largest export

item for India during most of the last decade. The imports have been considered as a negative threat to currency valuation so much that Indian Government has often put in place import restrictions and special tariffs. The demand for precious metals for consumer and industrial usage has not been the dominant reason for high imports. The expansionary monetary policy without a clear path to currency stabilization drives investor and consumer confidence away from the holding their excess wealth in domestic currency units.This disbelief is likely an explanation as to the higher demand for 'precious metal' imports because precious metals, gold in particular would be a better store of value than the local currency due to high and persistence inflation (Trivedi and Behera 2012).

With gold and silver considered as "real" assets for currency disbelievers, the prices of such fluctuate more based on speculations towards the global financial markets than the industrial demand for these metals. With gold prices almost tripling from 2007 to 2012 and Indian imports of gold increasing at a gradual rate over the same rate, the negative impact on currency was magnified during this period. The imports of gold and other metals in exchange for local currency not only put a downward pressure on domestic currency valuation but at the same time also contribute to a negative trade balance by arbitrarily increasing imports. This kind of import is in stark contrast to the imports of petroleum or crude which potentially covers domestic energy needs and fuels growth in domestic production.

High domestic inflation also tends to induce individual as well as institutional investors to keep their wealth in other currencies which are more stable in value than the domestic currency. This also causes an increase in the supply of domestic currency in the foreign exchange market thus reducing the currency valuation. An unclear monetary policy that has failed to keep inflation under check and has caused investors to buy into 'safe havens', is detrimental in currency value stabilization. This has, oftentimes, caused 'capital flight' from India resulting in high volatility and low currency valuation.[3]

Top Product Categories and Partners in India's Foreign Trade

Throughout this paper we have been looking at the nominal imports and exports of India and the corresponding trade balance. While on the aggregate, the trade deficit is important and both the imports and exports should be correlated with the foreign exchange rates, in the Indian economy one would expect to see imports to be negatively affected by a weak Rupee and exports to be positively affected. The traditional model may be a good way of looking at economy where countries import products for the consumption of their population and export products produced entirely (or mostly) sourced domestically by their residents.

Traditional analysis may not be adequate in the globally integrated world we have in today's integrated markets. Specifically, we live in a world where multinationals have extensive value chains that bridge many countries. Exports today are just as likely to be constructed using foreign sourced inputs as 100 percent domestically sourced. Exports of I-phones from China would be a perfect example of this integrated export scenario. China may export i-phones, yet these i-phones are assembled with chips, screens, and electronics sourced worldwide and shipped to China for final assembly.

In India's case imports interact with exports on a large scale.

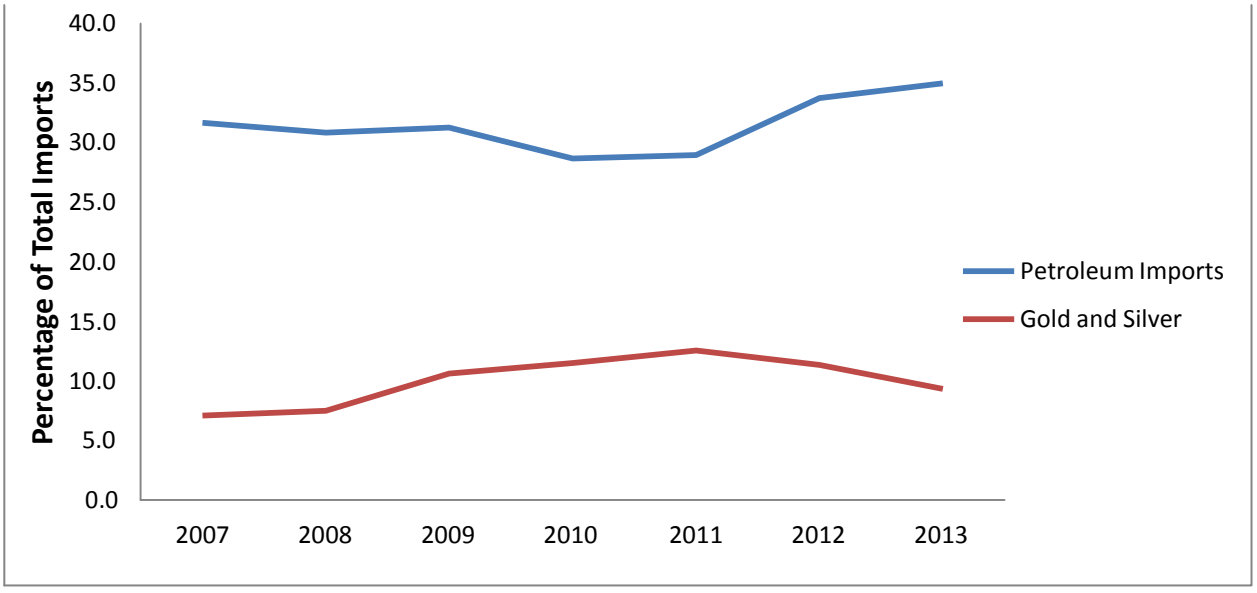
In the specific case of India, we have concerns that much of the Imports and exports are directly linked to each other and therefore traditional analysis would over-predict the changes in each. In

this section we explore this notion analyzing the mix of goods and services that India trades with its major trading partners.

'Petroleum' products have dominated Indian foreign trade in both exports and imports. It is the single largest import category and the second largest export category. With crude prices beyond the control of any single economy around the world, India largely imports any positive or negative effects of changes in the crude prices to the domestic economy. This renders the monetary authority with limited policy choices when it comes to maintaining price stability.

The second largest imports are 'gold and silver' whereas 'gems and jewelry' are the third largest export category. Together 'petroleum products' and 'gold and silver' constitute more than 40 percent (Figure 4) of the total imports for India and the domestic demand for both have been increasing in the country. For petroleum, it is the energy needs of a large growing economy and for 'gold and silver' it is the lack of confidence in the local currency. Since the global recession until early 2014, prices of petroleum and 'gold and silver' have increased significantly thus causing more damage to India's balance of trade.

FIGURE 4
(DEVELOPED BY CALCULATING RAW DATA REPORTED FOR INDIA BY ECONOMIC INTELLIGENCE UNIT COUNTRY DATABASES)



Since imports of petroleum are based on India's fast growing economy needs and imports of 'precious metals' are based on preference of investors for safe alternatives to currencies, changes in currency valuations have very little, if any, effect on the amount imported. Besides, a nominally devaluated currency magnifies the total currency value of imports if the amount of imported product is unchanged.

The other two import categories in the top four are 'electronics' and 'machinery' for which demand is based on consumption. In India, an internally growing economy with a fast developing middle class, the overall consumption of goods and services has been steadily increasing contributing to higher imports of such category of goods.

As for exports from India, the largest category has been 'Engineering products' for over a decade. The slow global recovery from the financial crisis did not increase the demand for such products by much. 'Agriculture and allied products' is currently the fourth largest category of exports but it has changed spots with 'petroleum' and 'gems and jewelry' for second and third place over the last decade.With the exception of 'agriculture and allied products' category,every other type of major export category is interdependent with an import category.

A prime example of this interdependence in India is petroleum. Petroleum is among the top of both India's imports and exports (#1, and #2, respectively). As such, it may be better stated that India exports "Oil Refinery Services" instead of the physical products currently being measured. Although a devalued INR may cause Indian refined products to be more attractive on the world's market, the currency devaluation should impact only the "Value Added" refining portion of the export. Therefore, a weak INR will therefore have a much smaller effect on exports than expected. Although Gold and Silver imports were discussed earlier, they too are used as a major import intermediate good for the export of "Gems and Jewelry" which is India's third largest export.

Our current method of accounting for imports and exports can significantly misrepresent the nations with which trade surpluses do exist. With respect to China, Sponsi and Koech(2013) show that between 2005 and 2009 the US-China bi-lateral trade deficit did not grow by 30 percent as traditionally reported but was flat when each countries numbers were recast to measured "Value-added" trade. By understanding what percent of India's imports are re-exported as components of the exported products, we would be able to develop more accurate models. Such models would be better equipped to predict the export and import elasticities and therefore the expected changes due to currency fluctuations.

India's top trading partners have a few familiar names for the study period.

In terms of the trading partners, U.S., U.A.E., China, and Singapore are currently the four largest export destinations for Indian goods and services measured as the percentage of total exports. As for import origins, China, Saudi Arabia, UAE, and Switzerland hold the top spots. With Chinese currency RMB mostly pegged at USD, any nominal devaluation of INR against USD should also devalue INR to RMB by similar proportions. Over the last several years, this has in fact been the case. However, we did not see this currency devaluation positively affecting the trade balance between India and China.

Imports from Saudi Arabia and UAE constitute primarily, crude petroleum and gold, respectively. Demand for both in India is rather inelastic to currency valuation to due reasons that we have discussed.

The most interesting point to note here is the amount of exports to a small country, Singapore. Taken at a face value, this suggest that an average resident in Singapore would have spent much as five times the amount for Indian made goods and services than an average resident in United States would have spent on Chinese made goods and services. Singapore is, in fact, not the end consumer of most of the goods and services imported from India. It rather functions as a "shipping company" for goods and services originating out of India towards the East Asian and Southern Indian Ocean destinations. So any fluctuations in INR to Singapore dollar (SGD) may not substantially impact the trading amount when the end destination is some other country.

The current studies analyzing currency valuation impact on trade balances rely heavily on bilateral trade data, which in India-Singapore case would be a complete anomaly.

CONCLUSION

Indian economy did not experience a positive impact on its balance of trade that one would expect with the nominal devaluation of INR against the world currencies, in particular USD. We consider this to be in line with the economic rationale unique to the Indian economy.

First, the decline in the nominal value of rupee has been primarily in line with the growth in money supply and inflation in the domestic economy during the study period. So any benefit of devalued currency to the foreigners is offset by higher domestic prices. Secondly, a monetary policy that lacks a clear path to price stability has added to the volatility that already exists in a free market monetary regime. A flight to safe havens such as gold and other stable currencies has been witnessed in the inflationary economy of India. Not only does it put a downward pressure on the nominal exchange rates but also increases the imports that are not necessary for consumption or investment in the fundamental sense. Last but not the least, the nominal decline in value did not boost imports from India even in the short run due to the mix of Indian export – import trade categories. Analyzing the export-import categories for the country, we observe that a substantial portion of imports are provided with "value-added" services in the country and then exported. This means that the short-term nominal decline in rupee value may not have a meaningful impact on the balance of trade as any benefit to the foreign buyers of Indian exports is significantly offset by the higher prices paid by Indian importers due to devalued currency.

To find an impact of currency valuation on trade balance in a modern integrated economic framework, the models that analyze aggregates may not be suitable. Capturing the "value added" part of exports is a new stream of thought that needs more attention in the international trade studies.

On a fundamental level, a deficit in the trade-balance may not be a negative sign for a growing economy such as that of India. A negative trade balance because of higher imports requires external financing thus causing a negative flow of capital or a net inflow of capital in the domestic country. With an economy that is supported mainly on domestic investment and consumption, restrictive foreign investment policy and unstable monetary policy can cause serious impediments to its aspirational high growth rates.

It is noteworthy, however, that the most recent change in the Indian fiscal regime's administrative leadership has indicated intent to implement many fundamental reforms that have the potential to provide a high growth environment in the near future and long term (IMF, 2014). Current low oil prices have also provided India with an unanticipated short term respite from domestic inflation, thus allowing the policy makers to focus on non-nominal issues that could allow the Indian economy to imitate or even surpass the high economic growth rate of its neighbor, China. At the same time, delays in such policy changes caused by political roadblocks and inherent instabilities in the system have already been evident thus causing some uncertainty for a stable growth environment (Iyer, 2015).

A robust monetary policy with clear intentions and a fiscal policy supporting infrastructure for Foreign Direct Investment (FDI) has the capability to provide long run price and exchange rate stability that is expected from one of the largest and fastest growing economies in the world.

ENDNOTES

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This research was supported by competitive research grant awarded by College of Business Administration, Texas A&M University-Kingsville to the corresponding author during the Summer of 2014.

RETENTION AND EARLY EXPOSURE TO ECONOMIC CONCEPTS

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ABSTRACT

There is a plethora of material available to assist teachers with infusing economics into the elementary and secondary education classroom. There are also numerous websites critiquing these activities. However, the number of articles examining the impact these activities have on elementary and middle school students' understanding of economics is considerably smaller. There is a paucity of research examining whether these younger students retain the concepts included in these lectures for more than a few months. This study fills that void by examining the extent to which these students are able to retain this knowledge for eighteen months.

A pre and posttest was administered to assess how much economics students learned from lessons presented in their sixth grade social studies class.These students and others attending the same middle school were then given the same posttest to assess how much of this information was retained.The scores of the students that participated in the lessons were compared to their original posttest scores and the scores of the other students in the middle school. In addition, their scores were compared to their peers by segmenting the students based on their curriculum.

There are several key findings from this study. Students are able to retain concepts more than eighteen months. In addition, we find that academically stronger students are better able to retain the information than others. Therefore, although there is limited time available in the elementary school day, infusing economic lectures into related material can have long lasting effects.

INTRODUCTION

Two years ago, as part of a research project, economic lessons were infused into the social studies classes for sixth grade students at an elementary school. In addition to collecting demographic data on these students, a pre and posttest was administered to assess how much economics they learned from the lessons. Benson and Stegner (2013) found that students described as higher achievers scored higher, and generally had the larger increases between the pretest and posttest. This study also took a first look at retention by asking these students twenty-one questions regarding all three lectures at the end of the school year – approximately two and a half months after the last lesson. The findings regarding retention mirrored those found with respect to learning. However, as educators, it is of more interest to determine how much is retained over a longer period of time. This study picks up where the last study left off, by examining the level of retention two years later.

STUDIES ON RETENTION

The extensive psychology literature on intelligence discusses how a knowledgeable

person develops a network between information received and his/her experiences and existing knowledge base. Retaining information so it can then be recalled and applied to new situations is critical for exhibiting intelligence in a given area. The education literature has documented how "active learning" methods have increased a student's ability to retain concepts. A study by Sosin et al. (1997) looked at factors influencing elementary school students' ability to learn economic concepts, but the posttest was administered in approximately the same time period as used in the Benson and Stegner (2013) study.

