Volume 5, Number 2 **ISSN 1533-3604**

JOURNAL OF ECONOMICS AND ECONOMIC EDUCATION RESEARCH

An official Journal of the
Academy of Economics and Economic Education
and the Allied Academies

Editor: Larry R. Dale
Arkansas State University

Academy Information
is published on the Allied Academies web page
www.alliedacademies.org

Whitney Press, Inc.

Printed by Whitney Press, Inc.
PO Box 1064, Cullowhee, NC 28723
www.whitneypress.com

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The *Journal of Economics and Economic Education Research* is published by the Allied Academies, Inc., PO Box 2689, 145 Travis Road, Cullowhee, NC 28723, USA, (828) 293-9151, FAX (828) 293-9407. Those interested in subscribing to the *Journal*, advertising in the *Journal*, or otherwise communicating with the *Journal*, should contact info@alliedacademies.org.

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JOURNAL OF ECONOMICS AND ECONOMIC EDUCATION RESEARCH

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LETTER FROM THE EDITOR

We are extremely pleased to present this issue of the *Journal of Economics and Economic Education Research*, an official publication of the Allied Academies' Academy of Economics and Economic Education Research, dedicated to the study, research and dissemination of information pertinent to the improvement of methodologies and effective teaching in the discipline of economics with a special emphasis on the process of economic education. The editorial board is composed primarily of directors of councils and centers for economic education affiliated with the National Council on Economic Education. This journal attempts to bridge the gap between the theoretical discipline of economics and the applied excellence relative to the teaching arts.

The Editorial Board considers two types of manuscripts for publication. First is empirical research related to the discipline of economics. The other is research oriented toward effective teaching methods and technologies in economics designed for grades kindergarten through twelve. These manuscripts are blind reviewed by the Editorial Board members with only the top programs in each category selected for publication, with an acceptance rate of less than 25%.

We are inviting papers for future editions of the *Journal for Economics and Economic Education Research* and encourage you to submit your manuscripts according to the guidelines found on the Allied Academies webpage at www.alliedacademies.org.

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ECONOMICS EDUCATION ARTICLES

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PREPARING ECONOMIC EDUCATORS FOR A NEW ERA: AN INTERDISCIPLINARY MODEL YIELDS TEACHER AND STUDENT GAINS

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ABSTRACT

This study examines the effectiveness of a three-year Masters of Economics Education program developed and delivered through an interdisciplinary partnership between a Northwest University's College of Business and College of Education. The research on the Idaho Economic Fellows Institute clearly supports this format of teacher preparation and/or professional development. Specifically the research showed that the program increased fellows' economic literacy and positively affected the fellows' teaching skills and techniques. There is also strong evidence that the institute influenced the economic content being taught by fellows as well as their students' success on standardized tests.

Researchers employed a mixed method approach to data collection, relying on standardized pre-post tests developed and validated by the National Council on Economic Education as well as instruments developed and validated by the authors.

INTRODUCTION

The call for reform in public education has been coupled with calls for reform in teacher preparation. In the current era of standards and high stakes testing, teachers' knowledge, skills and dispositions continue to be seen as a critical factor in student learning. The 1996 report *What Matters Most: Teaching for America's Future* (National Commission on Teaching

and America's Future) reiterates that teaching and quality teacher preparation are crucial for successful school reform. Hermanowicz, (1991) in reviewing recommendations for reform in the context of economics education states that "It is unconscionable … to continue, without correction, programs and practices that produce teachers who themselves have insufficient knowledge in economics" (p. 78). Reforming the process for educating pre-service teachers is just one concern. There is also a need to study and test new models of professional development for experienced teachers. As a result of the work of the National Council on Economic Education (NCEE) and its partnerships with universities, corporations, foundations and professional associations, economics educators, and teacher educators are in a position to rethink the ways in which teachers learn economics and economics pedagogy. The NCEE partnerships have spawned 49 state economics councils and 275 university centers for Economic Education to provide professional development opportunities for teachers. It is in the context of university centers exploring and validating new teacher education models that this article is written.

This study examines the effectiveness of a three-year Masters of Economics Education program sponsored by Idaho's Council for Economic Education and developed and delivered through an interdisciplinary partnership between the host university's College of Business and College of Education. This study was designed to provide formative assessment of the program so that professors and program developers could adjust the curriculum as necessary, to identify the program's impact on participating teachers' (called Fellows) economic literacy and pedagogy and to determine if the program of study affected participants' K-12 students' economic understanding.

BACKGROUND

A review of economics education literature indicates that the amount of economics coursework that a teacher has can impact students' economic knowledge. Walstad and Soper (1988a) find a positive and significant impact of teacher course work on the performance of students on the Test of

Economic Literacy (TEL). Furthermore, Lynch (1990) reports that "Not only do students learn more when their teachers have more training, but economics students whose teachers have had few courses may not learn any macro economics or international economics" (p. 295). The program was designed to better prepare teachers of economics and social studies to adequately develop the economic literacy of Idaho's K-12 students.

Allgood and Walstad (1999) studied practicing teachers enrolled in an innovative three-summer graduate program in economic education at the University of Nebraska and found that the participants gained in economic understanding, thought more like economists than traditional social studies teachers, and that the participants' economic understanding positively influenced student learning of economics. While the authors conclude by noting "the results suggest that intensive and lengthy instruction in economics for teachers has a long-term payoff in economic understanding for both teachers and students" (p. 109), their measure of improved economic understanding was limited to 232 students in 12 teachers' classes over the course of one semester. This study described herein more thoroughly documents these effects by tracking changes in student economic literacy over a three-year period, involving 3501 students.

For an Idaho teacher to be certified in social studies, the most common certification in the state for economics teachers, Idaho requires only two university courses in economics content. In looking at how Idaho economics teachers are educated, Jenkins and Nelson (2000) surveyed 368 Idaho educators to determine the preferred types of teacher training and the methodology used in economic education programs. Graduate university courses were rated as the most useful type of training for the integration of economics into the K-12 curriculum. The authors call for increased opportunities in Idaho for economics education, as well as a continuing effort to develop hands-on and engaging instructional strategies.

IDAHO ECONOMIC FELLOWS INSTITUTE

The Idaho Economic Fellows Institute was conducted at Boise State University from the summer of 1999 through the spring of 2002. The

Institute was modeled after a similar one conducted at the University of Nebraska 1993-1996. (Allgood and Walstad, 1999). The Idaho Institute offered Fellows 30 semester hours of graduate credit courses in three six-week summer sessions. The Fellows also earned nine hours of independent study credits during the school years, which gave Fellows the opportunity to develop curriculum units and engage in action research within their own classrooms. In each of the summers, Fellows were enrolled in two credits of pedagogy course work and six credits of economics course work. During the first summer, Fellows completed course work in macroeconomics, microeconomics, and instructional theory. In the second summer, Fellows completed course work in financial markets, industrial organization, and instructional and assessment practices. During the third summer, they enrolled in a course focusing on international economics and a course co-taught by education and economics professors that examined Fellows' instructional strategies for teaching economic analysis. While the master's degree coursework was interdisciplinary in nature, upon the completion of a thesis, fellows receive a Master of Arts in economics from the College of Business.

During summer course work, Fellows resided in university housing and participated in informal and organized social events. To counter what Goodlad (1990) described as "the social, intellectual, professional isolation of teachers (which) begins … in teacher education" (p.700), Institute organizers were deliberate in developing a cohort atmosphere that allowed Fellows to support each other to the extent that communication about professional matters between the Fellows would continue beyond their participation in the university classroom.

Thirty-one of the 35 teachers enrolled in the program completed the final academic year of the Institute. Twenty-five Fellows were secondary economics teachers, four were junior high or middle school teachers and two teach in elementary schools. Twenty-three of the Fellows had less than ten years experience, while eight had ten or more years. The prior economics education of the Fellows varied widely from no courses to a bachelor's degree including nine economics classes.

LIMITATIONS

The design of this study has two fundamental limitations. First, when measuring the economic literacy of the participating teachers, the same form of the Test of Understanding in College Economics (*TUCE*) was administered. As a result of annual administration the *TUCE*, participating teachers may have become "test wise" (Popham, 1993, p. 222). This may have contributed to the *TUCE* gains observed during the study. Among the student sample, different students were tested each year within teachers' classes. While this may weaken claims about the long-term effect on students' economic literacy, the multiple years of administration and large sample size mitigate this threat to validity.

FINDINGS

The evaluation of the Idaho Economic Fellows Institute was conducted in an iterative fashion during its three years of operation. Because of the mixed-method approach to data collection from a variety of sources, the authors describe below the relevant methodology employed within each portion of the evaluation study. To provide formative feedback to program providers as well as to conduct a summative evaluation of the impact on participant and K-12 student learning, multiple data sources were pursued to document each of the following: 1) development of economic literacy among the Fellows, 2) development of economic literacy among Fellows' K-12 students, 3) pedagogical repertoire of the Fellows, and 4) overall quality of Idaho Economic Fellows Institute. Each of the above items will be addressed and explained in detail in the following sections.

Fellows' Economic Literacy

To measure the economic literacy of the Fellows, we administered Form A of the Test of Understanding in College Economics (*TUCE*) three times over the three years of the Institute with the first administration being prior to the beginning of the first summer of coursework. The *TUCE*,

comprised of two 33-item selected-response assessments, one each for macroeconomics and microeconomics, sufficiently measured the wide range of abilities within the cohort, allowing us to measure differing levels of student growth. Similarly, Walstad (1984) and Allgood & Walstad (1999) report its validity when used in manners similar to this study.

Macroeconomics *TUCE*

Fellows' mean scores on the macroeconomics *TUCE* increased during each of the follow-up years. Whereas the majority of the improvement in mean scores occurred in the second year of the Institute, the overall improvement of scores was statistically significant $t(28) = 5.97$, $p < .001$. Of more relevant use to practitioners may be the overall effect size of 0.92, which indicates that the average Fellow's post scores are almost one standard deviation higher than at his\her entrance to the Institute. When using the *TUCE* national norms, the mean normed percentile score of the Fellows increased 34 percentiles from the 47th to the 81st percentile (See Table 1).

Table 1: Participants' Macroeconomics *TUCE* Scores (33 items)

Year of Institute	N	Mean	Std Dev	Percentile
Summer 1999	29	14.00	6.41	47th
Summer 2000	30	19.17	5.75	78th
Summer 2001	31	19.97	6.00	81st

Microeconomics *TUCE*

Fellows' mean scores on the microeconomics *TUCE* also increased during each of the follow-up years. Each year's scores were significantly higher than those of the previous year. The overall improvement in scores was statistically significant $t(29) = 5.51$, $p < .001$. The overall effect size of 0.69 indicates that the average Fellows' post scores were substantially higher than at his entrance to the Institute. When using the *TUCE* national norms,

the mean normed percentile score of the Fellows increased 19 percentiles from the 54th to the 73rd percentile (See Table 2).

Table 2: Participants' Microeconomics *TUCE* Scores (33 items)

Year of Institute	N	Mean	Std Dev	Percentile
Summer 1999	29	17.00	5.61	54th
Summer 2000	30	19.60	5.38	67th
Summer 2001	31	20.97	5.02	73rd

Fellows' prior economic training (as measured by university-level classes taken) was strongly correlated with their initial performance on the *TUCE* tests (See Table 3). That is, the more economics coursework individuals had, the better they scored on the initial *TUCE* exam. Participation in the Institute, however, weakened this advantage substantially. Specifically, when examining each of the *TUCE* exams (microeconomics and macroeconomics), we find an interesting phenomenon. While the correlation (r = .686) of prior coursework in economics was strongest for the first macroeconomics test, given in 1999, the correlation (r = .257) of the 2001 scores was not statistically significant. When examining the correlations for microeconomics the correlation across the two years remains significant, however, it does weaken. Further study is required to understand the differential effect of the Institute on Fellows' test scores.

Table 3: Correlation of University Classes Taken to *TUCE* Scores

Subject Area (Year of test)	Correlation (r)	p
Macroeconomics (1999)	.686	< .01
Macroeconomics (2001)	.257	ns
Microeconomics (1999)	.646	< .01
Microeconomics (2001)	.518	< .01

K-12 Student Achievement

To measure the economic literacy gains of the Fellows' students in grades 5-12, we used grade-level-appropriate corollaries to the *TUCE*. Because Fellows' class enrollments changed each year, the research did not follow longitudinal gains of individual students but rather examined achievement levels of fellows' successive classes. These assessments included the Test of Economic Literacy (TEL) for grades 10-12, the Test of Economic Knowledge (TEK) for grades 7-9, and the Basic Economics Test (BET) for grades 5 and 6. All test forms are normed and published by the National Council on Economic Education.

Mean student test scores improved each year the tests were administered. The overall improvement for each of the three tests was also statistically significant (TEL: $z = 21.93$, $p < .01$, TEK: $z = 2.96$, $p < .01$, BET: $z = 6.26$, $p < .01$), and substantial effect sizes (TEL: ES = 1.31, TEK: ES = 0.34, BET: ES = 1.55) indicate the practical significance of the results. As Fellow's progressed through the program, their students' success on standardized economic tests increased. Because each test has a different number of items, we also report the nationally normed percentile scores in the tables below (See tables 4-6).

Table 4: TEL Scores of Students in Grades 10-12 (46 items)

School Year	N	Mean	Std Dev	Percentile
1998 / 1999	1058	19.67	5.90	48th
1999 / 2000	812	22.69	6.97	59th
2000 / 2001	417	24.95	6.57	67th
2001 / 2002	430	27.61	6.49	75th

Table 5: TEK Scores of Students in Grades 7-9 (39 items)				
School Year	N	Mean	Std Dev	Percentile
1998 / 1999	159	17.23	5.25	53rd
1999 / 2000	358	17.67	6.58	55th
2001 / 2002	157	19.28	6.90	63rd

Table 6: BET Scores of Students in Grades 5-6 (29 items)				
School Year	N	Mean	Std Dev	Percentile
1998 / 1999	45	14.49	4.72	38th
1999 / 2000	45	16.84	4.28	53rd
2001 / 2002	20	21.25	3.54	78th

Table 4 clearly demonstrates the improvement in economic literacy among the high school students of the Idaho Fellows. The growth of 27 percentiles over three years yields an effect size of 1.31. The data suggests that as Fellows' knowledge and/or understanding increased so did their ability to better facilitate their students' economic understanding resulting in increased student gains on standardized tests. At the elementary level, it appears that students are learning much more, but the small sample size limits our ability to make strong claims regarding the significance of their growth. The middle school students demonstrate the least growth, but they appear to be making steady improvement. Once again, a smaller sample size limits our ability to draw any firm conclusions about their achievement, or lack thereof.

Teachers' Pedagogical Repertoire

To assess the pedagogical repertoire of the Fellows, we administered two instruments. The first is a series of surveys (comfort surveys) in which

teachers report their comfort with various concepts and skills in both economics and pedagogy. The Fellows reported comfort on a 4-point Likert scale: 4-Very comfortable, 3-Comfortable, 2-Uncomfortable, and 1-Very uncomfortable. The second series of surveys (change-in-practice surveys) asked Fellows to report the affect of their participation in the Institute on treatment of economic principles in their own classrooms. Fellows indicated whether economic concepts were newly added to their classroom curriculum, whether their treatment of specific economic concepts was enhanced, or whether their practice was unchanged as a result of their participation in the Institute.

Teachers' Comfort as an Indicator of Economic Literacy

The Economic Fellows program participants completed comfort surveys immediately before each summer Institute and again two months after their summer sessions. Curriculum goals, as stated in course syllabi, were used to identify concepts considered on the comfort surveys. Prior to the beginning of each summer session, professors validated the list of concepts to be taught in their courses. The 1999 comfort surveys measured the teachers' comfort level for macroeconomics concepts, microeconomic concepts, and pedagogy, using a scale of one to four-one being Very uncomfortable and four being Very comfortable. All 31 participants completed both the pre- and post-surveys. The 2000 comfort survey reported Fellows' levels of comfort with financial markets, industrial organization, and pedagogy concepts. Once again, all 31 participants completed both the pre- and post-surveys. The 2001 comfort surveys examined Fellows' comfort with international economics, economic conditions and analysis, and educational research topics. Thirty participants completed the 2001 surveys.

To check the reliability of each of the sub-tests in the comfort surveys, a Cronbach Alpha test was used to check for internal consistency. The reliability analysis for all six administrations of the comfort surveys over three years demonstrates that all instruments were reliable. The Cronbach Alpha values ranged from 0.79 to 0.98, with a mean value of 0.92. Thus, the individual items as a whole had relevant information and a high degree of

internal consistency on the three comfort sub-tests for each administration during all three years.

The means of the pre- and post-tests were compared using a paired-samples t-test (see Tables 7-9). The annual pre-post data gathered from the comfort surveys was used to recommend to professors and the program's director, specific concepts that should be revisited in subsequent courses. Thus, while an analysis of the Fellow's (group) *TUCE* scores would predict trends of understanding of relevant conceptual areas, (for example, macroeconomics) the comfort survey analysis provided immediate feedback on specific concepts within the larger areas. For example, seven items from macroeconomics taught during the first summer had nearly equivalent mean item scores on pre - and post-comfort surveys. In curriculum planning sessions for the second summer, professors committed to reteach these seven concepts and discussed different pedagogical practices to address the students' needs. To determine the benefit of re-teaching the concepts they were added to the post comfort survey administered at the end of the second summer. The results appearing in Table 10 indicate that the re-teaching strategy was beneficial to student learning.

Table 7: Analysis of Comfort Surveys (1999)

Content Area	N	Mean1	Mean2	t	p
Macroeconomics (31 items)	31	66.39	86.65	8.45	< .001
Microeconomics (44 items)	31	114.03	140.06	8.17	< .001
Pedagogy (25 items)	31	73.94	78.68	2.86	< .01

Table 8: Analysis of Comfort Surveys (2000)

Content Area	N	Mean1	Mean2	t	p
Financial Markets (31 items)	31	61.77	92.87	14.99	< .001
Industrial Organization (22 items)	31	54.26	69.55	8.60	< .001
Pedagogy (13 items)	31	34.87	41.23	6.38	< .001

Table 9: Analysis of Comfort Surveys (2001)					
Content Area	N	Mean1	Mean2	t	p
Economic Analysis (11 items)	30	29.71	36.43	9.84	< .001
International Economics (23 items)	30	55.23	77.23	9.54	< .001
Education Research (12 items)	30	23.13	32.93	7.45	< .001

Furthermore, to document the staying power of the Fellows' experience, or more appropriately, the retention of their comfort with economic concepts an additional survey was used. During fall 2001, we administered a retrospective comfort survey, asking Fellows to report on a randomly selected sub-sample of the concepts addressed during the 1999 and 2000 summer sessions. Table 11 clearly demonstrates that one to two years after their initial instruction, the Fellows maintained their comfort with economic concepts.

This result is important because self-reported comfort with economic concepts was found to be a good proxy for assessing economic literacy as measured by the *TUCE*. Fellows' scores on both the macroeconomics and microeconomics comfort survey pretests (1999) were positively and significantly correlated with their corresponding *TUCE* scores. Both correlations were significant at the 0.01 level (Macro: $r = 0.645$, $N = 29$, $p < 0.01$; Micro: $r = 0.584$, $N = 29$, $p < 0.01$). This potentially indicates the ability to have teachers self-assess their economic literacy.