SETTING AND METHOD

During the Spring 2012 trimester, lectures and activities were completed with students at an elementary school. These students were given a pretest the day before each lecture, and a posttest immediately following the lecture. In addition, another posttest covering all three lectures was given at the end of the trimester – approximately two and a half months later.

In November 2013, all eighth grade students at a middle school were given the same posttest distributed to the sixth graders at the elementary school which received the initial treatment. These middle school students include the sixth graders from the original study and students from four other schools in the district that did not receive the original economic lessons. None of these students had any economics lessons during that eighteen month period. To insure more complete coverage, the test, consisting of 21 multiple choice questions, was administered during a required 8th grade science class at the beginning of the second trimester. In addition to their test answers, data was collected regarding which elementary school was attended, and whether they were currently enrolled in an advanced or remedial math or English class.

COMPARISON OF TREATMET SCHOOL TE CITY STUDENTS TO OTHER 8TH GRADERS

Fifty-eight students who took the end of the trimester posttest at the treatment school also took the posttest in eighth grade. A larger number of students attended the lessons but were absent for the final posttest. The scores of the fifty-eight students that took both posttests are listed in Table 1.

Table 1

TREATMENT SCHOOL STUDENTS POST TEST SCORES IN 6TH AND 8TH GRADE

	Mean	Median	Number of Students
Treatment School 6th Grade	13.69	14	58
Treatment School 8th Grade	14.69	15	58

As Table 1 shows, these students' scores improved. Part of this increase could be the result of additional experiences and non-economic classes these students completed in the interim. The lectures covered the relatively basic concepts of public goods, monopolies and inflation. We know that as students increase their level of critical thinking and have more life experiences upon which to apply their learning to, they are better able to understand information.

It is important to assess whether the higher scores simply reflect the additional knowledge gained during the time that passed. In order to test whether the previous treatment

school students performed better than the other students, their scores are compared to the 8th grade students that did not attend the treatment school. Two hundred forty students completed the test. Of these students, approximately 25% attended the treatment school and took part in the initial study.

Table 2 below shows that the treatment school (TS) students performed better on the exam than the non-treatment school (NTS) students. A test was run to determine the robustness of this finding, whether the mean value of scores from treatment school students is different from the mean value of students from other elementary schools, who did not have the benefit of the lessons in economics. This hypothesis is stated more formally as follows:

$$H_0: \mu_{TS} - \mu_{NTS} = 0$$

$$H_1: \mu_{TS} \neq \mu_{NTS}$$

This hypothesis is tested with a two-tailed T test for the difference in means. The probability of finding the difference in means we observed if the two means are equal is reported as the P value.

Table 2
MEAN AND MEDIAN NUMBER CORRECT ALL 8TH GRADERS

	Treatment School	Non-Treatment School	Difference	t-test P-value
Mean	14.4925	11.2948	3.1977	0.000000040
Std. Dev.	3.8862	3.4048		
Number	67	173		

The table demonstrates that with at least 99.99 percent certainty we can reject the null hypothesis and thus it has been shown that the difference in means is significant. The lessons in economics were retained, and indeed embellished, for the eighteen months between the administered quizzes.

COMPARISON OF PEER GROUPS

At the treatment school, students were segregated into three groups based on their performance on a standardized test. The study conducted during the Spring 2012 trimester found that students in the highest group tended to retain the information (albeit over that short period of time) better than students in the other two groups. In order to determine whether this difference holds up over a longer period of time, the students' results from this study are separated based on the sixth grade grouping.

Table 3 provides the mean and median scores for the treatment school students based on their sixth grade groupings. Group 1 consists of the students with the highest standardized test scores, Group 3 had the lowest scores. All three groups showed an improvement in the median score, with Group 3 showing the largest percentage increase. The smaller percentage increase for the higher ranked groups could be attributable to the relative position of the first posttest score. The same approximate percentage increase for Group 1 would basically require these students to score 100%.

Table 3
MEAN AND MEDIAN SCORES BASED ON SIXTH GRADE GROUPINGS

	Mean	Median	Number of Students
Group 1			
6th Grade	17.316	17	19
8th Grade	17.105	18	19
Group 2			
6th Grade	13	14	24
8th Grade	14.958	15	24
Group 3			
6th Grade	10.2	9	15
8th Grade	11.2	11	15

The next step in this study is to compare how well students in each of the treatment school groups did relative to their peers. One way to find their cohorts is to look at the type of classes the 8th graders were taking. There are several tracks available for English and math at this middle school. Both of these subjects offer an honors course and a remedial class in addition to the regular track. In elementary school, students were placed in the three groups. In middle school, students are allowed to opt out of the honors track even if they are qualified to take those courses. Some teachers commented that at least a handful should be in the honors class but chose not to follow that track. Table 4 shows which track the treatment school students followed.

Table 4
ENGLISH AND MATH CLASSES TAKEN BY TREATMENT SCHOOL STUDENTS

	No Honors Classes	Only Honors Math	Only Honors English	Both Honors Classes	Number of Students
Group 1	1	6	0	16	23
Group 2	10	10	1	3	24
Group 3	20	0	0	0	20

It appears that peer groups can be approximated by comparing Group 1 with students taking both honors courses, Group 2 with those taking only one honors class, and Group 3 with students not taking any honors classes.

The means and medians of these peer groups are listed in Table 5. As this table shows,

the most significant difference in median scores is found when comparing Group 1 to the non-treatment school middle school students taking both honors classes. This reinforces the finding from the Benson and Stegner (2013) study, that academically stronger students are best able to retain the information.

Since it has been established that the scores from the treatment school are different, indeed larger, than other students attending the middle school, a one tailed test is used in subsequent tests. In these cases, the null hypothesis is that the average, or mean, score from the treatment school is larger than the mean value from other students at the middle school. Formally, the null and alternative hypotheses are:

$$H_0: \mu_{TS} - \mu_{NTS} = 0$$

$$H_1: \mu_{TS} \geq \mu_{NTS}$$

Table 5
MEAN AND MEDIAN NUMBER CORRECT ALL 8TH GRADERS BY PEER GROUPINGS

Comparison		Treatment School	Non-Treatment School	Difference	t-test P-value	Sig.
Treatment School 1 vs. 2 advanced classes	mean	17.3043	13.6800	3.6243	0.000012862	***
	std. dev.	2.5124	2.8537			
	number	23	25			
Treatment School 2 vs. 1 advanced class	mean	14.9583	12.5294	2.4289	0.001780018	***
	std. dev.	2.9706	2.9872			
	number	24	34			
Treatment School 3 vs. 0 advanced classes	mean	10.7000	10.4035	0.2965	0.348656690	
	std. dev.	3.0796	3.2850			
	number	20	114			
Treatment School 2 vs. 2 advanced classes	mean	14.9583	13.6800	1.2783	0.065749289	*
	std. dev.	2.9706	2.8537			
	number	24	25			
Treatment School 2 vs. 0 advanced classes	mean	14.9583	10.4035	4.5548	0.000000042	***
	std. dev.	2.9706	3.2850			
	number	24	114			

* p-value<0.10
** p-value<0.05
*** p-value<0.01

Treatment school Group 1 is compared to other students at the middle school taking two

advanced classes. Treatment school Group 2 is compared to other students taking one advanced class, and Group 3 is compared to other students who are not taking any advanced classes. Finally, treatment school Group 2 is compared to other students taking two advanced classes and those taking no advanced classes. Table 5 presents the results. Again, the t stat P value is the exact probability of finding the difference in means observed if in fact the means are the same. A low probability means that it is unlikely that the assumption that the means are equal can possibly be correct, and thus the null hypothesis will be rejected.

Clearly Group 1 has pulled the average score from the treatment school up. The mean score of 17.3 is 3.62 points higher than their peer group. The result is statistically significant and the null hypothesis of equal means is rejected for this group. Similar conclusions are found for Group 2, albeit the difference in mean scores is only 2.42 points higher than their peer group. Once again the results are significant at the 99.99 percent level. The mean score from Group 3 is higher than the mean score from the third group of other students. This result is not statistically significant. The authors would argue that the peer group established for Group 3 is not really a peer group. Students in Group 3 from the treatment school are the bottom 30 percent of students from that school, as primarily measured by standardized test scores. The peer group of 114 students presents 66 percent of all non-treatment school students at the middle school, and it can reasonably be assumed that among this group are higher achieving students.

There are two remaining means tested. The first is to test whether Group 2 students from the treatment school would perform better than the high achieving peer group. As shown, the mean from this group from the treatment school is higher than the mean from the highest peer group and this result is statistically significant at the 10 percent, or 90 percent confidence, level. Finally, one last comparison is to test whether Group 2 students from the treatment school, ten of whom took no advanced classes, would perform better than non-treatment school no advanced classes students. Clearly, the mean from the treatment school is significantly higher than the comparison group.

CONCLUSION

There are several key findings from this study. Students are able to retain concepts more than 18 months. Whether these students were better able to retain the information because of the active learning approach initially taken is beyond the scope of this study. Another result, which reinforces a finding from the initial study, is that academically stronger students are better able to retain the information than others. Therefore, although there is limited time available in the elementary school day, infusing economic lectures into related material can have long lasting effects. Given the difficulty many have understanding economic concepts, this seems like a valuable use of time.

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WHY ARE MORE MEN LIVING WITH THEIR PARENTS?

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ABSTRACT

The increase in adult males living with their parents has drawn attention recently in both academia and the popular press. The 2011 Census revealed the percentage of 25-34 year old men living at home grew from approximately 13 percent in 2001 to 17 percent in 2011 – a 31 percent increase in just over 10 years. What factors are driving this growing trend and what does this foreshadow for the future? The paper tests various sociological and economic theories by constructing an economic model of where child-adults choose optimal levels of consumption, leisure and residential independence. The model's predictions are then tested empirically using annual data from the United States over the period 1983 to 2013. Previous research has focused on cross-section longitudinal studies of 10-year census data and used linear probability and logit/probit models to analyze behavior at the individual level. This paper uses annual time series data from 1983-2013 to examine the behavior of a cohort population using socio-demographic and economic variables for that specific cohort. Our results show that more males are living with their parents because of changes in the rent-to-home price ratio, unemployment rate among 25-34 year old males, and real wages. In addition, we find that changes in sociological factors such as the average age of first marriage, the level of educational attainment, and the birth rate contribute to the increase. Interestingly, student and consumer debt show little impact.

INTRODUCTON

The increase in young adults living with their parents has drawn attention recently in both academia and the popular press.[1] The 2011 Census revealed the percentage of 25-34 year old men living at home grew from approximately 13 percent in 2001 to 17 percent in 2011 – a 31 percent increase in just over 10 years.[2] Since that time, the percentage has remained elevated and was 16.8 percent as of 2013. This is not a merely a short-run impact of the Great Recession of 2007-2009 but is a trend that has existed over recent decades.[3] Moreover, the patterns are similar for young adults, regardless of socioeconomic status, and exist in many western European countries. Though many of the claims by the popular press are suspect, the overall trend is worrisome, especially for 25 through 34-year olds who are traditionally attaining their highest level of education, starting their careers, purchasing their first home and experiencing their first marriage and providing their own health and car insurance during this age period. What factors are driving this cohabitation and what do they bode for the future?

Answers to this question are provided from both the economics literature and the sociology literature. Economists focus on the constraints to independent living faced by adults that include wages, employment, housing prices and the burdens of consumer and student debt. Sociologists explore the preferences of young adults and examine factors such as the median age

of first marriage, the sex-ratio and birth rates which may contribute to the social stigma or acceptance that comes from adults co-residing with their parents.

This paper tests both sociological and economic theories by constructing an econometric model with data for 25-34 year old males from the United States over the period 1983 to 2013. The time series data provide insight into this cohort's long-term trend and short-term adaptations to recessions that occurred over this period. Regressors are carefully chosen to avoid spurious results from trending variables and potentially high multicollinearity. Regression results indicate that sociological factors such as the birth rate and the average age of first marriage and economic variables, such as the rent-to-home price ratio, unemployment among the cohort and their real wages, have significant explanatory power. Somewhat surprisingly, increases in student loans and credit card debt appear statistically insignificant.

The paper is organized as follows. Section 2 examines the empirical literature from both economics and sociology on adult-parent cohabitation. It reveals that the unemployment rate, real wages, costs of living expenses and debt among the male 25-34 cohort tell only a part of the story. Changes in social norms such as average marriage age, the birth rate and other social factors are important as well. Section 3 incorporates the empirical results into a standard consumer optimization model to provide insight into the relevant econometric model. Section 4 examines the data and methodology. Section 5 presents empirical results and section 6 concludes.