Table 10: Formative Assessment of Macroeconomics				
Content Area (7 concepts)	N	Mean	t	p
Macroeconomics (Summer 1999)	31	14.39	-	-
Macroeconomics (Autumn 1999)	31	15.39	1.39	ns
Macroeconomics (Autumn 2000)	31	19.94	7.51	< .001

Table 11: Retention of Comfort Levels				
Content Area (7 concepts)	N	Mean	t	p
Six-Area Random Selection (1999, 2000)	30	142.16	-	-
Six-Area Random Selection (2001)	30	193.37	13.07	< .001

Effect on Fellows' Practice

Change-in-Practice surveys were used to determine whether participation in the Institute directly affected Fellows' instructional practices regarding a wide variety of economic concepts and pedagogical practices. The surveys were administered during the spring of 2000, 2001, and 2002. They explored the concepts/practices in Macroeconomics, Microeconomics, Financial Markets, Industrial Organization, Economic Analysis, International Economics, and Pedagogy. Each item on the surveys was rated in the context of the Fellow's own classroom on whether there was a) no change in teaching the concept, b) improved practice/teaching of concept, or c) inclusion of the item as a new concept/practice into their classroom repertoires.

This data reveals the value of interdisciplinary (economics and education) preparation in the teachers' professional development and how the Institute influenced the curriculum delivered by Fellows in their respective classrooms. Fellows reported teaching concepts normally not taught in the curriculum and being better teachers of concepts already in the curriculum. While more teachers reported that (as a result of their new learning) they were teaching economic concepts that they had not taught prior to their participation in the Institute, there were fewer teachers indicating that the strategies/practices taught in the pedagogy course were concepts in which they were unfamiliar. However, over 60% of the participants reported during their first two years in the institute that as a result of the pedagogy coursework, they were more skilled in using known instructional strategies/practices (See Tables 12 -14).

Table 12: Change-in-Practice Surveys (Spring 2000)			
Content area	N	"I have not taught this concept in previous years, but I do teach it now."	"I have taught this concept before, but I am teaching it better now."
Macroeconomics (31 items)	31	17.3 %	22.4 %
Microeconomics (44 items)	31	19.6 %	37.9 %
Pedagogy (25 items)	31	8.0 %	60.6 %

Table 13: Change-in-Practice Surveys (Spring 2001)			
Content area	N	"I have not taught this concept in previous years, but I do teach it now."	"I have taught this concept before, but I am teaching it better now."
Financial Markets (31 items)	31	12.3 %	23.8 %
Industrial Org (22 items)	31	8.8 %	45.7 %
Pedagogy (13 items)	31	7.9 %	67.2 %

Table 14: Change-in-Practice Surveys (Spring 2002)			
Content area	N	"I have not taught this concept in previous years, but I do teach it now."	"I have taught this concept before, but I am teaching it better now."
Economic Analysis (11 items)	30	36.5 %	8.1 %
International Econ (23 items)	30	31.3 %	6.1 %
Pedagogy (6 items)	30	6.1 %	6.7 %

For example, many Fellows reported knowing about and using cooperative learning strategies, however, after considering its use specifically within the context of economics education they reported being more comfortable and skilled at using it. Similar responses were associated with teaching tools such as the use of non-linguistic representation, comparing and contrasting, goal setting and other items. During the third summer, the responses indicate much less reported change. This is explained through a shift in emphasis from pedagogy to more of a focus on educational research to inform teachers' actions. As a result of the emphasis shift, the 2001 Change-in-Practice results indicate misalignment between the instrument and the experience of the Fellows. Although there was reported change in all categories, the amount of change associated with pedagogical concepts reflects the value of including pedagogy in the Fellows' course of study.

While this research did not explicitly consider why the known practices and concepts taught were reported as being used in a better manner, the change in Fellows' practices may be connected to the relevancy of the coursework to their work as teachers. Likewise, Fellows reported some change in practice as it pertained to macroeconomics and financial markets. However, it was in these two areas that the least amount of change was recorded. This indicates that the two may currently be a primary focus of existing economics curricula or not an area considered for K-12 curricula. The phenomenon calls for further research.

Institute Assessment

Analysis of the overall quality of Idaho Economic Fellows Institute explored several different facets of the Institute, including quality of faculty, quality of housing and amenities, and overall organization and support. Fellows provided feedback regarding these factors through surveys that included both Likert-type and open-ended responses. Furthermore, the surveys allowed Fellows to reflect on their experience and offer suggestions or considerations for the remainder of the three-year Institute.

Across the three years of data collection, Fellows consistently rated the instructors very well. The average rating of instructors for overall merit

was consistently between 4 and 5 on a five-point scale, with the final summer evaluation averaging 4.59. The courses were likewise evaluated consistently between 4 and 5, with courses in the third summer yielding an average of 4.42.

The overall evaluation of the Institute was consistently high, with the 2001 evaluation of 4.77 on a five-point scale. However, the open response nature of the surveys allowed the evaluators to identify specific areas in need of improvement. For example, during the 1999 summer, several Fellows indicated that the daily schedule of the courses was not optimal for their learning. After careful consideration of balancing the needs of the instructors and the needs of the Fellows, a modified schedule was designed that satisfied both parties' needs. As a result of the formative assessment, each year some subtle, yet important, program changes were implemented.

Although the professional development literature (Fullan, 2001; DuFour & Eaker, 1998) indicates that the creation of learning communities promotes collaborative learning experiences, provides academic and social support, and fosters learning, when educators are enrolled in advanced programs of study, they may or may not develop a learning partnership with others pursuing a similar degree. Within the Institute studied, program directors actively cultivated supportive relationships among the Fellows. During the Institute, the Fellows had opportunities to participate in Ropes courses, attend minor league baseball games, whitewater raft, and travel to the Federal Reserve Bank in San Francisco together. At the conclusion of their last summer together (2001), several Fellows remarked on the strength of the relationships and friendships generated among their peers. So strong were their feelings of camaraderie, many suggested that the Idaho Council for Economic Education facilitate reunion activities in the future. Such relationships rarely occur among participants in traditional forms of professional development or graduate study in education.

DISCUSSION

Our evaluation of the Idaho Economic Fellows Institute clearly supports this format of teacher preparation and/or professional development.

The three-year structured program contains many of the facets of professional development commonly referenced within the literature as critical to supporting high quality teaching (Abdal-Haqq 1996, Corcoran 1995, Daniels 1999, Dorph & Holtz 2000, Fine & Raack 1994, Joyce & Showers 1982, Little 1988, Novick 1996, Putnam & Borko 1997, Sullivan 1999, U.S. Department of Education 1995). These factors include professional development that is:

- based on the view of teaching as intellectual work and recognizes teachers as professionals;
- connected to knowledge of the content that is being taught, and is aligned with local or national content standards;
- ongoing, sustained over time, and allows time and follow-up support for teachers to master new content and strategies to integrate them into their practice;
- inclusive of training, practice, and feedback, providing opportunities to reflect, analyze and work on teachers' practice, and supports the inquiry into and study of teaching and learning;
- practical, and embedded in teacher work;
- collaborative, and provides opportunities for teachers to interact with peers through group inquiry into practice or coaching, and establishes a learning community of which all teachers are members;
- committed to treating teachers as active learners.

Learning experiences that incorporate the above factors create learning environments in which professional educators may work iteratively on improving and refining both their pedagogical repertoire and the understanding of subject matter.

Use of comfort surveys to approximate the economic literacy of the Fellows may allow educators to gauge their relative strengths within the larger discipline of economics. Our research indicates that it was not necessary to use a standardized assessment to test the Fellows' economic literacy. Simply put, teachers do not necessarily need to be tested to learn what they know. All one has to do is to ask teachers in a condition which is conducive to their honest response. Additionally, by engaging teachers in a reflective process it is possible to consider their input as to what constitutes

meaningful and necessary professional development. Thus, by replacing tests used to confirm what a learner knows, with specific content-related, non-threatening questions may, in fact, make professional development programs more humane, more responsive to the learners' needs and save valuable program resources.

Upon review of the data collected to date, we can confidently state that teacher training programs such as the Idaho Economic Fellows Institute can positively affect teacher knowledge, teacher comfort/confidence, teacher classroom practice, and student learning. To maximize the effect of such programs, we highly recommend that program directors engage in detailed, formative assessment conducted by third-party evaluators. In the case of the Idaho Institute, the use of formative feedback was critical to maintaining program quality and meeting the evolving needs of the participants.

Furthermore, it is possible to document the impact of focused, long-term professional development-not only on teacher knowledge, but also on student learning-when longitudinal data is carefully collected. It is important that evaluation of professional development programs move beyond the traditional rating of how teachers "enjoyed" the experience, or how useful they think the information is. These ratings, usually conducted immediately after the conclusion of the professional development experience, can be harmful to future professional development decisions. By carefully collecting a wide range of detailed, longitudinal data educators can be better informed to make decisions benefitting K-12 student learning.

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THE QUALITATIVE TRADITION: A COMPLIMENTARY PARADIGM FOR RESEARCH IN ECONOMIC EDUCATION

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ABSTRACT

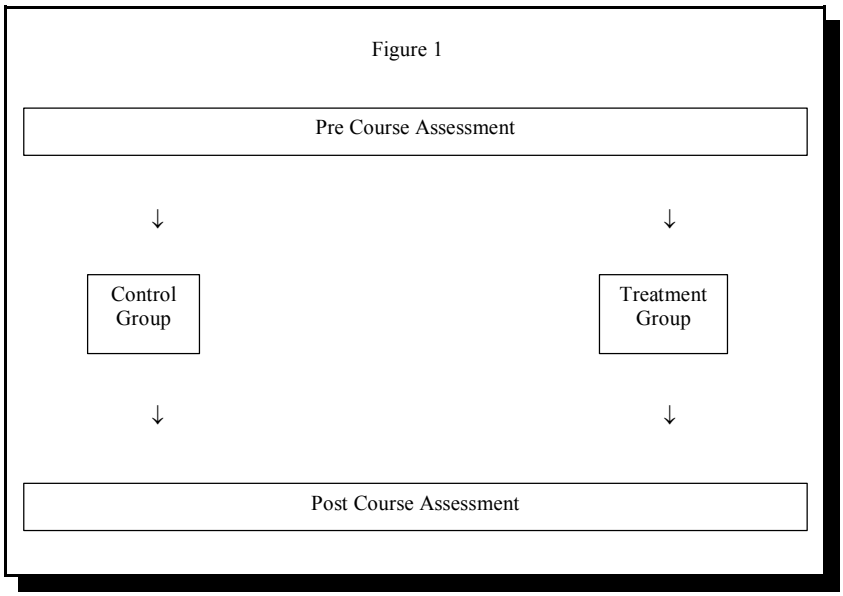
The qualitative tradition provides an alternative approach to investigate complex research and help augment the existing research about economic education. This study presents the underlying assumptions and methods for both quantitative and qualitative traditions and compares and contrasts the major differences between the two paradigms. Validity issues are addressed, and the article ends with a discussion on how qualitative research would compliment the existing literature in economic education. Quantitative research, based on deductive reasoning, start with the postulates in the researcher's mind. The researcher's pre-conceptions may cause her or him to overlook significant variables within the phenomenon. Qualitative research is able to overcome this quantitative difficulty by starting the research process with the participants. Through data collection and inductive reasoning, the qualitative researcher can develop testable hypotheses that were previously overlooked by traditional quantitative methods.

INTRODUCTION

Much of the research in economic education focuses on student performance and attitudes with the goal of improving teaching effectiveness and student learning. A framework often utilized is the input/output production model where student performance or attitudes is the dependent variable (see Figure 1). In this framework, a pre-course assessment is given.

Then students are divided between a control group and a treatment group. The treatment group receives the new pedagogical method. A post-course assessment is given when the course is finished. Teacher and student related variables are the explanatory variables in this model, along with effort to control for exogenous influences. Over the past two decades numerous studies have been conducted using either the TUCE (Test of College Economics) or the TEL (Test of Economic Literacy) scores as a proxy for student performance.[1] Numerous studies using TUCE or TEL scores in this input/output framework have been conducted to test new pedagogical techniques and their results have been published.[2] There is concern that the marginal impact of additional studies using the TUCE to test for significant variables in student learning has become trivial.[3]

Figure 1



For research purposes, in any classroom there are student-controlled variables, teacher-controlled variables, and any number of variables that are exogenous including: each student's opportunity cost, the teacher's opportunity cost, and the fit between the instructor's teaching style and each

student's learning style. The list of possible significant exogenous variables is infinite. One of the problems with the TUCE input/output framework is that the model has no power to investigate exogenous variables. For example, the input/output model has no way to control for a tragedy that occurs in the life of a student during the course of study.

Another problem with the input/output framework, like all models, is that the model is based on assumptions. The input/output framework assumes that participants desire to maximize their assessment scores. If instead, participants are targeting a passing grade rather than the highest possible score, the quantitative analysis used in the model will produce insignificant results.

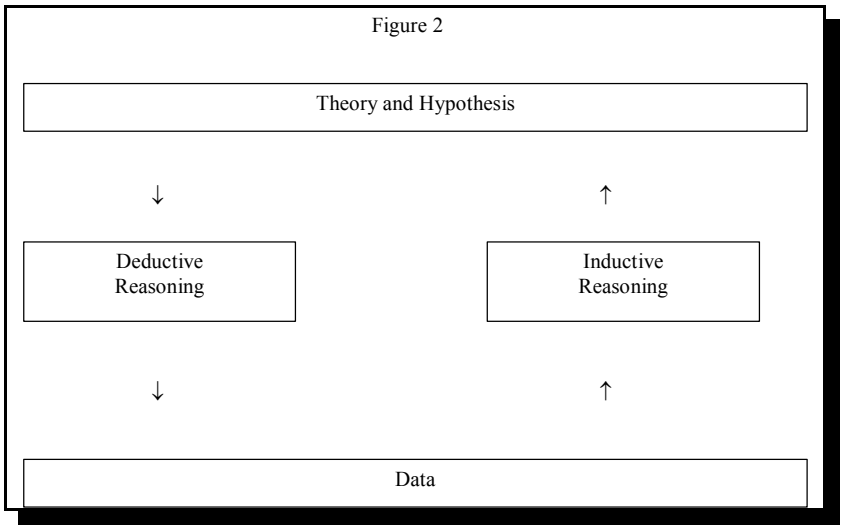
A new method of modeling is needed to investigate variables that are exogenous to the traditional input/output framework. The purpose of this paper is to present an alternative paradigm that is able to examine variables that are exogenous to traditional quantitative research in economic education, namely qualitative research methods. The qualitative tradition uses methods that would compliment the existing quantitative results and provide a new approach to solving issues that traditional methods of research in economic education have not yet been able to address.

This study presents the underlying assumptions and methods for both quantitative and qualitative traditions and will compare and contrast the major differences between the two paradigms. Validity issues will be addressed, and the article ends with a discussion on how qualitative research would compliment the existing literature in economic education.

QUANTITATIVE RESEARCH

The quantitative research tradition is based on deductive reasoning (see Figure 2).[4] A postulate is set a priori, and data is gathered to test the validity of the hypothesis. The method includes data collection and organization into quantifiable variables, the use of statistics as proxies for population parameters, and deliberate control for outside influences.

Figure 2



The methods used in quantitative research are built on five underlying assumptions that are distinctive from the assumptions of qualitative tradition. First, quantitative research assumes an objective social reality. Consequently, researcher can be detached from research participants and their setting.

Second, researchers are able to suspend their values and conduct research through a positive, rather than normative, approach. Causal relationships among social phenomena can be viewed from an objective, detached, and mechanical perspective. These first two assumptions allow the researcher to superimpose a priori a theoretical framework on the study.

Third, social phenomena are real only if they are observable. Knowledge is legitimized through research and testable hypotheses. If social behavior is not observable, than it is not quantifiable. For behavior that is not quantifiable, the validity of a claim cannot be tested, and it remains only an idea rather than knowledge.

Fourth, quantitative research assumes social reality is relatively constant and across time and space. Therefore, representative samples can be drawn from a population.

Finally, social realities can be organized as variables and analyzed through the use of statistical methods. Since the samples are adequately representation of the entire population, it is assumed that findings can be generalized as pertaining to the defined population.

QUALITATIVE RESEARCH

The qualitative tradition is based on inductive reasoning (see Figure 2). No hypotheses are set a priori. Data are gathered and examined, and theories are built on evidence extrapolated from the data. In this tradition, researchers study naturally occurring phenomena in all their complexities.[5] In the case of research in economic education, the classroom is a naturally occurring phenomenon in which research is conducted.

In conducting this type of research, the qualitative tradition is based on four assumptions. First, qualitative research assumes the participants construct social reality within each phenomenon. Also social reality is continuously constructed in local situations.

Second, the qualitative tradition assumes human intentions play a major roll in explaining causal relationships within social phenomena. Both the actions and values of the participants shape the phenomenon. Qualitative research allows for both objectivity and subjectivity on behalf of the participants.

Third, it is assumed by qualitative researchers, that they must become personally involved in the phenomena with the research participants, including sharing perspectives and assuming a caring attitude. Trust must first be established for qualitative interviews to result in open and honest communication.

Finally, qualitative research assumes that new concepts and theories can be discovered after data have been collected. Variables are not pre-determined. Rather, they result from reoccurring patterns in the data.

The goal of qualitative tradition is to understand natural occurring phenomena with all of their complexities. The researcher continuously collects data to understand a particular phenomenon. Data collection includes field notes of the researcher's observations, individual and group

interviews of participants, videotaping of the phenomenon (for example, an economics class), and journaling based on reflection.

To be effective, the researcher must indwell both the study's participants and himself or herself. Indwelling allows the researcher to observe the behavior in the phenomenon most relevant to the problem being pursued. The researcher indwells the subjects by living with them in the phenomenon. In the case of economic education, this would include attending class with the students and observing them as they study. The researcher indwells himself or herself though reflecting deeply on the subject and developing theories through internalizing the phenomenon and using inductive reasoning.

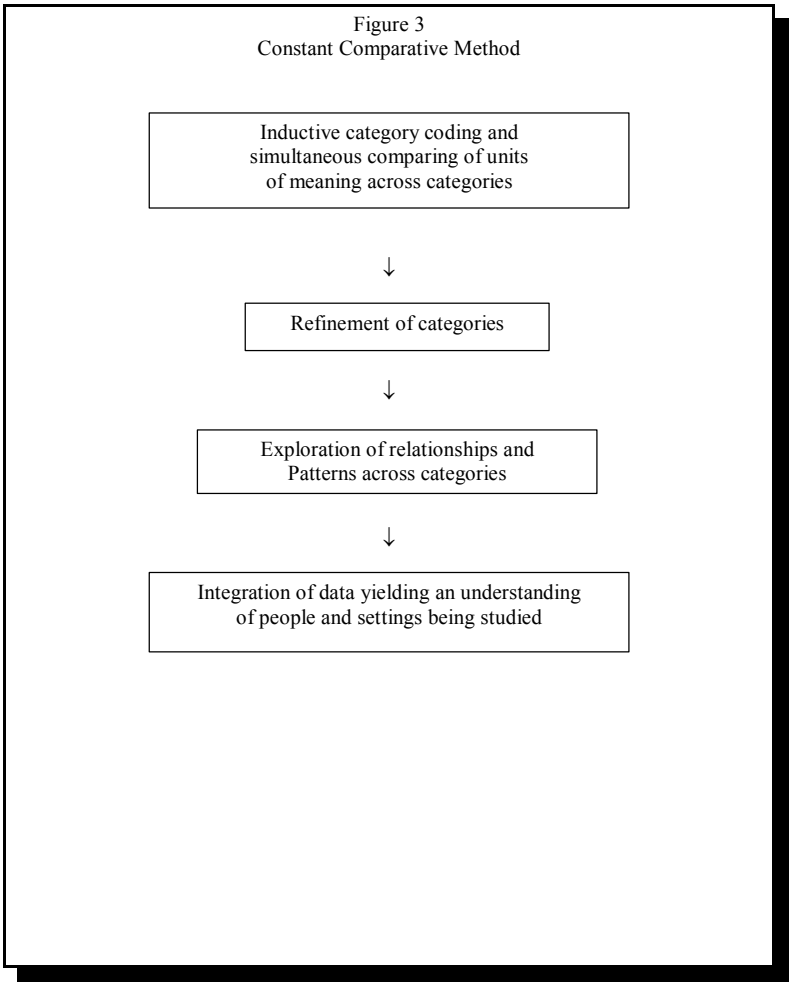
QUALITATIVE RESEARCH METHODOLOGY

Qualitative research begins with the researcher selecting a focus of inquiry. In the case of economic education, it may be the experience of college students in a principles level economics course. At this point, like the quantitative tradition, the researcher conducts a review of the literature for relevant studies. Next the researcher selects a sample to study. Unlike the quantitative tradition, after selecting the sample, the researcher starts building relationships with the participants of the phenomenon. Qualitative researchers actively seek to minimize differences between themselves and the participants of the study. This includes, but is not limited to, spending time with the participants, building friendships, and gaining their trust. After trust has been established, the researcher interviews each participant, and records the interview either by audio- or videotape. For each interview, the researcher starts with open-ended questions. The interviewer allows participants to take control of which direction their answers lead. With each answer, the researcher continues to ask open-ended questions. But overall the researcher determines the focus of inquiry. If the interview drifts too far on a tangent, the researcher guides the interview back to the intended focus. After each interview, the entire conversation is transcribed, word for word. The interview process is repeated for each participant in the phenomenon.