LITERATURE REVIEW

Economic constraints facing young adults, such as low or declining real wages, high unemployment and increasing costs of living, have been studied as causal factors in adult-parent cohabitation. The most common empirical studies apply linear probability models (LPM) and logit models to longitudinal data. Early research by Card and Lemieux (2000) focused on the impact of labor market conditions on cohabitation on 16-24 year olds in the six provinces in Canada and the nine regions of the United States for the years 1970, 1980, 1990 and 1993. Using a linear probability model, the authors found that decreases in wages and in local employment-population ratios (the authors' proxy for business cycle conditions) raised the likelihood of adult-parent cohabitation among the 16-24 year-old cohort. In particular, a 10 percent decrease in average real wages for the male cohort brought a 1.3 percentage point increase in the likelihood of adult-parent cohabitation. Every 10 percentage point decrease in the employment-population rate caused a 3.8 percentage point reduction in the likelihood of adult-parent cohabitation. Yelowitz (2007) shows that a one percentage point increase in unemployment lowers the probability of 18-34 year olds living independently by 0.9 percent over the time period 1980–2000. The same study shows that higher yearly earnings lower the likelihood of living at home by 36 percentage-points. Hill and Holzer (2007) show that hourly wages have a significant impact on adult-parent cohabitation for 20-22 year olds in 1984 and 2002 and that this relationship was robust to different gender, education, race, and ethnicities. The authors also claim that economic factors explain only a fraction of the increase in parental cohabitation. Kaplan (2012) explains the labor-market-uncertainty-cohabitation link by showing cohabitation provides insurance against potential job loss for adult children in periods of high labor market uncertainty and unemployment inter alia.[4] Bell et al (2007) provide support for the argument by showing how independent young adults suffered greater "income inadequacy" during the mid-

1980s to 2000 period than coresiding adults and concluding most of the increase in adult-parent cohabitation. Qian (2012) notes that the labor market risk is higher for younger workers than older because young workers have a greater likelihood of termination when employers follow a "last hired, first fired" rule.[5]

Higher housing expenses such as rent and home prices are often cited as contributing to the cohabitation trend. Haurin, Hendershott, and Kim (1993, 1994) use a cross-section of young adults in 1987 and show higher rents cause more young adults to cohabitate with parents. Yelowitz (2007) shows increases in housing prices, but not monthly rent, increase the likelihood of young adults living with parents. In particular, a $10,000 increase in the median house price leads to a 0.61-percentage-point increase in the likelihood an independent adult will cohabitate and a 0.21-percentage point increase in a cohabitor remaining in parental home. A $100 increase in monthly rent, however, caused a 0.82 percentage-point decrease in the likelihood of an adult remaining at a parental home. In the end, the author's results indicate that housing and rent costs explain no more than 15 percent of the total change in independent living arrangements over the 1980-2000 period.

The financial burden of student and consumer debt has received considerable attention of late. Dettling and Hsu (2014) argue that greater indebtedness, as measured by larger balances on student loans, credit cards and auto loans accounts, account for 30 percent of the increase in adult-parent cohabitation of 18-31 year olds since 2005. This impact on adult-parent cohabitation from higher debt is twice as large as the impact from economic variables (higher median housing prices and county wide unemployment). Other research suggests a minimal impact and present evidence that young adults' income has risen sufficiently to finance the higher debt. For example, Chiteji (2007) uses panel data to examine the relationship between debt among males and females ages 25-34 and "markers of adulthood" such as homeownership, marriage and parenthood. Her results indicate debt does not have a significant impact on these markers. In fact, from 1992 to 2007 the percent of households with credit cards fell from 70.7 percent to 66 percent by 2007, while the percent with credit card debt rose only slightly from 70.1 percent to 71.4 percent.

Many studies in the literature, such as Garasky, Haurin, Haurin (2001) indicate sociodemographic variables have a much larger impact than economic variables. A 2014 Gallup Poll revealed that marital status was the most significant predictor of whether a 25-34 year old lived with parents. Seventy-five percent of these adults who lived with their parents were single and never married. That was twice the rate among those of the same ages who lived on their own. As further evidence, ethnic groups whose cultural traditions support late marriages are more likely to live at home (Qian, 2012).[6]

The birth rate is also highly correlated with adult-parent cohabitation. Hill and Holzer (2006) show that having a child significantly reduces the likelihood of living at home. Glick and Lin (1986) examine this relationship going back to the 1940's to the early 1980's and postulate that decreases in birth rates result in less crowded and more accommodative parental homes thereby leaving more space and funds for young adults to live with their parents.

An increase in the sex ratio (the number of men to women in a reference population) may increase female bargaining power as more men compete with one another for relatively-scarce females. Theory indicates that a higher sex ratio may lead to higher male earnings, labor force participation and lower unemployment (Angrist, 2002). To achieve higher earnings, males have been shown to increase their pre-marital investments, measured by years of education, literacy and occupational choice when the sex ratio increases. Lafortune (2013) shows that "a

change in the sex ratio from one to two leads men to increase their educational investment by 0.5 years on average. . ."

For men and women between ages 25-34, increases in educational attainment decrease the likelihood of adult-parent cohabitation regardless of factors such as marital status, employment, income, and labor force participation. In particular, Qian (2012) reports that 25-34 year olds who were "never married", "divorced", or "married" are all less likely to live with their parents as educational attainment rises. Similarly, those with "some college" were less likely than those with only a high school degree to live with their parents. Those with salaries greater than $20,000, less than $20,000, those in school, unemployed, and not in the labor force, all show decreasing likelihood of living with parents for higher educational attainment.

THE MODEL

To model the interaction of the salient variables from the literature review, we consider the optimization problem facing an adult child deciding whether to coreside with parents. Useful models of household formation decisions include McElroy (1985) who constructed a utility maximization model with Nash bargaining to derive indirect utility functions that jointly determine work, consumption and household membership. Rosenzweig and Wolpin (1993) design a model that compares co-residence as a mechanism by which altruistic parents support their children with the financial transfers from the parent under separate residence. Other optimization models include Manacorda and Moretti (2006), Ermisch and Di Salvo (1997), and more. Common factors that emerge in most utility functions for the co-residence decision include a disutility from co-residence (generated by a social stigma or a privacy cost) and the provision of a household good that has public good qualities. The budget constraints of adult children commonly include the price of housing, market wage, and transfers from parents.

We imagine the child maximizing utility subject to an income and time constraint. Utility comes from consuming a private good, C, which is rivalrous and excludable along with a household good, G which is non-rivalrous and non-excludable and can be provided by the child g_c or the parent g_p. Private goods include things such as shoes and clothing while household goods consist of furniture, appliances, items sold in sets (e.g., dinner plates and eating utensils), and other shared goods. Though most goods lie between the private-public extremes, we can examine the polar cases without loss of generality. The utility function is given by:

$$U(C, g_c, l, \phi) = C^{1-\alpha-\beta} G^{\alpha} l^{\beta}(1 + v\phi) \tag{1}$$

with $G = g_c + (1 - \phi)g_p$ as done in Kaplan (2010). The parameter v is a vector of attributes and conditions that affect the child's preference for independence. The independence parameter, ϕ, ranges from total dependence, $\phi = 0$, to complete independence, $\phi = 1$. Sociodemographic factors such as the average age of first marriage, the sex ratio, the level of educational attainment and the birth rate are assumed to determine the preferences for adult-parent cohabitation. In particular, the social stigma of living with one's parents as an adult has been shown to be lower in societies where men marry later, have fewer children, and are outnumbered by women in their cohort.

In addition to consumption goods, C and G, the child's income may also go toward interest payments, r, on debt, D, for which some percentage, χ, is subsidized (as done for student loans). The price of housing, P_H, given by the rent-to-price ratio which is the average rental

price divided by the average house price. If rental prices decline, P_H decreases, and the burden of living independently is eased. If average house prices rise, young adults are less likely to purchase a home but their parents – a group who is more likely to own a home – may experience a positive wealth effect. Thus, P_H may decline from an increase in home prices which may spur more transfers to adult children, easing the financial burden of moving out of their home.[7] Independent children's housing costs are halved if married or partnered, $k = 2$.

Goods are purchased with income derived from hours worked L at the real wage, w, transfers from parents or government, T and interest, r, on real assets, A. The private good is the numeraire good while the household good is priced at P. The budget constraint is as follows:

$$wL + T + rA = C + Pg_c + \chi rD + \phi \frac{P_H}{k} \tag{2}$$

With total time divided among leisure and hours worked – i.e., $1 = L + l$ – the child's maximization problem is:

$$Max_{C,\, gc,\, l,\, \phi}\, C^{1-\alpha-\beta} G^{\alpha}\, l^{\beta}(1 + v\phi) \text{ subject to } w(1 - l) + T + rA = C + \chi rD + \phi \frac{P_H}{k} + g_c \tag{3}$$

The Lagrangian, M, for this problem is:

$$M = C^{1-\alpha-\beta}(g_c + (1 - \phi)g_p)^{\alpha}\, l^{\beta}(1 + v\phi) + \lambda(wL + T + rA - C - \chi rD - \phi \frac{P_H}{k} - g_c) \tag{4}$$

The demand for independence is derived by taking setting the derivatives of the Lagrangian with respect to C, g_c, l, ϕ, and λ equal to zero, $\frac{\partial M}{\partial C} = 0$, $\frac{\partial M}{\partial g_c} = 0$, $\frac{\partial M}{\partial l} = 0$, $\frac{\partial M}{\partial \phi} = 0$, $\frac{\partial M}{\partial \lambda} = 0$, and solving for ϕ^*, which is:

$$\phi = \frac{T + w + rA - r\chi D + Pg_p}{2(Pg_p + \frac{P_H}{k})} - \frac{1}{2v} \tag{5}$$

Equation (5) indicates that the optimal amount of independence is positively related to real transfers, the real wage, real net worth, being partnered and the social norm for independence. These signs conform to the results from the empirical literature.[8] The last two factors indicate that a delay in the average age of marriage will decrease an adult-child's desire to live independently as will a decrease in the birth rate and the cohort's sex ratio. Independence is negatively related to the price of housing, the price of household goods and the amount of consumer and student debt. The real interest rate is positively related to independence if the value of assets owned exceeds the value of subsidized debt owed.

DATA AND METHODOLOGY

cohort's average real weekly wage and the percentage cohabiting with parents comes the *Current Population Survey's Median Usual Weekly Earnings (all occupations)* and *Table AD-1 Young Adults Living At Home: 1960 to Present*, respectively. The average cohabitation percentage was approximately 15 percent with a peak of 17.1 percent in 2011 and a low of 12.86 percent in 2000. The average real weekly wage was $700 and fell consistently from 1983 to 1995, grew from 1996 until 2002 when it peaked at $746, after which it fell and remained low ending at $706 in 2013.

Table 1
SUMMARY STATISTICS

	Birth Rate	Labor Force Rate	% Males at Home	Unemployment Rate	Marriage Age	% with only HS Degree	% with at least BA Degree	Educational Exp	Rent Price	Health Care Exp	Net Assets	Transport Exp	Wage	Male to Female Ratio
Mean	14.6	92.43	14.72	6.25	26.89	34.51	26.72	627	4.71	1603	-3809	8779	700	100
Median	14.3	93.00	14.57	5.86	26.9	32.35	26.79	627	4.93	1553	-2792	8795	700	100
Max	16.7	94.70	17.10	10.95	29	41.33	31.32	1029	5.33	2079	6033	10329	746	102
Min	12.6	88.8	12.86	3.38	25.4	29.1	23.32	350	3.10	1267	-25120	7135	656	97
Std. Dev.	1.09	1.76	1.17	2.03	0.94	4.01	2.11	205	0.61	217	6406	795	26	1.095
JB Prob	0.64	0.23	0.51	0.13	0.65	0.17	0.66	0.39	0.004	0.50	0.000	0.73	0.60	0.63
Obs	31	31	31	31	31	31	31	30	31	30	30	30	31	31
Unit Root	Y	Y	Y	N*	Y	Y	Y	N**	N**	Y	N	Y	Y	Y

N* = no unit root at 5% level when intercept is included, N** = no unit root at 5% level when trend and intercept are included

Data on the cohort's unemployment rate and labor force participation rate came from the *Bureau of Labor Statistics*. The cohort unemployment rate serves as a proxy for the impact of the business cycle on this particular group. The mean and median male unemployment rate was 6.25 and 5.86 percent, respectively, for our cohort with a peak of 10.95 percent in 2009 and a low of 3.38 in 2000.

The measure used for housing costs is the rent-to-home price ratio calculated from the *Case-Shiller Rent Price* data. This ratio ranged from 4.93 to 5.33 over the 1983-2013 period. This ratio is preferred to other measures of housing costs, such as average fair market rents, annual per-capita housing expenditures, and home sale prices, which were highly multicollinear with important sociodemographic factors in the model and rendered them statistically significant.[9] For example, average 2-bedroom fair market rents have a 0.97 correlation with marriage age, suggesting that the postponement of first marriage leads to more adults renting thus driving up the rental price, which confounds the relationship between adult-parent cohabitation and rental prices.[10] Another alternative measure, total housing expenditures, is statistically insignificance as is expected if higher rental prices cause reductions in demand for housing.[11]

Table 2
CORRELATION

	% Men at Home	Birth Rate	Unemployment T Rate	Marriage Age	% BA Degree Plus	% High School Degree Only	Educational Exp.	Rent Price	Health Exp.	Change in Assets	Transportation Exp.	Wage
% Men at Home	1											
Birth Rate	-0.325	1										
Unemployment Rate	0.596	-0.293	1									
Marriage Age	0.576	-0.874	0.395	1								
% BA Degree Plus	0.138	-0.860	0.194	0.795	1							
% High School Degree Only	-0.143	0.929	-0.051	-0.836	-0.842	1						
Educational Exp.	0.352	-0.891	0.302	0.902	0.855	-0.863	1					
Rent Price	0.342	0.220	0.387	-0.268	-0.285	0.452	-0.344	1				
Health Exp.	0.480	-0.814	0.427	0.942	0.790	-0.799	0.896	-0.336	1			
Change in Assets	0.109	0.432	-0.116	-0.346	-0.281	0.498	-0.510	0.451	-0.365	1		
Transportation Exp.	-0.442	-0.460	-0.474	0.250	0.554	-0.611	0.455	-0.538	0.252	-0.329	1	
Wage	-0.418	-0.509	-0.002	0.339	0.737	-0.566	0.486	-0.376	0.386	-0.382	0.616	1
Sex Ratio	-0.338	-0.190	0.051	0.057	0.138	-0.239	0.207	-0.387	0.142	-0.527	0.352	0.48

Annual average inflation-adjusted living expenses for the combined cohort from 1984 to 2013 came from the *Bureau of Labor Consumer Expenditure Survey*. Though a negative impact from these expenditures is often cited in popular media, none is statistically robust in explaining adult-parent cohabitation when controlling for other economic and social factors. These measures included education expenditures that rose 145 percent from $396 to $968 from 1984 to 2013, transportation expenditures that rose 4.3 percent from $8,361 to $8,720, health care expenditures that rose 53 percent from $1,360 to $2,079 and housing expenditures that rose 53 percent from $1,360 to $2,079.[12] Credit card debt has also grown over this period. Draut and Silva (2004) report the average credit card debt of 24-35 year olds rose 55 percent from $2,640 to $4,088 (in 2001 dollars) between 1992 and 2000.