The transcriptions are then analyzed. One widely used method of

analysis is the Constant Comparative method (See Figure 3).[6] The Constant Comparative Method of analyzing qualitative data combines inductively coding data into broad categories with a simultaneous comparison of all units of meaning obtained (Glaser and Strauss, 1967).

Figure 3
Constant Comparative Method



The Constant Comparative Method involves coding data by category, and looking for patterns both within and across manuscripts.[7] Once patterns

are recognized, the phenomenon is revisited, and more data is collected to better define these patterns and theories. After analyzing the new data, categories are redefined as new patterns immerge or the original organization of words, themes, and topics are reconfirmed. From these reconfirmed patterns, the qualitative researcher then develops theories about the phenomenon.[8],[9] The theories that emerge through qualitative research then can be either published as a case study or research report, or used to form testable hypothesis for quantitative research. The research process ends when a point of saturation occurs. The point of saturation occurs when additional interviews yield no new information about the phenomenon.

FIVE FUNDAMENTAL DIFFERENCES BETWEEN QUALITATIVE AND QUANTITATIVE RESEARCH

(1) Quantitative research is conducted in either a natural or artificial setting where certain variables and influences can be purposely controlled. Qualitative researchers intentionally strive to do their research in the natural setting that it occurs. Also, quantitative research takes an objective, detached stance towards research participants and their setting, whereas qualitative researchers become personally involved with the research participants and immerse themselves in the research setting.

(2) Quantitative research attempts to capture social realities through quantifying behavior and looking for statistical correlations between variables. By contrast, qualitative research makes holistic observations of the institutional context within which the social interaction occurs. Qualitative research firmly believes the values are deeply embedded in social science research, and attempts to capture behavior through recorded interviews, observations, dialogs, and pictures.

(3) Quantitative research starts with pre-conceived postulates and hypotheses set a priori to determine what data will be collected. By contrast qualitative research develops theories from patterns that occur as data are analyzed. Quantitative is based on the deductive

reasoning process, and contributes to knowledge through the validation of postulates, whereas qualitative uses inductive reasoning, and contributes through uncovering new postulates and theories. Qualitative researchers have issues with using a priori null hypotheses to begin the research process since the values of the researcher determine the questions and answers that will be studied, and overlook variables that significantly affect the phenomenon.

(4) Quantitative research, through random sampling, seeks participants or observations to be as homogenous as possible to control for heterogeneous sample problems. Differences within a sample cause statistical problems including heteroskedasticity of the residuals. By contrast, qualitative studies, though purposeful sampling, are strengthened by diversity among participants within a focus of inquiry. Diversity broadens the breath of perspectives and understanding within the social phenomenon. For qualitative studies, the saturation point occurs when additional interviews yield no new information about a social phenomenon. Thus, phenomenon containing diverse populations is beneficial to broaden the breadth of perspectives.

(5) Quantitative research, based on statistical representation of population parameters, assumes that research results can be generalized to the population. Qualitative research examines data and develops theories within a specific focus of inquiry, but makes no claim to generalize result beyond the specific context of the phenomenon.[10] The qualitative tradition makes no claim to generalize results to a larger population.[11]

VALIDITY ISSUES

The quantitative tradition relies on surveys and tests as instruments. The tradition has a two-part approach to establishing research validity. First, the researcher appeals to the properties of the instruments in terms of reliability and validity.[12] Second, the researcher uses statistical modeling

techniques that do not violate any of the assumptions of the sampling distribution.[13]

By contrast the qualitative tradition uses people and their words as instruments.[14] Humans-as-instruments means persons, with all of her or his own experiences, skills, and biases affect each participant's behavior within the phenomena. Lincoln and Guba (1985) argue that humans-as-instruments is a more holistic approach to the dynamics of social phenomena than quantitative instruments. Humans-as-instruments allows for participants' interpretations within the phenomenon. What people do and say reflects how they interpret both their world and the phenomenon.[15]

Traditionally for the qualitative tradition, the criteria for judging the adequacy of research have been trustworthiness and usefulness of the phenomenological study (Maykut and Morehouse 1994).[16] In the last decade the qualitative tradition has turned to measurement validity to address validity issues within qualitative research (Adcock and Collier 2001). Evidence for measurement validity for both quantitative and qualitative research is demonstrated through construct, criterion, and construct validity.

For any branch of research, whether qualitative or quantitative research is conducted, there are four levels of conceptualization according to Adcock and Collier (2001).

Level 1: *Background Concept*-the meaning(s) given to a concept outside the research community by society as a whole.

Level 2: *Systemized Concept*-the concept as defined within a research community.

Level 3: *Indicators*-measures of the systemized concept used within the research community. For quantitative research, this includes the numerical scoring of the data. For qualitative research, this includes the coding of the transcripts.

Level 4: *Research Scores*-the actual indicator scores generated by a particular study.

For establishing the measurement validity of any study, content validity assesses the degree to which the indicators (level 3) of the instrument

represent the systemized concepts (level 2) established by previous studies within the research community.

Criterion related validity assesses whether the scores produced by the indicators (level 3) are empirically associated with the scores for other variables, called criterion variables, which are considered direct measures of the phenomenon being studied.

Construct validity assesses whether a given indicator (level 3) is associated with other indicators (level 3) in away that conforms to the theoretical expectations about their interrelationship. In both traditions, evidence for validity can be demonstrated through content, criterion, and construct validity.

HOW QUALITATIVE STUDIES WOULD COMPLIMENT THE EXISTING BODY OF RESEARCH

Quantitative research, based on deductive reasoning, starts with the researcher. More precisely, it begins with the postulates in the researcher's mind. A timeless obstacle faced within the quantitative tradition is that the postulates the researcher stipulates a priori are not necessarily the dynamics that are driving the investigated phenomenon. The researcher's pre-conceptions may cause her or him to overlook significant variables within the phenomenon.

Qualitative research is able to overcome this quantitative difficulty by starting the research process with the participants. By setting no hypothesis a priori, the qualitative researcher begins instead with open-ended questions. Through allowing participants, who create the phenomenon, to explain which influences are significant, the qualitative researcher is able to investigate variables that are exogenous to quantitative models.

Through data collection and inductive reasoning, the quantitative researcher can develop testable hypotheses that were previously overlooked by traditional quantitative methods.

Qualitative studies provide an alternative approach to investigate complex research and help augment the existing research about economic education.

ENDNOTES

1. *The Test of Understanding of College Economics* 3rd edition by Philip Saunders. *Test of Economic Literacy* 3rd edition by William Walstad and Ken Rebeck.

2. According to Saunders and Walstad, as of 1989, approximately 250 research studies had been published on the topic of teaching college economics. A 1979 study John Sigfried and Rendig Fels appeared in the Journal of Economic Literature surveying 179 published articles on the topic of research in economic education.

3. To Quote Saunders and Walstad: "Why has there been such a precipitous decline in reported research findings? Several possibilities come to mind. First, the easy questions naturally were addressed first. As the most important questions are answered and as the remaining become ever more difficult, fewer potential research efforts yield a positive expected net present value" page 272.

4. The quantitative research tradition has been referred to as the positivist approach.

5. Michael Polanyi (1962, 1967) articulates the phenomenological position at length.

6. See Glause and Strauss (1967). See also Lincoln and Gruba for additional procedural information on the Constant Comparative method. Figure 3 is taken from Figure 9.4 on page 135 of Maykut and Morehouse (1994).

7. The qualitative researcher is looking for patterns across people's words, actions, and documents.

8. Computer programs are available to assist with analysis, including EthnographTM and LISQUALTM.

9. Also anomalies are discovered that do not fit the current theories related to the phenomenon. Further analysis of these anomalies can both call into question current theory and result in new directions for research to be pursued.

10. To quote Maykut and Morehouse: "One can further state that for the qualitative researcher, the person or event can only be understood within the context or background. The person that emerges out of the context is not a universal person or event, but rather a contextual person or event" page 33.

11. For researchers desiring to generalize results for studies within the qualitative tradition, making results generalizable is possible through conducting a meta analysis across studies.

12. Evidence for reliability is established through split-half reliability and test-retest reliability. A coefficient alpha is often used to provide evidence for split-half reliability. Evidence for validity is established through demonstrating the content, construct, and criterion related properties of the instrument.

13. Often the normal distribution is the assumed sampling distribution.

14. The qualitative tradition assumes human behavior is too complex to be captured in a one-dimensional instrument.

15. Addressing interpretations in the phenomenon may shed light on student behavior in the economics classroom including academic performance.

16. Given the recent debacles of the stock market including misreporting by Enron, World Com, and Xerox, trustworthiness needs to be a criterion for judging manuscripts in both research traditions.

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INTERSECTION OF TEACHERS' PERCEPTIONS AND STATE ECONOMIC STANDARDS

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ABSTRACT

The need for basic economic education has never been clearer. For students to achieve the economic literacy required in a democracy, they need to be taught by teachers who have the knowledge and capacity to design appropriate standards-based economic curriculum. Scholarship points to the intersection between comfort and knowledge as prerequisite for the economic education desired. This paper presents a study of elementary school teachers' and their knowledge of and comfort with major economic concepts. Results confirm the necessity of continuing professional development for teachers to ensure that knowledge of, comfort with, and economic curriculum development are achieved.

MAKING THE CASE FOR ECONOMIC EDUCATION

In today's complex and global society, the need for basic economics education has never been clearer. Students (as well as their teachers) need economics and personal finance knowledge in order to become productive participatory members of a global society. But before students can be taught, their teachers need both the knowledge of and comfort with the teaching of economics. And that is where the professional development of teachers, via academic courses or in-service programming plays a key role.

The National Council on Economic Education (NCEE) in conjunction with State Councils on Economics has helped establish content standards

nationwide in economics for K-12 students. These national content standards provide a curriculum and instructional framework for teachers because, "There is universal agreement that education standards can be an important tool in improving student achievement. Standards also inform students and their parents what society considers essential knowledge that children should learn during their K-12 education." (Pacific Research).

NCEE also regularly conducts surveys to "determine the status of economic and personal finance education in the United States." When the surveys first began in 1998 there were 38 states (76%) with economics as part of their instructional standards. By 2002 those number had grown to 48 states (96%). These economic standards may stand alone or may be embedded into the social studies standards of that state. Of the 38 states requiring some form of economic education in 1998, 25 required testing of students' knowledge of economics. By 2002 this had increased to 27, with four states planning or developing testing protocols. (NCEE Survey of the States: Economic and Personal Finance Education in Our Nation, 1998, 2000 and 2002). In addition, the standards movement and the No Child Left Behind Act are playing a crucial role in economics education and as advocates for economic literacy goals for all children.

STANDARDS AND ACCOUNTABILITY IN INDIANA

Indiana teachers are now required to develop standards-based curriculum in economics education. Under the Indiana General Assembly's direction, standards were designed that "are world-class, clear, concise, jargon-free, and by grade level" (Academic Standards - Social Studies 2001). The standards are benchmarked to content in the National Assessment of Educational Progress (NAEP) and the National Council for Economic Education Voluntary National Content Standards in Economics. Recommended by the Indiana Education Roundtable, the standards were developed by the State Board of Education in summer 2001. The goal of the social studies standards, as stated in the teacher edition of the Indiana Academic Standards for Social Studies, is "the development of informed, responsible citizens who participate effectively in our democracy." (Indiana

Academic Standards - Social Studies, 2001) To achieve this goal, the standards integrate knowledge with skills for inquiry, thinking and participation. The Indiana standards are organized around five content areas outlined by the National Council for the Social Studies. Those content areas are History, Civics and Government, Geography, Economics, and Individuals, Society, and Culture.

Throughout their school years, all students should be gaining the economic knowledge and skills to help them become well-informed about the world around them and to prepare them to be responsible and effective citizens of Indiana and the United States. To achieve this, NCEE has developed a scope and sequence from kindergarten to twelfth grade (see Appendix A). Key topics, concepts, and skills are to be introduced early, reinforced, and expanded. Indiana's standards, scope and sequence are based on the NCEE's Voluntary National Content Standards in Economics. They are stated in the teacher edition of the Indiana Academic Standards for Social Studies as follows:

Kindergarten - students explain how people do different jobs and work to meet basic wants.
First Grade - students will explain how people in the school and community use goods and services and make choices as both producers and consumers.
Second Grade - students will describe how people in a community use productive resources, specialize in different types of jobs, and depend on each other to supply goods and services.
Third Grade - students will explain how people in the local community make choices about using goods, services, and productive resources, how they engage in trade to satisfy their economic wants, how they use a variety of sources to gather and apply information bout economic changes in the community, and how they compare costs and benefits in economic decision making.
Grade Four - students will study and compare the characteristics of Indiana's changing economy in the past and present.
Grade Five - students will describe the productive resources and market relationships that influence the way people produce goods and services and earn a living in the United States in different historical periods.

Grade Six - students will examine the influence of physical and cultural factors upon the economic systems of countries in Europe and the Americas.
Grade Seven - students will examine the influence of physical and cultural factors upon the economic systems found in countries of Africa, Asia, and the Southwest Pacific.
Grade Eight - students will identify, describe, and evaluate the influence of economic factors on national development from the founding of the nation to the end of Reconstruction.
High School Level - students will understand that productive resources are limited; students will understand the role that supply and demand, prices, and profits play in determining production and distribution in a market economy; students will understand the organization and role of business firms and analyze various types of market structure in the United States economy; students will understand the roles of government in market economy are the provision of public goods and services, redistribution of income, protection of property rights, and resolution of market failures; students will understand the means by which economic performance is measured; and students will understand the role of money and financial institutions in a market economy.

Teachers in Indiana are not only expected to design and implement economics curriculum that enhances this economic literacy, but they will be held accountable for the economic literacy of their students. To that end, the Indiana Department of Education will begin pilot testing of social studies, including economic literacy in 2003. Full testing was supposed to begin in grade 5 in Fall 2004 (covering the K-4 standards). This testing has now been put on temporary hold due to the state budget crisis. Testing for 7th grade is scheduled for Fall 2006 (covering the 5th and 6th grade standards - note that these will be the same students who were tested in Fall 2004). In Fall 2008 the final 9th grade tests are scheduled to be added and they will cover 7th and 8th grade standards these are the same students tested in 2004 and 2006).

WHAT TEACHERS NEED

National goals, state legislative initiatives, and school corporation objectives are making economic literacy important. However, the burden for implementing standards falls on individual Indiana classroom teachers.

In-service efforts of corporations via workshops, completion of courses by classroom teachers, and even practica in economics education by undergraduate social studies methods students, assist in this effort. As stated in the article Developing and Implementing Standards, "Even where first class standards have been approved, the mechanism developed to implement these standards vary markedly in effectiveness." (Pacific Research). So even though standards exist, teachers are left to figure out how these standards play out in their classrooms. This may be especially true of economics because many of Indiana's elementary teachers have not had any formal training in economics, especially in the teaching of economics.

To correct that problem, the authors (Parkison and Sorgman) have been engaged in team-teaching a pedagogy-based survey course in economics education as well as running a Center for Economic Education at Indiana University Kokomo. Their published research demonstrates that teachers' economic literacy is enhanced, their comfort with economics is heightened, and confidence in their ability to develop and implement curriculum is increased as a result of their course. (Parkison & Sorgman, 1998; Parkison and Sorgman, 1999; Parkison & Sorgman, 2000; Sorgman and Parkison, 2002).

Table 1: Teachers' Self-Reported Results of Learning

	Pre Course mean	Post Course mean	T-values for differences in means
Knowledge of Economic Concepts	2.00 (1.15)	3.96 (0.99)	4.58*
Comfort with Economic Concepts	1.85 (1.07)	4.12 (0.98)	5.64*
Comfort with Implementation of Economic Concepts	2.31 (1.44)	4.08 (0.89)	3.76*

Standard deviations in parentheses
*denotes significance at the 1% level

The authors' published research affirms the importance of the intersection of knowledge and comfort in enhancing teacher efficacy in teaching economics in the elementary school. It makes explicit that teachers' effectiveness in teaching economics education requires knowledge about economic concepts and comfort in working with those economic concepts.

RESEARCH PROJECT: INDIANA UNIVERSITY KOKOMO AND PARTICIPATING AREA SCHOOLS

Indiana University Kokomo is located in north central Indiana. It is a commuter campus serving eleven counties. The Division of Education has an undergraduate elementary education degree and secondary certification in four content areas. Upon completion of the social studies certification program, the students are eligible for an Indiana Teacher's License for grades 5-12. The education degree and social studies certification program both require at least one course in economics. In fact, IU Kokomo is the only teacher education program in the state of Indiana which requires an economics course for all elementary education majors.

The authors designed and administered a survey protocol based on National Council for Economic Education key economic concepts (see Appendix A) to better understand the relationship between teachers' knowledge of economics and their comfort with economics and implementation of economic concepts for teachers. The elementary schools surveyed in Spring 2003 were in the Indiana University Kokomo Teacher Education Program service area and are the schools where the majority of practica and student teaching placements are made.

While a test of the actual economic knowledge base of the surveyed teachers' would have been valuable, we chose to ask teachers to self-report their knowledge of the concepts in the standards that will be expected of them to cover. The major hypotheses that guided the study were drawn from the author's published research and anecdotal commentaries by teachers who feel the pressure of meeting state standards, but have low knowledge and comfort levels in teaching economics in the elementary grades. Additionally, comments by elementary undergraduates who develop and implement

economics-based social studies curriculum confirm that their classroom teachers seem to have little understanding of economic concepts and how to implement the standards expected. However, it must be noted that most teachers commented that they want to meet standards and deepen their economic knowledge base. Some welcome practica for that very reason, while others take the authors' campus-based course in economics education to build economic literacy and enhance comfort with standards-based economics education.

DATA

The basic economic concepts used in the survey of knowledge and comfort were taken from the NCEE's Voluntary National Content Standards in Economics Those concepts were the basis of the Indiana economic standards. Additionally, they are used when assessing economic knowledge in NCEE reports. They are organized around grade levels to show which concepts are introduced and reinforced at the various grade levels. As seen in Appendix A, the economic concepts progress from simple micro concepts such as scarcity and opportunity cost to macro concepts such as international trade. Teachers were asked about each of these concepts and then their overall knowledge and comfort scores were calculated by averaging.

Table 2: Average Knowledge and Comfort Score for area teachers

Population	Mean Knowledge	Mean Comfort
Overall	2.39 (0.973)	2.47 (0.962)
*standard deviation in parentheses		

The variables in the survey (knowledge and comfort) suffer from two major data flaws: they are self-defined by the teachers and self-reported by the teachers. We did not have an independent measurement of teacher knowledge in that no nationally normed test of economic knowledge was given. We also asked the teachers to self-report how comfortable they felt in teaching the economic concepts.