While college tuition and fees have risen steadily over the past few decades, government grants have fallen and student loans have risen. Specifically, the average inflation-adjusted tuition at 4-year colleges has risen 163 percent, from $10,373 in 1983 to $27,293 in 2012, while that for public 4-year college tuition 230 percent, from $2,305 in 1983 to $7,605 in 2012.[13]

Educational attainment data come from the *U.S. Census Bureau, Current Population Survey, 2013 Annual Social and Economic Supplement*. Within our data set, a higher percentage of bachelor and advanced degrees within the 25-34 year old male cohort is negatively correlated (-0.16) with adult-parent cohabitation, while a higher percentage of high school-only degrees is positively correlated (0.15) with adult-parent cohabitation. Educational attainment is highly correlated with the real wage for our cohort. A higher percentage of males with bachelor and advanced degrees is positively correlated with the real wage (0.74) and a higher percentage of males with only a high school degree is negatively correlated with the real wage (-0.56). Increases in the male-to-female ratio are positively correlated with the percentage of the population acquiring bachelors and advanced degrees and negatively correlated with the population percentage with only high school degrees, as implied by LaFortune (2013) and Angrist (2002).

Birth rate comes from *US Department of Health and Human Services*. The median age of first marriage and the sex ratio are derived from male and female population data from the

Census Bureau's Current Population Survey, Annual Social and Economic Supplement. As with the economic variables, many of the social ones are highly correlated and serve as substitutes for one another in the analysis. Birth rate and median age of first marriage have a correlation of -0.87.

Creating a robust econometric model to estimate the causal impacts of economic and sociodemographic variables on adult-parent cohabitation using time series data requires testing and correcting for potential multicollinearity, non-normality of errors, reverse causality and unit-root processes. The potential for multicollinearity is evident from the high correlation between many of the variables in Table 2. Correlations above 0.80 – equivalent to a Variance Inflation Factor, VIF > 5 – are problematic. To avoid excluding potentially useful variables, however, those with significant *t*-stats and variable signs that conformed to theory were included in regressions even when their VIFs exceeded 5.

EMPIRICAL RESULTS

Table 3 and Table 4 show the regression results for various OLS modeling specifications using the percentage of males 24-34 living with parents and its logged value as dependent variables. The negative impacts of higher unemployment and lower real wages for this male cohort are statistically significant and robust throughout the various model specifications. A $100 increase in average weekly wages decreases cohabitation by 2 to 2.7 percentage points. The logged model indicates a 1 percent increase in weekly wages decreases cohabitation by 1 to 1.3 percent. A one percentage point increase in the cohort's unemployment rate causes a 0.07 to 0.13 percentage point increase in cohabitation. These two variables are shown to explain more than 75 percent of the variation when accounting for serial correlation.[14]

The cost of housing, as represented by the rent-to-home price ratio, is significant in most models. Each increase in the rent-to-home price ratio causes cohabitation to increase by 0.43 to 0.61 percentage points. For the logged model, a one percent increase in the rent-to-house price ratio causes a 2.6 to 3.7 percent increase in adult-parent cohabitation.

The significance of expenditures of 25-34 year olds males is not robust when controlling for sociodemographic factors. Health care expenditures, changes in net assets, and education expenditures for this group have the correct signs, but are insignificant when the median age of first marriage and/or the birth rate is included in the model. The aggregation of this data may confound important variable relations. For example, it is possible that the increase in educational costs, financed in large part by credit card debt (due to lower government grants), are offset by the increase in real wages for those who completed college while those without a college or advanced degree may experience higher unemployment and decreasing real wages such that the overall real wage remains relatively constant. If so, tuition and credit card debt can rise significantly but not have a statistically significant impact on adult-parent cohabitation for the 25-34 cohort when controlling for their unemployment rate and real wage.

Table 3
REGRESSION RESULTS
DEPENDENT VARIABLE: MALES AT HOME

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Intercept	26.32 ***	25.82 ***	-17.71	-18.02	-10.41	-37.44 ***	-12.25	1.83	-14.39 **	-13.11 **	-10.41
Male Weekly Wage	-0.017 ***	-0.018 ***	-0.026 ***	-0.025 ***	-0.027 ***			-0.022 ***	-0.021 ***	-0.021 ***	-0.027 ***
Male Unemployment Rate	0.192 ***	0.162 *	0.110 *	0.124 *	0.126 *			0.095 *	0.066 **	0.0623	0.126
Average US Rent-Home Price Ratio		0.20	0.612 ***	0.540 ***	0.594 ***				0.453 ***	0.429 ***	0.594 ***
Log(Health Care Expenditures)			6.344 ***	6.366 ***	4.943 **						4.943 **
Net Assets (in $100)				0.001							
Log(Education Expenditures)					0.626						0.626
% of 25-34 Males with HS Degree Only						0.40 ***	0.37 ***	0.21 *	0.114 **	0.131	
Male Marriage Age						1.69 ***	1.59 ***	1.23 ***	1.38 ***	1.363 ***	
Birth rate						-0.48 **	-0.50	-0.387 *		-0.08	
Male-to-Female Sex Ratio							-0.21 *	-0.07			
AR(1)	0.83 ***	0.84 ***									
Adjusted R^2	0.79	0.79	0.75	0.79	0.75	0.70	0.73	0.87	0.90	0.89	0.75
Durbin-Watson	2.41	2.50	1.55	1.55	1.46	1.16	1.35	2.07	2.34	2.37	1.46
Jarque-Bera (prob)	0.51	0.45	0.95	0.76	0.83	0.38	0.21	0.63	0.49	0.52	0.83
Number of Obs.	30	30	30	30	30	31	31	31	31	30	30

All values are in inflation adjusted and specific to 25-34 year-old males except where stated.
* Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

A model with only sociodemographic data, such as Model VII, can explain 73 percent of the variation in cohabitation. Once unemployment and real wages are added, the explanatory power rises above 87 percent as in Models VIII-X. The remaining analysis will be done on the non-logged and logged versions of Model IX as they are theoretically consistent and appear most robust (i.e., have the maximum number of observations, the highest adjusted R^2 values, statistically significant coefficients, normally-distributed errors, and other strong modeling properties). In addition, Model IX has less multicollinearity than other specifications further bolstering confidence in our inferences. A Ramsey RESET test with one, two and more fitted terms shows no modeling misspecification (each test's *F*-stat probability above 0.4 for a null hypothesis of no modeling misspecification). The model IX results from table 3 are as follows.

$$Males\ at\ Home_t = -14.39 - 0.021W_t + 0.07U_t + 0.45Rent_t + 0.11OnlyHSdegree_t + 1.38MarriageAge_t$$

The existence of unit roots in the regression variables indicates that the regression results may be spurious. Only the unemployment rate and rent-price ratio are stationary, and only trend stationary at that. The validity of a nonstationary OLS model depends upon the model being theoretically consistent and the errors being stationary. Regarding the first criterion, the model coefficients have the proper signs as shown in equation (5) and reasonable magnitudes. Regarding the second criterion, an Augmented Dickey-Fuller (ADF) test of the model errors rejects the null hypothesis of a unit root at the 2.02 percent significance level.

Table 4
REGRESSION RESULTS
DEPENDENT VARIABLE: LOG(MALES AT HOME)

	I	II	III	IV	V	VI	VII	VIII	IX	X	XI
Intercept	8.018 ***	8.012 ***	7.54 ***	7.346 ***	8.603 ***	-0.897 **	0.813 ***	7.599 ***	6.314 ***	6.448 ***	8.346 ***
Log(Male Weekly wage)	-0.821 ***	-0.825 ***	-1.238 ***	-1.21 ***	-1.289 ***			-1.048 ***	-1.004 ***	-1.012 ***	-1.300 ***
Male Unemployment Rate	0.014 ***	0.012 *	0.008 *	0.009 *	0.012 **			0.006 **	0.005 **	0.004	0.009 **
Average US Rent-Home Price Ratio		0.012	0.037 ***	0.032 ***	0.026 *				0.027 ***	0.026 ***	0.036 ***
Log(Health Care Expenditures)			0.411 ***	0.413 ***	0.257						0.323 **
Net Assets (in $100)				0.0001	0.0002 *						
Log(Education Expenditures)					0.070 *						0.040
Percentage of Male 25-34 with HS degree only						0.027 ***	0.025 ***	0.014 **	0.008 ***	0.009	
Male marriage Age						0.115 ***	0.108 ***	0.084 ***	0.093 ***	0.092 ***	
Birth rate						-0.029 *	-0.030	-0.024		-0.005	
Male-to-Female Sex Ratio							-0.014	-0.005			
AR(1)	0.81 ***	0.82 ***									
Adjusted R^2	0.79	0.78	0.74	0.73	0.74	0.69	0.73	0.87	0.89	0.88	0.74
Durbin-Watson	2.39	2.44	1.50	1.58	1.52	1.15	1.35	2.1	2.30	2.33	1.43
Jarque-Bera (prob)	0.44	0.41	0.96	0.85	0.48	0.45	0.21	0.62	0.47	0.49	0.85
Number of Obs.	30	30	30	30	30	31	31	31	31	30	30

All values are in inflation adjusted and specific to 25-34 year-old males except where stated.
* Significant at the 10% level, ** Significant at the 5% level, *** Significant at the 1% level.

The OLS results do not change significantly when we incorporate the cointegration into the model using a Canonical Cointegrating Regression, CCR, and Fully-Modified OLS, FMOLS. The CCR model (Park, 1992) transforms the variables using stationary components in a cointegrating model that results in error terms uncorrelated with the regressors. The procedure has been shown to yield asymptotically efficient estimators in small samples where the error term is normally distributed, as in this model (Han, 1996). The CCR yields the following results (the three asterisks indicate significance at the 1% level):

$$Males\ at\ Home_t = -18.70^{***} - 0.020W_t^{***} + 0.05U_t + 0.48Rent_t^{***} + 0.14OnlyHSdegree_t^{***} + 1.49MarriageAge_t^{***}.$$

Similar to the CCR method, the FMOLS method (Phillips, 1992) generates asymptotically unbiased and efficient parameter values using a semi-parametric correction to eliminate problems caused by long-run correlations among stochastic regressors and the cointegrating equation. The FMOLS for our model yields the following results:

$$Males\ at\ Home_t = -20.76^{***} - 0.020W_t + 0.03U_t^{***} + 0.49Rent_t^{***} + 0.15OnlyHSdegree_t^{***} + 1.55MarriageAge_t^{***}.$$

The only significant difference is that male unemployment is shown to be statistically insignificant. For the logged version of Model IX from Table 4, we get the following results:

$ln(Males\ at\ Home_t) = 6.31 - 1.0ln(W_t) + 0.005U_t + 0.03Rent_t + 0.01OnlyHSdegree_t + 0.09MarriageAge_t$.

As with the non-logged model, the Ramsey RESET test with one, two, and more fitted terms shows no modeling misspecification. An Augmented Dickey-Fuller (ADF) test of the log model errors rejects the null hypothesis of a unit root at the 1.42 percent significance level. Like the non-logged Model IX, the OLS results do not change significantly when we incorporate the cointegration into the model using the CCR and FMOLS forms. As with the previous case, only the statistical insignificance of male unemployment differs from the original model. The CCR yields the following results (the three asterisks indicate significance at the 1% level):

$ln(Males\ at\ Home_t) = 5.81^{***} - 0.97ln(W_t)^{***} + 0.003U_t + 0.03Rent_t^{***} + 0.01OnlyHSdegree_t^{***} + 0.10MarriageAge_t^{***}$.

The FMOLS yields the following results:

$ln(Males\ at\ Home_t) = 5.62^{***} - 0.96ln(W_t)^{***} + 0.002U_t + 0.03Rent_t^{***} + 0.01OnlyHSdegree_t^{***} + 0.11MarriageAge_t^{***}$.

CONCLUSION

So why are more men living with their parents—so called adult-parent cohabitation? Results from our time-series models support the economic literature that labor market conditions, especially lower real wages and higher unemployment, contribute significantly to the variation in cohabitation. In particular, a $100 decrease in average weekly wages increases male adult-parent cohabitation by 2 to 2.7 percentage points. A one percent increase in the cohort's unemployment rate causes a 0.07 to 0.13 of a percentage point increase in adult-parent cohabitation. The cost of housing also contributes, such that a one-unit increase in the rent-to-home price ratio causes a 0.5 percentage point increase in cohabitation.

Our results also support the sociodemographic literature that educational attainment and the median age of first marriage contribute to cohabitation. In particular, a 10 percentage point increase in the percentage of the 25 to 34-year old male population that do not progress beyond a high school diploma causes a 1.5 percentage point increase in cohabitation. A one-year increase in the median age of first marriage for males causes a 1.5 percentage point increase in cohabitation.After controlling for the above variables, other economic variables from the literature, such as student and consumer debt, health care expenditures, and the employment-to-population ratio, appear statistically insignificant. Similarly, sociodemographic variables, including the sex-ratio and birth rate, appear statistically insignificant, as well. Though the majority of these variables are correlated with adult-parent cohabitation, they are not statistically robust to different regression forms and their inclusion creates problematic multicollinearity without providing any additional predictive value. For example, the male-to-female ratio is cited as being important to cohabitation. As females become relatively scarcer, men competing for these potential mates are less likely to live with their parents. This outcome of male competition, however, is captured sufficiently by the changes in wages and educational attainment caused by

such competition. The correlation between the sex-ratio and wages is 0.48 and wages are negatively correlated at -0.42 with adult-parent cohabitation. In other words, the sex ratio variable provides no additional predictive power beyond its impact on wages and educational attainment though it has a -0.34 correlation with adult-parent cohabitation in our time series data. Similarly, educational expenditures are cited as being important to cohabitation but their impact on cohabitation also appears to be captured through the changes in educational attainment (with which they have a 0.86 correlation) and wages. Thus, the results suggest that the economic and demographic variables in the logged and non-logged version of our representative model (Model IX) account for many of the effects of these frequently-cited factors over the 1983-2014 period and explain much of the rise in adult-parent cohabitation among males aged 25-34.