HYPOTHESIS ONE

It was hypothesized that the there would be a strong correlation between comfort and knowledge. The authors have published a number of articles which demonstrate that the results of an economics education course team-taught by faculty in business and education results in increased knowledge and increased levels of comfort with economics concepts and their implementation. The new data were analyzed to see if there was a correlation between levels of knowledge and comfort for teachers in the university's service area.

This hypothesis was proved in that Knowledge (the independent variable) and Comfort (the dependent variable) were closely and positively correlated.

N = 70 Pearson's r value = 0.94

The Pearson's r value indicates a strong and positive correlation. This is predictable since it is difficult to feel comfortable teaching a concept unless one has the understanding of that concept. In essence, teachers' who reported a high knowledge level were very likely to have a high comfort level and visa versa. We also looked at various subpopulations and their mean knowledge and comfort scores. An example is shown below but none of the demographic subpopulations of gender, school type, grade level taught etc. were statistically significant.

Table 3: Average Knowledge and Comfort Scores for area teachers Sorted by grade level taught

Population	Mean Knowledge	Mean Comfort
Overall	2.39 (0.973)	2.47 (0.962)
Grades K-3	2.52 (0.979)	2.43(1.026)
Grades 4-6	2.60 (1.016)	2.50 (0.977)

*standard deviation in parentheses

In essence, teachers' who reported a high knowledge level were very likely to have a high comfort level and visa versa. Thus, a strong case can be made for increasing teachers' knowledge base in economics and economics education.

HYPOTHESES TWO AND THREE

Since the new standards-based requirements in economics for Indiana teachers were implemented only in 2001, it was hypothesized that the veteran teachers would be less knowledgeable about and comfortable with economics education and economic standards. The teachers surveyed averaged 13.9 years of teaching experience in a region where IU Kokomo is the only campus in the state that requires an economics course for undergraduate elementary education majors. Therefore, it is hypothesized that the teachers were unlikely to have had a course in economics or exposure to standards-based economics curriculum. Since these teachers are the educators that Indiana University Kokomo elementary methods students are likely to work with when they implement required standards-based curriculum in the social studies methods course, their economic literacy and comfort with economic concept were important.

There were two hypotheses tested. The first was that the mean of economic knowledge levels for teachers with less than five years in teaching would be greater than the mean of economic knowledge levels for teachers with more than five years teaching. The second was that the mean of comfort levels for teachers with less than five years teaching would be greater than the mean of comfort levels for teachers with more than five years in teaching. While both of these hypotheses were true, they were not statistically significant at any level of significance.

Looking at the data, especially the standard deviations, make it quite clear why that is the case. Although more recent teachers clearly had higher knowledge and comfort levels, there was such wide variation within each subpopulation that the standard deviations far outweighed the calculated differences in means. This may imply that even new teachers' need

additional professional development in economics, economics standards, and economics education.

Table 4: Average Score of Knowledge and Comfort Sorted by years of experience

Population	Mean Knowledge	Mean Comfort
Up to and including five years experience	2.52 (1.05)	2.55 (1.09)
Over five years experience	2.45 (0.899)	2.30 (0.873)
*standard deviation in parentheses		

EFFECTIVE MECHANISMS TO ENSURE STANDARDS ARE MET

Compliance with economic standards clearly lies with the classroom teacher. That requires they possess both an understanding of standards and capacity to develop curriculum. Thus, they may need help in understanding the standards and developing standards-based curriculum. To that end, the National Council for Economic Education (NCEE), its affiliated state councils, and its 275 university based Centers for Economic Education provide training to approximately 120,000 teachers who teach 8 million students. NCEE courses and curriculums are one method of giving teachers both the knowledge of economics and the comfort with the teaching of economics. Indiana University Kokomo is a Center for Economic Education, accredited by NCEE, and provides such opportunities. The Indiana Site Review Team visited Indiana University Kokomo in November 2002 and cited our courses as a strength for the Center. They noted, "These popular courses integrate economic content and pedagogy, and are a model for other Centers for Economic Education." Our format is a unique team-taught partnership and pairing of an economist who finds public school instruction intriguing and an educator who understands the importance of correct economic content. The course is designed to enhance undergraduates' economic literacy and to develop standards-based economic and

age-appropriate curriculum. This course has resulted in many teaching awards and published research for the two instructors confirming that the goals of increased economic literacy and development of economic curriculums were achieved.

CONCLUSIONS

Elementary children need informed teachers who can design and implement appropriate curriculum. Without that, their teachers will be like the adults in the Foundation for Teaching Economics and the Gillette Company survey, reported in the Indianapolis Star on July 5, 2003, "91% of them said they apply basic economic concepts each day, but only 25% could answer questions about those concepts." (p. B-7)

Published research on these economic courses provide ample evidence that teacher comfort is increased, teacher knowledge is expanded, and teachers are more ready to implement the economics in their classrooms. One classroom teacher who took the course said, "This class stimulated me to think about implementing as a part of my curriculum. I would not have done as much with econ in my room! And the kids loved it!" Another teacher noted, "I really enjoyed the class and learning not to be afraid of economics. I enjoyed the instructors and their openness to us trying a variety of lessons. I enjoyed interacting with other educators and seeing what they did and learning from them."

Economic standards have been set and are here to stay. To ensure that they are met, professional development in economic education is vital. Without professional development, the content needed and the comfort required will not be in place.

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ECONOMICS ARTICLES

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MEASURING SHOCKS TO EXCHANGE RATE UNDER FLOATING REGIME

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ABSTRACT

The effect of nominal and real shocks to real exchange rates under floating exchange rate system was examined. The real exchange rates in this study were measured in terms of domestic currency relative to the U.S. dollar. Thailand was used as an event study during the economic crisis. Ever since the floating exchange rate system was in effect in the third quarter of 1997, some policymakers have called for policies designed to keep the exchange rate within the target range. A vector autoregression (VAR) was employed to investigate the joint behavior of real and nominal exchange rates in order to identify the nominal and real shocks that caused fluctuations in the real exchange rate. Based upon the results of a bivariate VAR model, the impulse response functions showed that real shocks had a thriving impact on changes in real exchange rates in the twelve- month forecast horizon. Furthermore, variance decompositions revealed that real shocks were much more robust than nominal shocks during the period under study.

INTRODUCTION

At the pinnacle of the Southeast Asian economic crisis, nominal and real shocks that affect real exchange rate have become more prevalent in macroeconomic policy analysis. Nominal shocks are typically referred to a shock from monetary policy, while real shocks stem from economic fundamentals, such as changes in preferences, productivity, and inflation expectations. If the real shocks to real exchange rate dominate nominal shocks, monetary policy measures alone cannot be used to cope with fluctuations in the real exchange rate, especially in the long run. Nominal

exchange rate in Thailand had long been pegged, with occasional interrupting devaluation until the second quarter of 1997. The gradual decline in international reserves coupled with the attack on domestic currency (Thai baht) by speculators forced the Bank of Thailand to float the exchange rate. After entering the floating exchange rate regime, the nominal exchange rate in terms of baht per U.S. dollars depreciated sharply until the end of 1997. Consequently, data from Bank of Thailand (2002) showed that the net flows of portfolio investment, especially investment in equity securities, substantially decreased in 1998. Furthermore, short-term external debts gradually fell from 1997 to 2001. These events might be attributed to the short-run exchange rate risk faced by local and foreign economic agents. In early 1998, the baht began to appreciate and accelerated by the end of the year. In recent years, the nominal exchange rate has fluctuated to a lesser extent with an upward trend. This substantially improved the trade balance. Thus, the country has begun to experience a trade surplus.

According to international finance literature (Gan, 1994), movements in the real exchange rate can be viewed as a random walk process during a period of floating nominal exchange rate. Short-term capital flows can cause exchange rate volatility. This phenomenon is common in recent developments in Asia and Latin America. Bodnar, Dumas, and Marston (2002) found that exchange rate changes had a substantial impact on the pricing behavior of exporting and importing firms. One approach to alleviate exchange rate volatility is to measure and investigate the sources of fluctuations in real and nominal exchange rates.

REVIEW OF RELATED LITERATURE

The studies of movements in real exchange rates are generally related to the notion that prices in different countries move towards equality in common currency term. The empirical works devoted to purchasing power parity (PPP) are motivated by the presence or absence of unit roots in real exchange rates and cointegration between nominal exchange rates and different measures of relative prices, such as wholesale prices versus consumer prices. If the null hypothesis of stationarity for the bilateral real

exchange rate or real effective exchange rate is rejected, it is unlikely that PPP will hold. Bahmani-Oskooee (1993) and Liu (1992) presented contradictory results regarding the validity of the PPP hypothesis. Detailed PPP puzzle can be found in Rogoff (1996). Recently, Culver and Papell (1999) investigated long-run Purchasing Power Parity (PPP) with short-run floating exchange rate data by using tests where stationarity and cointegration were the null, rather than the alternative, hypotheses. The results show that the null hypothesis of stationarity of the real exchange rate or the cointegration between the nominal exchange rate and the domestic and foreign prices cannot be rejected in most cases. Therefore, there exists the evidence of PPP. Another empirical work by Papell (1997) employed 20 observations of quarterly data from 21 countries to test for real exchange rate stationarity. The results as a whole were consistent with log-run PPP.

Beyond the PPP hypothesis, there are attempts to investigate the causes of fluctuations in real exchange rates and to pinpoint the relative importance between transitory and permanent shocks. Economic theory does not generally offer a concrete specification of the dynamic relationship among variables. Furthermore, the case where endogenous variables may appear on both sides of the equations also makes the estimation and inference more complicated. A vector autoregression (VAR) is thus an alternative approach to deal with such problems. The three varieties of VARs are reduced form, recursive, and structural models. See Stock and Watson (2001) for further details. Blanchard and Quah (1989) proposed the long-run restriction on a structural VAR that nominal shocks have no permanent effects on the real exchange rate. This restriction is widely used in the literature. Lastrapes (1992) distinguishes real versus nominal sources of fluctuations in real and nominal exchange rates under a flexible exchange rate period using the bivariate vector autoregression (VAR) model. The restriction that nominal shocks had no permanent effect on real exchange rate was imposed. Using data from the United States, Germany, United Kingdom, Japan, Italy, and Canada, the results showed that real shocks dominate nominal shocks for both exchange rate series over short and long frequencies. Chen and Wu (1997) used the same restriction to investigate the relative importance between nominal and real shocks to fluctuations in real

exchange rates. Employing quarterly data from Japan, Korea, Taiwan, and the Philippines, their findings from the long-run structural VAR approach indicated that real shocks were more important only in two cases, Japan and Korea. A recent study by Alexius (2001) showed that the movements in real exchange rates in the Nordic countries were mainly due to real supply shocks. In addition, the permanent component dominates the variances of changes in real exchange rates in most cases.