ENDNOTES

1 The popular media has recently focused on stories of highly-educated children living at home with their parents, attributing the cause to increased student loan and credit card debt. The trend exists, however, for all socioeconomic cohorts and for all levels of educational attainment.

2 Qian (2012) shows that the 25-34 year old adult-parent cohabitation increased more in the 2007-2009 recession than in previous recessions going back to the 1980s and 1990s.

3 The *Time* Magazine cover headline in 2005 "*Meet the Twixters, young adults who live off their parents, bounce from job to job, and hop from mate to mate. They're not lazy. . . They Just Won't Grow Up.*" is representative of such views.

4 Kaplan (2010) claims labor market fluctuations explain the majority of the *Boomerang* phenomenon, by which formerly independent adult children move back into parent households: "[c]ontrolling for a host of observable characteristics, as well as unobserved heterogeneity, I find that the effect of transitioning from employment to non-employment is to increase the hazard of moving back home by 64 percent for males and 72 percent for females. Although non-labor market factors (marriage, childbirth, parental circumstances) also play an important role, co-residence movements, and household formation in general, is very much an economic phenomenon."

5 Qian (2012) also argues that unemployment may impact the decision to cohabitate with parents more than changes in real wages "the unemployed had the highest percentage for living at home, followed by those with incomes lower than $20,000 . . ."

6 Asian Americans, one of the common ethnic groups to marry later, are also more likely to live in expensive regions which itself contributes to higher adult-parent cohabitation (Qian, 2012).

7 The authors thank an anonymous reviewer who suggested house price increases could decrease transfers if higher property taxes and insurance premiums result and outweigh the wealth affect. The authors do not have strong intuition about which would prevail.

8 Results do not change significantly if utility is assumed to exhibit constant returns in the private goods, l and C, the utility function can be specified as $U = C^{1-\beta}G^{\alpha}l^{\beta}(1 + v\phi)$ which gives a similar demand for independence of $\phi = \frac{T + w + rA - rcD + Pg_p}{(2 + a)(Pg_p + P_H k)} - \frac{(1+a)}{v(2+a)}$.

9 The HUD's annual average fair market rent for 2-bedroom apartment was used but was statistically insignificant. Similar to the results from Yelowitz (2007), it was highly collinear with other data causing troublesome levels of multicollinearity in many specifications.

10 The Bureau of Labor's Real Housing Expenditures of 25-34 year olds gave similar but less statistically significant results in addition to being highly multicollinear with the other variables, making parameter inferences suspect. Consumer Expenditure Survey calculates housing expenditures for 25-34 year olds was used as well which gave similar results but was statistically insignificant and was highly collinear with other data causing troublesome levels of multicollinearity in many specifications.

11 Housing expenditures matters. Housing expenditures exceeding thirty percent of household income have historically been considered an indicator of housing being unaffordable and this ratio for men and women 25-34 combined rose from 28.3 percent in 1980 to 41.3 percent in 2009, according to Demos analysis of American Community Survey data. Regressing logged real housing expenditures lagged one year against the rent-house price ratio indicates our cohorts adjust to higher prices by reducing housing demand.

Average real housing expenditures remain constant or even fall slightly with higher rents, correcting for serial correlation.

12 The log of real average health care expenditures was found to have statistical significance but only for 2 model specifications but was not robust to other specifications. Draut and Silva (2004) report that nearly fifty percent of uninsured adults aged 19 to 29 reported difficulty paying medical bills.

13 Avery and Turner (2012) present arguments for an under-borrowing by college students. "The claim that student borrowing is "too high" across the board can – with the possible exception of for-profit colleges – clearly be rejected. Indeed, media coverage proclaiming a "student loan bubble" or a "crisis in student borrowing" even runs the risk of inhibiting sound and rational use of credit markets to finance worthwhile investments in collegiate attainment" (2012, p 189).

14 Both the employment-population ratio of 25-34 year old men and their labor force participation rate were used as substitutes for male unemployment and neither changed the parameter values significantly but each introduced greater multicollinearity than the cohort unemployment rate. In addition, the US unemployment rate was used as a recession proxy but had the same negligible effect and high multicollinearity.

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MEASURING KNOWLEDGE IN PRINCIPLES OF ECONOMICS COURSES

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ABSTRACT

Students enter introductory economics courses carrying a set of preconceived notions about the economy. These beliefs can shape their worldview and learning environment. This paper examines student factual knowledge and biases regarding key economic indicators both before and after taking introductory economics. Results indicate that students' awareness of unemployment and inflation rates are upwardly biased, while their beliefs regarding income growth are downwardly biased. If left uncorrected, these biases may hamper a student's ability to understand economic theories and models. These results can provide direction for tailoring educational approaches to more effectively engage student demographic cohorts that underperform.

INTRODUCTION

The subject of student learning is a perennially popular topic in academics. Pressure from all quarters to demonstrate student learning outcomes has increased in recent years, culminating in the 2011 book *Academically Adrift: Limited Learning on College Campuses* by Richard Arum and Josipa Roksa. *Academically Adrift* chronicles the lack of student learning in the modern classroom and calls for increasing the rigor of the classroom experience. Every semester, thousands of college students enroll in principles of economics courses throughout the world. Depending on their high school curriculum, they often enter the course with little to no training in the subject manner. In 2011, the Council for Economic Education reported in its "Survey of the States" that 22 states require a high school course in economics. In 2014, the same report listed 24 requiring states. Instructors typically expect most students entering their introductory courses and all students completing their courses to have some awareness of the historical and current trends surrounding common economic variables such as inflation, unemployment, and growth. Do they possess this awareness, and how accurate are their beliefs about the economy? This study examines the factual economic knowledge held by Principles of Economics students, both at the beginning and end of the semester.

The study data was collected at a regional four-year open enrollment institution having a total student head count of approximately 7,000. Typical for a regional institution, the students represent a wide variety of demographic, age and income levels. As such, it is reasonable to assume that student knowledge about economic issues mirrors the knowledge base of the general public that they come from. As Nobel laureate James Buchanan (1993, p.10) notes, there is a public attitude that "The operation of markets is within the working knowledge of everyone.

Every man his own economist or "do-it-yourself economics" has been a characteristic feature of policy discourse since the professionalization of the science." Steven Miller (2009, p 33-4) builds on the remarks of Buchanan by observing "The phrase "every man his own economist" is at the heart of the belief gap between economists and the public. The public may well disregard economic theory and evidence because they believe themselves to be closer observers of the most important economic issues."

Although students typically enter principles of economics classes with scant economics training, the "every man his own economics" bias may lead them to *overestimate their knowledge* about the economy. In addition, they may be less inclined to change their beliefs, as they may place less credibility in the teachings of experts. Miller uses Paul Krugman to support his case that the discourse between economist and the public is dissimilar to most relationships between an expert and a layperson. In most disciplines the layperson will defer to the opinion of the expert. Krugman (1996, 78-9) notes that "When it comes to economics…it seems to be generally accepted that there is no specialized knowledge to master. Lawyers, political scientists, historians cheerfully offer their views on the subject." Thus everyone feels qualified to hold their 'expert' opinion merely because they participate in the economy. Miller (2009, p. 33) asserts that "many non-economists are willfully ignorant of economic theory, yet at the same time eager to denounce it."

The implication is that despite the fact that students may have been exposed to economic facts through the media or academic coursework, they may willingly choose to cling to possibly distorted beliefs regarding the economy. Often these distortions and biases reflect the opinions of informal teachers: parents, family members, friends, etc. Long before taking an economics course, students likely listened to the viewpoints of this set of trusted individuals and then, compiling those tidbits, formed their own thoughts about how the economy works. As Caplan (p. 132) notes in his 2007 book, "rational irrationality" is the premise that people form and hold onto these misconceptions if there is little or no cost associated with being wrong. These misconceptions are like a security blanket, cocooning the student in the glow of (false) knowledge and eliminating the need to actually think and evaluate facts and economic positions. An eye-opening anecdote regarding student clinging to preconceived beliefs comes from Harvard physicist Eric Mazur as he recounts a conversation with a student concerning material in his course (Mazur, 2009).

> *"I expected that the students would have no trouble tackling such questions, but much to my surprise, hardly a minute after the test began, one student asked, 'How should I answer these questions? According to what you taught me or according to the way I usually think about these things?'"*

The above observations beg the question: are our students failing to learn basic economic facts because of the (ill-informed) knowledge and biases that they carry into the class? In a 1999 study, Walstad and Allgood show that principles of economics classes seem to add fairly little to college seniors' economic knowledge. They find that students who did not have an economics course answered 48 percent of questions correctly concerning basic economic concepts, while students who took an economics course answered 62 percent of the questions correctly. This brings up the question of why students struggle to grasp even the very basic economic concepts taught in a principles course. Students being "rationally irrational" by clinging to the prejudice of prior misinformation may explain Walstad and Allgood's (1999) findings that principles of economics courses add little to college seniors' knowledge.

In response to this, the economics literature gradually began to focus on misperceptions and their effects on student learning.

Tang and Robinson (2004), expanding on Meyer and Shannon (2002), find that students have high misconceptions about basic economic statements. Additionally, they find that students with greater misconception struggle more than students with less. For example, students that believe "Economics is the study of money" tend to have more difficulties thinking like an economist compared to students with fewer misconceptions. Goffe (2013) finds that students entering Principles of Macroeconomics courses have significant biases towards economic facts and beliefs. He finds that students answer the questions from the Survey of Americans and Economists on the Economy (SAEE) (1996) survey more similar to the general public (that typically hold a pessimistic view of the economy) than to professional economists at the beginning of his courses.

Following the above body of literature, we explore the extent and persistence of student bias about economic facts at the beginning and the end of Principles of Economics courses. We are interested in the effect that exposure to new economic information (through introduction of economic facts and theories) has on student knowledge about the conditions and performance of the economy. Most research surrounding economic education has followed a traditional path of using input-output models to examine performance of students in the courses. These studies typically used variables observed at the student-level such as age, gender, ACT score, etc. to predict performance. Our research deviates from the typical input-output model of economic research into one that focuses on student learning (i.e., how much additional knowledge do students have after they complete a course in principles of economics). Building on the foundation laid by Miller (2009) and Goffe (2013), we explore the relationship between incoming and outgoing knowledge and bias about economic facts.

METHODS

In order to measure student knowledge of economics, we administer a pre- and post-survey to students in every section of principles of economics during both the fall and spring of the 2011 and 2012 semesters. The sample represents a total of 14 sections of principles of microeconomics, 20 sections of principles of macroeconomics, and 958 students.

Students were asked to provide answers to the best of their ability for the following historical questions regarding the U.S. economy from 1950-the present:

Average annual U.S. unemployment rate
Average annual U.S. inflation rate
Percentage growth in real income (over the entire period)
The number and average duration of U.S. recessions (over the entire period)

Students were also asked to supply their best estimate of the following questions regarding the current U.S. economy:

Current U.S. unemployment rate
Current U.S. inflation rate
Percentage of U.S. workers employed at minimum wage jobs
Proportion of federal income tax paid by the top 20 percent of income earners
Proportion of federal income tax paid by the bottom 20 percent of income earners

Finally, students were asked to project the following measures over the next 60 years for the U.S. economy:

Average U.S. unemployment rate
Average U.S. inflation rate
Total rate of real income growth per capita

In order to aggregate the data across semesters and years and to make the data easier to interpret, the observations were centered about the 'truth'. This was done by subtracting the actual measure (e.g. the current unemployment rate) from the student's estimate. This results in a measure of bias. For example, if the student believed the unemployment rate was 10.2 percent when it was actually 7.8 percent, we report a measure of bias of positive 2.4 (10.2-7.8). This process allowed aggregation across time (as the true values change from semester to semester and year to year), and lead to a measure that is easier to interpret. When students were asked about questions that had no 'truth' (for example, the future unemployment rate or percentage of prices controlled by the government), we did not calculate bias and instead reported the numbers in their natural units of measure.

From the students' responses, it became apparent that a very small minority of students either did not understand the questions or concepts that were asked of them, or purposefully chose to respond with highly unrealistic answers. For example, one student answered the question of average inflation rate with an astronomically high number of 1,000 percent per year. Including such outliers into any calculation involving the mean or variance had the potential to dramatically skew the results. To alleviate any distortions from outliers, the following percentiles are reported for each variable: 5^{th}, 25^{th}, 50^{th} (median), 75^{th}, and 95^{th}. In addition, the percentage of students with a positive bias, the mean, and standard deviation for the middle 90 percent of the data is reported, and a t-test of the difference between the pre- and post- sample means for the middle 90 percent is conducted. By excluding the top and bottom 5 percent, potential problems concerning any outliers that can spoil the reliability of the mean, standard deviation, and t-tests is addressed.

RESULTS

Unemployment

Table 1 provides a summary of the student biases to questions about unemployment. Across the board, students exhibited a large positive bias regarding unemployment. This means that students typically overestimated the unemployment rate compared to the truth (both historically and currently). Almost three-quarters or 73.5 percent of the students entered the classroom with a positive bias about the current level of unemployment, and 86.8 percent began the semester with a positive bias about the historical unemployment rate. On the first day of class, the median student believed the current unemployment rate was 2.6 percent higher than it actually was, while they believed the historical rate was 4.3 percent higher than it actually was. Although a substantial positive bias remained at the end of class, student bias did decrease as a result of their experience in class. These decreases were statistically significant at the 1 percent level. This indicates that student knowledge regarding unemployment levels increased.

Table 1
STUDENT BIAS-UNEMPLOYMENT RATE

	Historical		Current		Future	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*
Q5	-1.2	-1.7	-2.4	-4.0	2.0	2.0
Q25	1.3	0.3	0.0	-0.2	7.0	6.0
Median	4.3	2.3	2.6	0.5	10.0	8.0
Q75	19.3	5.3	16.5	3.8	20.0	11.0
Q95	54.3	41.0	45.5	36.3	50.0	40.0
% With Pos. Bias	86.8%	75.7%	73.5%	63.1%	*N/A*	*N/A*
Mean	9.6	4.5	7.7	2.9	13.7	10.3
Std. Dev.	12.6	7.8	11.0	6.7	9.9	6.9
Sample Size	N = 560		N = 592		N = 578	
t-stat (p-value)	t = 10.261 (0.000)		t = 10.878 (0.000)		t = 8.005 (0.000)	

With regard to unemployment, the students assessed in the study appear to have a fairly pessimistic outlook on the future that may have reflected the current economic situation with unemployment above its historical means. The median student entered the class believing unemployment would average 10 percent over the next 60 years, and they left the class believing it would average 8 percent. Their increase in optimism was statistically significant at the 1 percent level, although for the sake of the economy one can only hope the students are still excessively pessimistic.

Inflation

Table 2 provides a summary of the student biases to questions about inflation. Similar to the unemployment results, students generally exhibited a positive bias regarding inflation. This means that most students entered the classroom believing that inflation was much greater historically and currently than what it really was. For current inflation, 89.2 percent of students had positive bias, while 85.9 percent of students had positive bias about the historic level of inflation. The median student believed the current level of inflation was 8.5 percent higher than it actually was, and they believed the historic level of inflation was 11.3 percent higher than the truth. Clearly, students possess a distorted view of the true levels of inflation in the economy.

Table 2
STUDENT BIAS-INFLATION RATE

	Historical		Current		Future	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*
Q5	-1.7	-1.7	-1.6	-1.3	1.0	1.9
Q25	2.3	0.3	2.4	0.3	4.0	3.0
Median	11.3	6.3	8.5	3.3	10.0	5.0
Q75	36.3	26.3	18.5	10.5	20.0	12.0
Q95	86.3	91.1	48.8	41.6	45.0	40.0
% Pos. Bias	85.9%	78.2%	89.2%	82.0%	*N/A*	*N/A*
Mean	19.3	14.7	11.5	6.6	12.6	9.7
Std. Dev.	20.6	19.2	10.9	8.1	10.5	9.0
Sample Size	N = 569		N = 558		N = 573	
t-stat (p-value)	t = 4.951 (0.000)		t = 9.762 (0.000)		t = 5.856 (0.000)	

It is slightly perplexing that students hold such a large positive bias about inflation. Most students are relatively young, thus their historical basis of comparison is short. Most were not around to remember "the good old days" when gasoline was $0.47 per gallon, eggs were $0.77 a dozen and a stamp cost $0.10. One possible explanation for the substantial bias lies with the fact that for many, their point of reference for economic knowledge is most likely to be parents, grandparents, and/or newspapers. Many grew up in a household where their parents frequently lamented with anecdotal observations such as, "It seems like prices just keep going up!" or "Back when I was your age, bread cost a (fill in the appropriately small coin price)." Also, Shiller (1997) finds "inflation" being the most commonly used term in a search of news stories from NEXIS system. He also finds that people often associate negative effects relating to their standard of living from the costs of inflation. Thus, students may be reflecting the bias on the issue of inflation from various sources and overestimating its value.

Even though the substantial positive bias remained at the end of the semester, it did exhibit a statistically significant drop. The percent of students with positive bias toward the historical rate dropped 8 percentage points to 78 percent, and the percent with positive bias toward the current rate dropped 7 percentage points to 82 percent. At the end of the semester, the median student's best guess of the historical inflation rate was 6.3 percent with 3.3 percent for the current rate. Since during the sample period inflation was extremely low (1 percent to 1.5 percent), this shows vast improvement in knowledge regarding inflation from the start of the term.

Regarding future rates of inflation, students entered the class with a fairly pessimistic regard to future inflation. At the beginning of class, the median student believed inflation would average 10 percent over the next 60 years, while they believed it would average only 5 percent by the end of class. These results are consistent with the general pessimism students showed about the future when examining unemployment. The difference in means between the beginning and end of class was statistically significant at the 1 percent level. As a result of their experience in class, students substantially lowered their expectations regarding future inflation rates. This is likely due to the significant improvement in knowledge about historical and current rates.

Growth

Table 3 reports the results of student bias about growth rates for wealth, jobs, and income. In contrast to their beliefs about employment and inflation, students substantially underestimated the true growth rate in wealth, jobs, and income over the past 60 years. On the first day of class, fewer than 5 percent of students exhibited a positive bias for any of these measures of economic performance. The median student began the semester with a bias of -442 percentage points regarding the overall growth of personal wealth. In other words, the median student believed that the rate of growth in personal wealth over the past 60 years was 442 percent less what it actually was. The median student also underestimated the historical 60 year growth rate in jobs and personal income, by 162 percent and 206 percent, respectively.

Table 3
STUDENT BIAS-GROWTH RATE

	Personal Wealth		Jobs		Past Personal Income		Future Personal Income	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Q5	-460	-459	-193	-194	-224	-224	-15.0	-6.0
Q25	-452	-452	-177	-177	-216	-216	3.0	4.0
Median	-442	-442	-162	-157	-206	-206	10.0	10.0
Q75	-417	-417	-132	-127	-186	186	20.0	20.0
Q95	-342	-262	-42	103	-76	-26	95.0	50.0
% Pos. Bias	0.8%	0.5%	4.6%	9.7%	2.6%	2.6%	*N/A*	*N/A*
Mean	-432.3	-429.3	-153.2	-143.2	-198.6	-196.6	11.1	12.3
Std. Dev.	25.0	35.9	28.3	54.0	24.8	34.7	12.6	11.6
Sample Size	N = 671		N = 589		N = 608		N = 551	
t-stat (p-value)	t = -1.990 (0.047)		t = -4.567 (0.000)		t = -1.291 (0.196)		t = -2.012 (0.045)	

While the result are consistent with the overall pessimism expressed by students regarding inflation and unemployment, the underestimation errors in the growth rates of wealth and income are somewhat surprising given the same group overestimated inflation by such a wide margin. Students believe that prices are rising (far more rapidly than they truly are) and they believe incomes are shrinking (when they are in fact growing). By the end of class, student knowledge about growth barely changed, with only the change in bias about jobs being statistically significant at the 1 percent level. Students held a very conservative outlook for the growth rate for personal income, with the median student believing income will grow by only 10 percent in the next 60 years.The results in the growth area may indicate two areas for potential improvement for instructors teaching Principles of Economics courses: (1) the minimal change in knowledge regarding growth rates may point to the need for more instruction in this area with particular focus being paid to growth rates that exceed 100 percent as students may not feel comfortable in reporting percent changes of this magnitude; (2) connection of applied examples of the changes in personal wealth, jobs, and income to the economic indicators of such. While students are likely to appreciate that their standard of living is much higher than their parents or grandparents, the results here may indicate that they are unable to quantify the difference.

Recessions, Price Controls, and Debt

Table 4 shows student bias regarding the number and duration of recessions, the extent of government price controls, and national debt as a percentage of income. Students substantially underestimated the number of recessions the U.S. has experienced in the past 60 years, with a median bias of -7 on the first day of class. Only 5.6 percent of students overestimate the number of recessions the U.S. has experienced. By the end of the semester, the median bias drops to -6, and the percentage of students with a positive bias climbs to 8.4 percent. At the time of the study, the U.S. economy had experienced 10 recessions over the past 60 years, so the median student estimated 3 recessions at the beginning of the semester and 4 at the end. The mean response between the first and last day of class is statistically significant at the 1 percent level which indicates that the level of knowledge may be improving, but students still exhibit a substantial negative bias. In complete contrast to the results on inflation and unemployment, students are now overly optimistic regarding the number of recessions in the U.S. Students appear to do a fairly

good job of estimating the average duration of recessions, with a median bias of positive 1 on the first day of class and -1 on the last. In the 60 years prior to the study, the average recession length was 11 months. The median student estimated the average recession length to be 12 months at the beginning of the term and 10 months at the end.

Table 4
STUDENT BIAS-RECESSIONS, DEBT, AND PRICE CONTROL

	Number of Recessions		Average Duration of Recessions		% Prices Gov't Controlled		Debt as a % of Income	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*	*Pre*	*Post*
Q5	-8	-8	-7	-8	2.0	1.0	-85.1	-88.1
Q25	-8	-7	-4	-5	15.0	10.0	-53.6	-62.8
Median	-7	-6	1	-1	40.0	20.0	-23.6	-30.1
Q75	-5	-3	7	3	70.0	50.0	2.7	1.9
Q95	2	3	25	13	100.0	90.0	206.4	203.8
% Pos. Bias	5.7%	8.4%	55.9%	42.2%	*N/A*	*N/A*	28.6%	27.2%
Mean	-6.2	-5.2	2.5	-0.3	44.3	30.5	-13.5	-21.1
Std. Dev.	2.1	2.7	7.8	5.5	29.9	25.6	55.6	55.0
Sample Size	N = 588		N = 618		N = 612		N = 456	
t-stat (p-value)	t = -8.308 (0.000)		t = 9.064 (0.000)		t = 10.590 (0.000)		t = 2.663 (0.008)	

Students tended to believe the government controls a substantial proportion of all prices. The median student estimated that the government controls 40 percent of all prices on day one of class and 20 percent of all prices on the last day of class. This decrease is significant at the 1 percent level and may be in large part to the textbook emphasis on market-determined prices. Despite the fact that the drop is significant, students still believe the government exercises an extremely heavy hand when it comes to price determination.

The median student tends to underestimate national debt as a percentage of income by 23.6 percent at the beginning of the semester, and underestimates national debt as a percentage of income by 30.1 percent at the end of the semester. The difference in means is statistically significant at the 1 percent level. In contrast to all other economic measures in this study, students become more biased regarding debt as a percentage of income as a result of their experience in the Principles classes.

Minimum Wage and Taxes

Table 5 shows student beliefs about minimum wages and taxes. The median student has and upward bias of 36.5 regarding minimum wage. Since the actual number of workers earning minimum wage at the time of the study was small but positive, the median student believed that slightly more than 36.5 percent of the population earns minimum wage. By the end of the semester, this bias drops to a still substantial 26.5. The means are statistically different from one another at the 1 percent level. The large positive bias both at the beginning and end of the course may be another indicator of students' point of reference as they are likely to have characteristics similar to minimum wage workers. Thus the students' life experiences may cause bias in their perception of wages in the U.S.

Table 5

STUDENT BIAS-MINIMUM WAGE AND TAXES-CURRENT ECONOMY

	% Earning Min Wage		Top 20% Tax Burden		Bottom 20% Tax Burden	
	Pre	*Post*	*Pre*	*Post*	*Pre*	*Post*
Q5	7.1	1.1	-89.6	-84.6	5.8	3.8
Q25	22.1	14.2	-76.0	-69.6	13.0	8.0
Median	36.5	26.5	-60.6	-46.0	25.8	15.8
Q75	55.1	42.5	-35.3	-21.0	45.8	33.0
Q95	75.3	67.1	-4.6	-1.0	83.0	75.8
% Pos. Bias	99.6%	96.6%	3.3%	4.2%	99.8%	99.3%
Mean	36.4	28.6	-54.2	-45.9	31.5	22.7
Std. Dev.	17.2	17.4	23.6	24.2	21.1	16.8
Sample Size **t-stat** **(p-value)**	N = 583 t = 9.801 (0.000)		N = 577 t = -7.246 (0.000)		N = 554 t = 9.303 (0.000)	

With respect to taxes, students have a substantial negative bias regarding the proportion of federal income taxes paid by the top 20 percent of all income earners, and a substantial positive bias regarding the proportion of taxes paid by the bottom 20 percent. In other words, students sampled in this study believe that top income earners pay a smaller proportion of taxes than they actually do and that bottom income earners pay a greater proportion. The median student has a bias of -60.6 in regard to the tax burden of the top 20 percent of all income earners and a +25.8 bias toward the tax burden of the bottom 20 percent of all income earners. While these biases improve by the end of the class, they are still substantial with a bias of -46.0 for the top earners and +15.8 for the bottom earners. The reduction in mean bias is significant at 1 percent for both the top and bottom 20 percent, but the bias remains large. Generally, students believe that the 'rich' are not paying their share and the 'poor' pay more than their share. This bias may come from the income profiles of the students and their families.

CONCLUSIONS AND DIRECTIONS FOR FUTURE RESEARCH

The overall results of the survey clearly show that students carry into the classroom a substantial amount of misinformation regarding the economy. Every measure (with the exception of the duration of the average recession) shows substantial bias, with students typically being overly pessimistic in nature. Students believe inflation and unemployment rates to be much higher than current and historical statistics. Similarly, students are negatively biased with respect to growth in wealth, income and jobs, believing that the rate of growth for all to be much lower than what is reflected by actual data. Students also carry a distorted view of the tax burden carried by various strata of income earners. By the end of the semester, bias lessened and student knowledge improved (with the sole exception of debt as a percentage of income), but there remains a substantial amount of incorrect knowledge surrounding the economy at the end of the semester. Clearly, much work remains to get students to the point that their beliefs about the economy match reality.

While these distorted beliefs point to the possible need for reflection on course material presentation in order to better connect students to the data, they also have the potential for broader social implications. For example, a voter with a distorted view of income, unemployment, and tax burdens may support a different set of social policies than one with the correct beliefs. To the

extent that the average voter if misinformed (and we would like to think students completing a college course in economics are more informed than the average voter), politicians can play on that misinformation to garner votes. The results of this study reinforce the findings of Caplan (2007) regarding the "pessimistic bias" of most voters. Caplan states there is a "tendency to overestimate the severity of economic problems and underestimate the (recent) past, present, and future performance of the economy" (p. 44).

In addition, the psychology literature is filled with examples demonstrating that people tend to overestimate their abilities and are overly confident in their futures (e.g., Kennedy, Lawton, and Plumlee, 2002; Kruger and Dunning, 1999). Furthermore, the more incompetent someone is, the more likely they are to overestimate their abilities and make poor choices. Kruger and Dunning (1999) assert that "…when people are incompetent in the strategies they adopt to achieve success and satisfaction, they suffer a dual burden: Not only do they reach erroneous conclusions and make unfortunate choices, but their incompetence robs them of the ability to realize it" (p. 1121). In other words, the more ignorant an individual is about a topic, the less they are able to recognize their own ignorance (or the ignorance of others). As Charles Darwin famously noted (1871) "ignorance more frequently begets confidence than does knowledge" (p. 3).

Not only does this ignorance or bias lead to bad choices, it also leads the individual to be very confident in the 'correctness' of the choices they made. In a series of tests by Kruger and Dunning (1999), students who performed in the bottom quartile consistently ranked themselves as significantly above average. In contrast, students in the top quartile significantly underestimate their relative performance levels. The more ignorant you are the more confident you are in your incorrect choices, while the more knowledgeable you become, the less (over)confident you become in your choices.

These results were subsequently confirmed by Kennedy, Lawton, and Plumlee (2002). According to Kennedy, Lawton, and Plumlee "these 'self-serving biases' can result in overly optimistic future planning and the overprediction of business growth" (p. 243). A study by Tang and Robinson (2004) suggests that economic misconceptions actually increase as students' progress from having one semester of economics to having two semesters of economics, and their ability to think and reason as an economist actually decreases.

This work in the psychology arena supports the importance of the present findings. When people are ignorant, they tend to make poor choices and tend to be more confident in their choices. Clearly, principles of economics students both enter and exit their initial economics classes with a substantial amount of ignorance. Thus, they are predicted to boldly and confidently make poor assumptions about the economy and poor personal choices regarding economic matters. Further attention needs to be devoted to develop methods of reducing the bias and ignorance that students carry as they leave principles of economics.

Logical extensions of this research include examining the effect demographic variables may play on student biases. For example, are students that come from high income families likely to have a positive bias on taxes for the top 20 percent compared to students from low income families? The principles of economics courses sampled here relayed data to students through lectures and discussion. Perhaps further attention should be devoted to possible pedagogical methods used in the classroom and their effectiveness at reducing bias. In addition, the effect that biases play in the formation of policy opinions needs to be researched more, as it can have broad social implications.

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GRADES DIFFERENCE BEFORE AND AFTER USING AN ONLINE INTERACTIVE HOMEWORK SYSTEM -- A CASE STUDY IN TEACHING ECONOMICS AT ALABAMA STATE UNIVERSITY

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ABSTRACT

The application of new technology in classes is always an important topic. It helps the teachers to improve teaching methods and track down students' performance effectively, and it provides the students a more convenient platform to learn and progress. Ever since late 20th century, the use of computational techniques and internet has been profoundly influenced the modern lectures, especially in colleges and universities nowadays.

In this study, we use unique information from our teaching experience of Economics at Alabama State University. In spring 2013, we started using a new online interactive homework system -SaplingLearning - in our principles of economics (Macroeconomics & Microeconomics) classes. Based on our sorted and anonymous student records, we conduct statistical and econometrical examinations to compare their grade differences before and after using SaplingLearning.

The result shows that after using SaplingLearning in our classes, the students' exam grades did experience a significant increase overall. To be specific, this grade improvement is especially significant in our Macroeconomics classes. The application of this new technology in our classes did benefit the students in terms of improving their learning outcomes.

INTRODUCTION

Over time, much has changed and evolved in education and teaching techniques. The age of chalk and blackboard allowed students to take notes and highlight key concepts; however, this old-school teaching–learning process was constrained rigorously by the lack of creativity. Without enough diversification in learning and practicing, students always feel difficulty in fully understanding what they learned in the classroom. These troubles consequently cause frustrations, which will discourage students' incentives and interests.

The combination of teaching and modern technologies has started ever since the late 20th century, when the use of computer technology and internet started to be applied widely. This also brought profound influence on teaching at all levels. In Vachris (1999) and Coates et al. (2004), the authors analyzed the effectiveness and potential problems of online teaching of Economics at various universities including Christopher Newport University, SUNY Oswego and University

of Maryland. The importance of internet technology and how it should be included in the teaching of Economics have also been discussed thoroughly in Agarwal and Bay (1998), Katz and Becker (1999), and Becker (2000). Besides economics, the teaching of many other subjects has also been profoundly influenced by various online applications and it has received plenty of attention ever since the beginning of the 21st century (Bates and Poole, 2003; Switzer and Csapo, 2005; Lawless and Pellegrino, 2007; Bolliger and Wasilik, 2009; Dede and Richards, 2012).

As we can find from all these studies, educators have always been searching for a better way to motivate students. Finding an effective homework system, for example, is one of the proposed solutions. How can students' learning interests be stimulated? This new system should be refreshing, eye-catching, and convenient. With a high-tech design and user-friendly interface, both students and teachers can benefit greatly from it. The entire teaching–learning process, therefore, becomes more efficient and better fits our education goals.

SaplingLearning is a good example of this advanced homework program. Being Internet-based, it allows students round-the-clock access to their online assignments and tutorials. It provides various types of questions: multiple choice, matching, and calculation, as well as figure drawing. Featuring an attractive layout, the assignments present diversified methods for the students to practice, study, and truly understand what they have learned. As a result, students feel more attracted and excited, with learning willingness and motivation.

SaplingLearning also brought a great advantage to the teachers as well. Its online test banks include a vast ocean of questions at different difficulty levels, with abundant flexibility in designing homework; immediate help from professional teaching assistants makes things even easier. The grading system offers alterative options; teachers can choose how many times the questions can be accessed and how many points will be deducted each time an incorrect answer is entered.

Moreover, it provides accurate feedback on students' work. Upon the completion of each question, a detailed explanation will also be given to help the students fully understand what the relevant knowledge is, as well as how to apply it appropriately. This instant feedback greatly enhances students' impressions of their exercises, as well as how to apply practically their knowledge.

In the College of Business Administration (COBA) at Alabama State University, we started using SaplingLearning during the Spring Semester in 2013. To be specific, the courses are preliminary, such as Principles of Economics I (Principles of Macroeconomics) and II (Principles of Microeconomics). The reason we chose these courses is because they are required for all business majors. Therefore, it avoids potential selection bias. What's more, it gives us a larger sample size for our tests to proceed. One of the most important educational targets in COBA is to lead technological progress, not only by introducing students to the progressing world but also by benefiting them with the advanced technology. Our goal is to improve the students' study outcomes, as well as their learning motivation. Using a cutting-edge homework system, such as SaplingLearning, became an important step.

The intent of this study is to compare students' academic performances in the same courses before and after the application of SaplingLearning. Through this comparison, we hope to examine whether SaplingLearning improves the study outcomes of our students and if yes, how. We use basic comparative statistics, a longitudinal analysis, and t-tests to look into the grade differences before and after SaplingLearning. Econometric tests are also used to look into details of grade determinants. The results are positive; overall, after using SaplingLearning, we can expect better in/after-class performance from our students. This result is significant in our Principles of Macroeconomics class, but not so significant in Principles of Microeconomics.

This study is organized as follows. Section 1 is the introduction. Section 2 describes the background of the college as well as SaplingLearning, the online homework system. Section 3 describes the data and comparative statistic results. Section 4 reports the econometric test results and Section 5 concludes the entire paper.

BACKGROUND AND SAPLINGLEARNING HOMEWORK SYSTEM

Alabama State University is a HBCU (Historically Black Colleges and Universities). It was founded in 1867, in Marion, AL. It is known as one of the nation's oldest institutions of higher education founded for black Americans. Today, being located in Montgomery, AL, it offers nearly 50 undergraduate and graduate degree programs, and hosts over 5500 students from more than 40 US states and various countries. The student-teacher ratio is about 20 to1, which ensures that our students will receive enough attention and mentoring. The College of Business Administration is one most featured college at Alabama State University. It offers multiple programs and degrees: Bachelor of Science in Accounting, Finance, Management, Marketing, Computer Information Systems, as well as Master of Accountancy. It is now nationally accredited by the Association of Collegiate Business Schools and Programs (ACBSP).

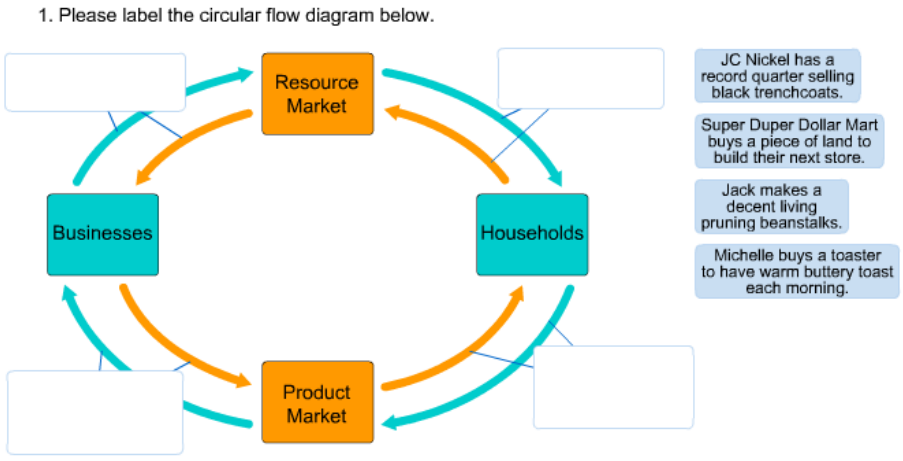
We adopted SaplingLearning because of our specific mission: more coaching, less lecturing. We believe that promoting students' learning motivations and interests is far more important than simply talking and slides-showing in front of students in the classrooms. A new technology – SaplingLearning – provides just the right platform we need. On one hand, it is based on internet, and have vivid and user-friendly website. It fits the new generation's need for a new learning tool. On the other hand, we want to encourage our students to more frequently use these tools and get more familiar with relevant computer skills. These will be critically important for their career development. Another advantage of SaplingLearning is its affordable price; comparing with other online learning tools, it is much cheaper especially for our underrepresented students with low family income.

We substituted our traditional homework assignments to be completed on papers with SaplingLearning. Notice that SaplingLearning is not a tool that the teachers use to lecture in our classroom, but an after-class learning tool for the students. If they have questions or problems with the assignments, they can come to the teachers and seek for help. They can also contact the technical support of SaplingLearning regarding technique issues.

This new online homework system is based on a vast selection of question banks. They include all levels of difficulty with diversified types of questions. One valuable merit of these questions is practical exercise. Normally in the textbook, only theoretical concepts instead of explicit examples are given. The instructors need other real life examples after classes for the students to fully understand the concepts and the models. After all, Economics is a social science about human beings' lives and decisions, which requires plenty of practical applications.

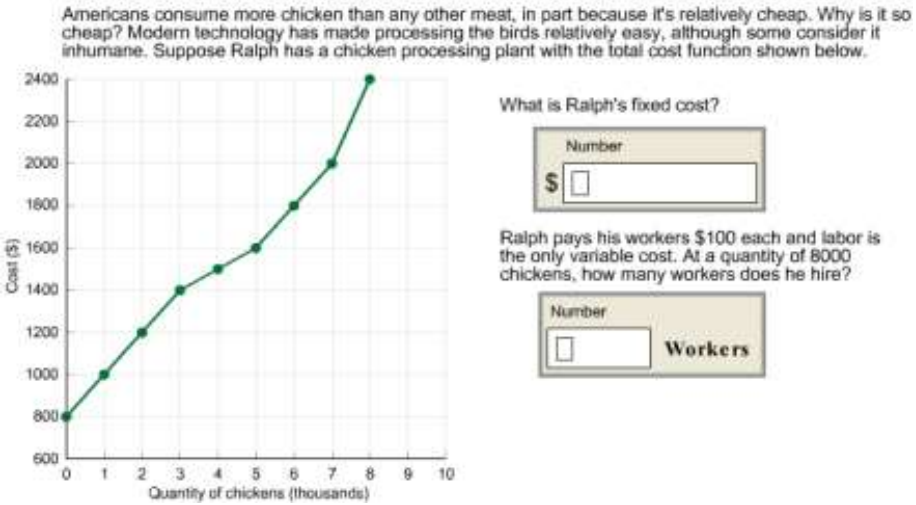
In Figure 1, Example 1, the Circular Flow Diagram—one of the most important economic models explaining how the free market works—instead of introducing concepts, such as "business pays to buy resources," SaplingLearning uses real-life examples, such as "Jack makes a decent living pruning beanstalks." Students often feel confused about theoretical definitions. These explicit examples will help students clearly understand the economic theories they learned in class and how to apply them in real life. After all, economics, as one of the major social sciences, studies human behaviors and society. To correlate the textbooks and reality is the most important goals of teachers.

Figure 1
EXAMPLE 1 FROM SAPLINGLEARNING.COM
Source: Www.Saplinglearning.Com



Besides the practical case studies, SaplingLearning also provides exercises, such as drawing curves and calculations. In the following Figure 2, Example 2 - production and costs analysis — students are given with a real example. With the curve and numbers, students are supposed to answer two typical questions as a business owner. The calculation of fixed costs depends on flexibly using the definition from the textbook and on students' abilities to read graphs. The number of workers to hire depends on students' understanding of fixed costs, variable costs, and their fundamental mathematical skills. This exercise features a difficulty level that is above average. A more complicated exercise like this will examine students' comprehensive skills and motivate them to practice more.

Figure 2
EXAMPLE 2 FROM SAPLINGLEARNING.COM
SOURCE: WWW.SAPLINGLEARNING.COM



DATA AND COMPARATIVE ANALYSIS

The data we use come from the grade records of COBA students who took Principles of Economics I and II from spring 2009 to summer 2014. We started to use SaplingLearning in spring 2013. Meanwhile, there is no remarkable change to the enrollment and recruitment of COBA students; we assume the students' backgrounds and qualities remain the same. Meanwhile, the in-classroom teaching style also remains the same. We use the same text book for both Micro and Macro courses – Economics Principles, Problems, and Policies, by C. McConnell, S. Brue and S. Flynn – for all the sampled years. We follow the same syllabus and cover the same chapters each semester. The in-classroom lecturing style is the same, before and after the application of SaplingLearning; it is a combination of lecturing and interaction between students and teachers. The teachers are of the same quality; we both earned our Ph.D. degrees in Economics before took the positions at ASU, and we both have at least 3 years of undergraduate-level teaching experience.

The available grades include students' exam scores, grades of writing assignments, and attendance rates. Each semester, the students have 2–3 in-term tests; we will use the average of all these test scores to measure the students' midterm exam performances. Besides the midterm, there is also one final exam for each student. To avoid any biases, notice that semester after semester the exams are similar to each other without fundamental changes. From time to time we may change the background, frameworks or just the numbers in the questions, but the tested concepts and key points remained the same. So did the grading scheme. This pattern stopped after summer 2014.

Each semester, students must also complete an essay focusing on one cognitive statement. The statement is different each semester, but it only examines the students' logic and writing skills. We then compare the average marks of students' midterm exams, final exams, writing assignments, as well as the attendance rates before and after SaplingLearning use. The attendance rate is defined as the ratio between a student's attendance number and the total number of classes in each semester.We assign an identification number to every sampled student. This study is completely anonymous; besides the identification number, nothing else reveals the student's true identity. We will then use the cross-sectional information to examine their grade differences before and after using SaplingLearning.

We compare the average scores on the students' midterm, final, writing assignments, and attendance rates. Through the comparison, we intend to analyze whether a significant improvement occurs in our students' performances with the help of SaplingLearning.

Full Sample

Table 1.1 reports the comparison between two periods: before and after SaplingLearning (pre SL vs. post SL). Altogether, we have collected information from 353 students, among which 165 are before SaplingLearning usage and 188 are afterwards. The overall averages of students' exams (midterm and final), writing assignments, and attendance rates have all increased since we started SaplingLearning in our classes. The midterm average increased from 69% to 82%, while the final exam average increased from 65% to 78%. Both improvements feature very low t-test P values, meaning there is a significant increase in the students' grades.

Meanwhile, the essay average increased from 75% to 78%. The average attendance rate also increased, by 2.6%. However, both improvements are not significant. By using SaplingLearning, students' learning incentives and capabilities increased much, their exam grades remarkably improved. However, their essays and attendance are not promoted with much significance. This is also without much surprise; online homework enhances students' understanding towards the textbook and our lectures, but does not help much upon their writing skills and reporting to classes.

Table 1.1
COMPARISON OF AVERAGE GRADES (%) – PRE SL VS. POST SL

	Midterm Exam	Final Exam	Writing Assignments	Attendance Rate	# of students
Before SL.	68.7	64.5	74.7	79.0	165
After SL.	82.0	77.5	78.0	81.6	188
t-test					
t value	-8.4	-6.1	-1.3	-1.68	
P value	1.9e-15	2.9e-09	0.18	0.19	

Table 1.2
ANNUAL REPORT ON AVERAGE GRADES (%), 2009 – 2014

	Midterm Exam	Final Exam	Writing Assignments	Attendance Rate	# of students
Before SL.					
2009	72.9	49.7	67.4	83.5	28
2010	68.9	59.7	78.4	85.4	28
2011	66.7	85.4	60.2	76.2	20
2012	68.1	65.9	75.8	76.1	89
After SL.					
2013	83.0	67.6	80.4	88.9	64
2014	81.8	79.9	77.2	78.5	124

Table 1.2 shows more details of how the grades change annually. Year after year, students' performances fluctuated consistently. Besides the use of SaplingLearning, many other factors influence students' performances. For example, university policies, teaching skills, and even enrollment could all present obvious effects on grades. However, generally speaking, the students' average performance has significantly improved since SaplingLearning was used.

Principles of Economics I

Next, we examine the annual change in students' grades in each class: Principles of Economics I (Macroeconomics) and Principles of Economics II (Microeconomics). Table 2 shows the comparison Principles of Economics I. In a comparison of before and after SaplingLearning, we again detect a significant improvement in the grades of students' midterms, final exams, writing assignments, and attendance rates. The t-tests generate very low P-values on midterm and final exams, indicating the high significance of grade improvements. However, the improvement of students' writing and attendance is again not significant, just as what we detected in Table 1.1. SaplingLearning helps students raise their exam grades, but does not affect their writing skills as much.

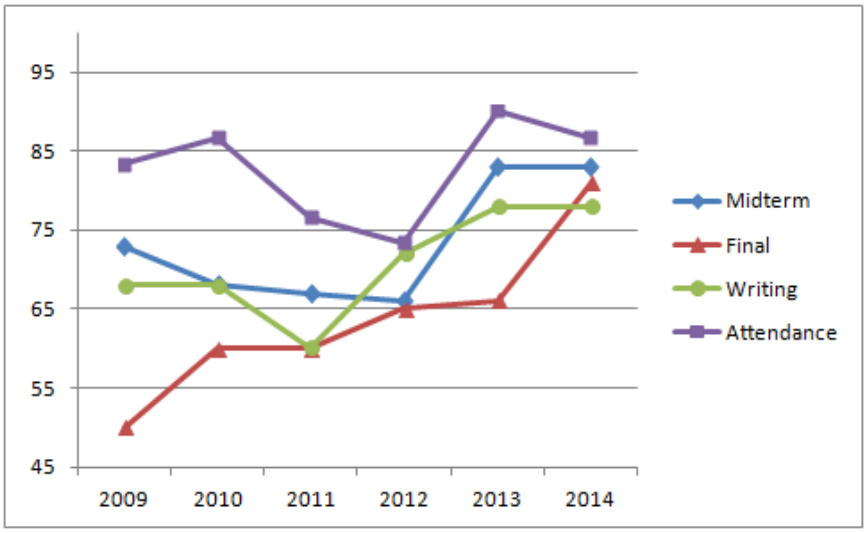
Table 2
COMPARISON OF AVERAGE GRADES (%) – PRINCIPLES OF ECONOMICS I

	Midterm Exam	Final Exam	Writing Assignments	Attendance Rate	# of students
Before SL.	67.7	63.8	74.0	78.9	141
After SL.	83.2	78.7	79.4	80.5	130
t-test					
t value	-8.9	-6.3	-1.7	-1.0	
P value	2.2e-16	1.5e-09	0.1	0.3	

Figure 3 is for the annual growth path of students' grades from Principles of Economics I (Principles of Macroeconomics). SaplingLearning was implemented in the class in 2013. From 2009 to 2014, the average attendance rate, midterm mark, and writing assignment mark all vary every year. However, the average score of the students' final exam has been increasing every year, from 50% to 81%.

Figure 3

ANNUAL GROWTH OF STUDENTS' PERFORMANCES (PRINCIPLES OF ECONOMICS I)



Principles of Economics II

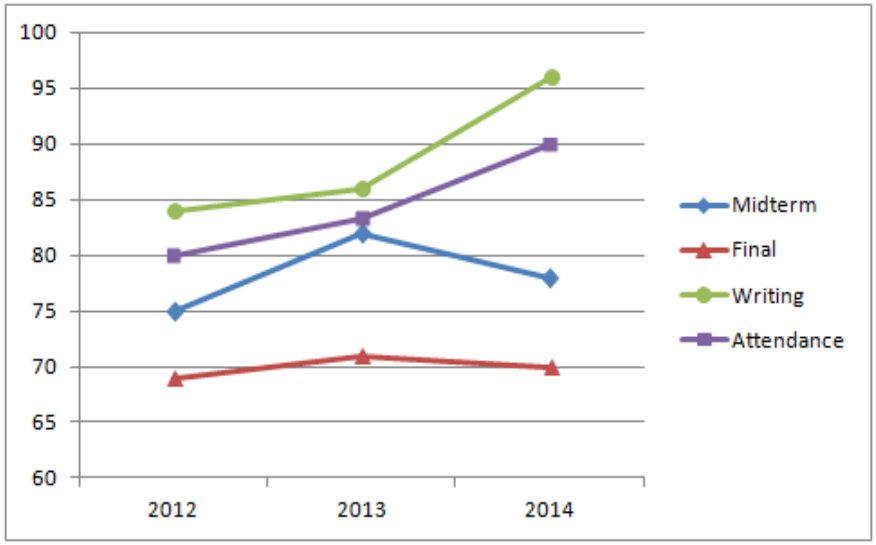
Table 3
COMPARISON OF AVERAGE GRADES (%) – PRINCIPLES OF ECONOMICS II

	Midterm Exam	Final Exam	Writing Assignments	Attendance Rate	# of students
Before SL.	74.6	68.7	79.8	79.4	24
After SL.	75.7	70.5	84.6	87.6	58
t-test					
t value	-0.3	-0.5	-1.1	-1.5	
P value	0.8	0.6	0.3	0.1	

Table 3 shows the comparison of grades in Principles of Microeconomics. Statistically speaking, the average performance of the students also increases, but not significantly. Figure 4 depicts the growth change for Principles of Economics (II) from 2012 and 2004. Before 2013, there was only in 2012 that this class was offered by us. Later SaplingLearning was only used in this class twice, in autumn 2013 and summer 2014. The average attendance rate and writing assignment mark have been improving every year. Average scores of the midterm and final exam did not monotonically increase, however.

Figure 4

ANNUAL GROWTH OF STUDENTS' PERFORMANCES (PRINCIPLES OF ECONOMICS II)



LINEAR REGRESSION TESTS

We also examine the effects of students' writing and attendance rate on their exams. Two tests were conducted: one with the fixed effect of SaplingLearning usage and the other without. To be specific, the regression equations are:

$$\text{Final Exam Score}_{it} = \beta_1 \text{Writing Grade}_{it} + \beta_2 \text{Attendance Rate}_{it} + \theta_t + \varepsilon_{it} \quad (1)$$

$$\text{Midterm Exam Score}_{it} = \beta_1 \text{Writing Grade}_{it} + \beta_2 \text{Attendance Rate}_{it} + \theta_t + \varepsilon_{it} \quad (2)$$

where β s are the coefficients of student i's corresponding performance on his or her final/midterm exam in semester t. θ_t is a time dummy variable; θ_t= 0 before 2013 when we started using SaplingLearning; θ_t= 1 after 2013. We do this test under three different scenarios: among all students, among students in Principles of Economics I, and among students in Principles of Economics II. Table 4 shows the results.

In column (i) of both Table 4.1 and 4.2, among all students, one more point on the writing assignment adds another 0.28 points to the final score and 0.20 points to the midterm. Unsurprisingly, good students with good writing skills tend to maintain good performances throughout the semester. However, attendance rates do not significantly affect the exam scores. This is also not difficult to understand; to take care of the majority of students, we tend not to teach at a difficult level in our classes. Therefore, good students might miss several classes, but they can catch up easily with the rest of the class by self-studying.

Next, we turn to the most important effect in our study: the fixed effect of SaplingLearning. The use of SaplingLearning starting in spring 2013 does have a significant effect on enhancing students' grades. It significantly improved both final and midterm exam marks to increase around 13 points. Briefly, using SaplingLearning indeed improves students' performances.

Table 4.1
RELATIONSHIP AMONG FINAL SCORE, WRITING, ATTENDANCE
NOTES: * REPRESENTS SIGNIFICANCE AT 1%.**

Dependent Variable: Final Exam Score	(i) All	(ii) Prin. of Econ I	(iii) Prin. of Econ II
β_1 (Writing Grade)	0.28***	0.29***	0.38
	(0.10)	(0.11)	(0.24)
β_2 (Attendance Rate)	-0.05	-0.06	0.19
	(0.25)	(0.30)	(0.34)
θ (Fixed Effect of SaplingLearning)	13.4***	15.6***	0.45
	(2.13)	(2.40)	(3.75)
Adjusted R^2	0.12	0.14	0.06
# of students	353	271	82

Table 4.2
RELATIONSHIP AMONG MIDTERM EXAM SCORE, WRITING, ATTENDANCE
NOTES: * REPRESENTS SIGNIFICANCE AT 1%.**

Dependent Variable: Midterm Exam Score	(i) All	(ii) Prin. of Econ I	(iii) Prin. of Econ II
β_1 (Writing Grade)	0.20***	0.19**	0.18
	(0.07)	(0.08)	(0.24)
β_2 (Attendance Rate)	0.19	0.23	0.31
	(0.19)	(0.22)	(0.34)
θ (Fixed Effect of SaplingLearning)	12.9***	15.0***	0.74
	(1.58)	(1.72)	(3.43)
Adjusted R^2	0.20	0.24	0.03
# of students	353	271	82

We have similar findings among the students taking Principles of Economics I (Principles of Macroeconomics). In column (ii) of both Tables 4.1 and 4.2, a better writing performance means higher midterm and final scores; however the attendance rate does not affect students' grade. After using SaplingLearning, the exam marks significantly increased at least 15 points.

However, no such significant improvement was detected for Principles of Economics II (Principles of Microeconomics), as reported in column (iii).The fixed effect θ is significant neither in Table 4.1 nor 4.2. This conclusion fits the description in Figure 4. Notice that although the exam scores were not significant improved upon using SaplingLearning, students' attendance rate and writing skills still were.

CONCLUSION

In this study, we looked into students' grade improvements when using SaplingLearning in COBA, Alabama State University. We found a significant improvement in students' grades since 2013, when we started SaplingLearning in our class. Overall, the scores of students' midterms, final exams, and essays, as well as their attendance rates all significantly increased. With the help of SaplingLearning, the interactive online homework system, we can expect higher grades from our students. When we conducted comparison studies in each class we taught, it was found that the grade improvement was significant in Principles of Economics I (Principles of Macroeconomics). The improvement of exam scores was not significant in Principles of Economics II (Principles of Microeconomics); this may be because of the limited observation we collected from the latter. However, students' attendance rate increased remarkably.

Still, in a nutshell, students' performance did improve after the application of SaplingLearning in our Economics classes at Alabama State University. One of our possible future works is to look into the details of how the students personally feel about this new online technology; designing a survey, asking them for their own opinions and feedbacks will be a good idea to start our next study.

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