A bivariate VAR model is applied in this paper to capture the relationship between nominal and real exchange rates and to assess the influence of shocks on the fluctuations of real exchange rates in Thailand under the floating exchange rate system. This reduced form VAR is widely used as a reliable tool in data description, and forecasting. The VAR analysis reports results from impulse responses and forecast error variance decompositions (Stock and Watson, 2001). The next section deals with methodology, data description and empirical results. The conclusions, and research and practical implications are presented in the last section.

MODEL AND METHODOLOGY

To measure fluctuations in exchange rates, the fluctuations affected by nominal shocks must be isolated from the part affected by real shocks. In general, these shocks (or disturbances) are not directly observable, but can be inferred from the joint behavior of the exchange rate series characterized by a vector autoregression (VAR) as employed in Lastrapes (1992), and Chen and Wu (1997). A reduced form VAR framework is formulated with zero restrictions on the coefficients of the lags of a subset of variables. If some restrictions are imposed, lack of sufficient observations will not provide sufficient degrees of freedom to obtain reliable estimates. This unrestricted VAR involves two equations:

(1)	level or first differences of real exchange rates as a function of past values of level or first differences of real and nominal exchange rates and
(2)	level or first differences of nominal exchange rates as a function of past values of level or first differences of nominal and real exchange rates.

In essence, a reduced form VAR representation is shown as:

$$(1)\ q_t = a_0 + \Sigma_i^k a_i s_{t-i} + \Sigma_i^k b_i q_{t-i} + u_{1t}$$
$$(2)\ s_t = \alpha_0 + \Sigma_i^k \alpha_i s_{t-i} + \Sigma_i^k \beta_i q_{t-i} + u_{2t}$$

where

$q = s + p^* - p$

q is the level or first differences of the logarithm of the Thai baht/U.S. dollar real exchange rates.

s is the level or first differences of the logarithm of the Thai baht/U.S. dollar nominal exchange rates.

*p** refers to the logarithm of U.S. wholesale price indices.

p denotes the logarithm of Thai wholesale price level.

In summary, five main procedures are undertaken:

(1)	Unit Root Test
(2)	Predictive Causality
(3)	Variance Decompositions
(4)	The Impulse-Response Functions
(5)	Integrated Autoregressive Moving Average

(1) Unit Root Tests

Because VAR approach is suitable when each series is stationary, I(0), or integrated of order one, I(1), it is imperative to test whether each series contains a unit root in its level or first differences. The unit root tests such as the ADF (Dickey and Fuller, 1979) and PP (Phillips and Perron, 1988) are applied at level and first differences of each series.

However, the most widely used VAR is based upon the condition that economic variables are known to be integrated of order one, I(1), with no cointegration. Therefore, unit root test is performed on both level of and first differenced series of nominal and real exchange rates.

(2) Predictive Causality

After testing for unit root, the standard Granger-causality tests as employed in Chow (1987) were employed to examine whether lagged values of one variable help predict the other. If variations of nominal exchange rates do not help predict variations of real exchange rates, the coefficients on lags of real exchange rate series will all be zero in the reduced-form nominal exchange rate series equation, and vice versa.

(3) Variance Decompositions

The next step is to estimate the reduced form model in two stages: *Stage 1*: each variable is regressed on its lags and past values of other variables and, *Stage 2*: the Cholesky factorization technique is used to obtain the residuals from each reduced form equation. The Cholesky factorization of the reduced form VAR covariance matrix can be computed. For detail discussion and derivation of this topic, see Hamiliton (1994).

The reduced form VAR is used to generate the error terms in each equation. These error terms are the unanticipated movements in the variables after taking into account past values. The stochastic error term in the first equation is monetary innovation or impulse in the language of VAR, while one in the second equation is real innovation.

(4) The Impulse-Response Functions

In practical applications of impulse-response analysis, estimates replace unknown parameters (Diebold, 2001). This immediately yields point estimates of the impulse-response functions that can be shown on graphs to ease interpretation.

(5) Integrated Autoregressive Moving Average

Moreover, the method of fitting real exchange rate changes to the ARIMA (p, 1, q) based on Beveridge and Nelson (1981) is employed because

changing order of variables in VAR representation can alter the results. If the real exchange rate series is I(1) process, an ARIMA model of the first difference of the series is estimated. As a result, the importance of real shocks using the impulse response from the simple VAR model can be confirmed.

DATA

Data were collected from International Financial Statistics CD ROM of International Monetary Fund (IMF). They include the monthly nominal exchange rate, which is the ratio of domestic currency to foreign currency (Thai baht/U.S. dollar), and Thailand and the US's wholesale price indexes (WPIs) with the base period of 1995. The empirical analysis in the present paper is based only on short-term series since the nominal exchange rate has just been floated in July 1997. So, data under this study ranges from July 1997 through 2002. Data for computing effective real exchange rate are not available on the monthly basis. Instead, the real exchange rate is computed as the product of the nominal exchange rate and the relative price levels between the US and Thailand, as usually defined in macroeconomic literature such as Culver and Papell (1999). This is justified by the fact that transactions in terms of U.S. dollars are dominant in the global market, as U.S. dollars are widely used in all parts of the world, including Latin America, the Middle East, and East Asia.

EMPIRICAL RESULTS

(1) Unit Root Test

With a critical value of 5 percent, Table 1 shows that both ADF and PP tests indicate nonstationarity of the log of real exchange rate (q) at level while yielding contradictory results in the nominal exchange rate (s) at level. However, with critical value of 10 percent, the ADF test shows stationarity of log of real exchange rates while the PP test rejects the null hypothesis of stationarity. The contradictory of these two tests yields inconclusive results

on real exchange rate series. Furthermore, ADF and PP statistics show that first differences of nominal and real exchange rate series are stationary. They are I(1), at 1 percent level of significance, according to MacKinnon critical values (MacKinnon, 1990). In other words, the first differences of nominal and real exchange rate series are not affected by seasonality and structural breaks. Both series at level and first differences do not exhibit a deterministic trend as coefficient of the trend term is insignificant.

Table 1: Unit Root Tests for Nominal and Real Exchange Rates

Variables	ADF Test		PP Test	
	No Trend	Trend	No Trend	Trend
Log of s	-3.223*	-3.434	-3.266*	-3.277
Log of q	-2.611	-2.851	-2.485	-2.633
Log of s	-5.635*	-5.614*	-6.407*	-6.377*
Log of q	-5.952*	-5.917*	-6.847*	-6.805*
Critical Value at 5%	-2.912	-3.486	-2.911	-3.486
Note: *significance at 5 percent level.				

(2) Predictive Causality

The standard Granger-causality tests were implemented in this step. Since the series of real exchange rates is I(1), and the series of nominal exchange rates is I(0) resulting from unit root tests with the level of significance of 5 percent, a reduced form bivariate VAR was performed by using first differences of real exchange rates and nominal exchange rates at level. If variations of the nominal exchange rate at level do not help predict variations of first differences of the real exchange rate, the coefficients on lags of first difference real exchange rate series will all be zeros in the reduced-form level nominal exchange rate series equation, and vice versa.

These equations were estimated using lag lengths of 2, 4, and 6 months. However, the lag length of 6 provided the best estimates of coefficient from causality test under Akaike Information criterion (AIC, see

Pindyck and Rubinfeld, 1997). The results of the standard Granger causality tests showed bi-directional causation between the two series. This implied that level of nominal exchange rates caused changes in real exchange rates at 1 percent level of significance, and changes in real exchange rates caused level of nominal exchange rates at 5 percent level of significance. In other words, the series of level nominal exchange rates help predict the series of changes in real exchange rates, and the series of changes in real exchange rates also help predict the series of level nominal exchange rates.

(3) Variance Decompositions

Variance decompositions and impulse response function using the lag length of four according to AIC criterion are described below.

Table 2 presents the variance decompositions of changes in real exchange rates and the level of nominal exchange rates. The results give the fraction of the forecast error variance for each variable that is attributable to its own innovations and to innovations in another variable. The forecast error variances are reported for forecast horizons over twelve months. Two columns under (a) of Table 2 shows within the first two months, 96.168 percent of the error in the forecast of changes in the real exchange rate is due to real shocks (q). When compared with six and twelve months, the percentages of forecast error increase to 95.479 and 95.327 percent, respectively. In Table 2, the last two columns under (b) also reports the variance decompositions of level nominal exchange rate due to real (q) and nominal shocks (s). The forecast error variances for level nominal exchange rate are similar to shocks to real exchange rate changes, but with a somewhat higher percentage point. For example, within the first two months, 96.861 percent of the error in the forecast of level nominal exchange rates is due to real shocks. The percentages of forecast error increase to 97.066 and 96.423 percent in 6 and 12 months, respectively. The salient feature of the variance decomposition results is that the predominant source of fluctuations in real exchange rate changes and level nominal exchange rates is due to real shock.

Table 2: Variance Decomposition

Forecast Horizon	a. Changes in Real Exchange Rate (Δ q)			b. Level of Nominal Exchange Rate (s)		
	Standard Error	% from Δ q	% from s	Standard Error	% from Δq	% from s
1	0.0388	100.000	0.000	0.0423	94.273	5.727
2	0.0397	96.168	3.832	0.832	96.861	3.139
3	0.0422	95.715	4.285	0.285	97.567	2.433
4	0.0429	95.190	4.810	0.810	97.566	2.434
5	0.0443	95.474	4.526	0.526	97.318	2.681
6	0.0444	95.479	4.521	0.521	97.066	2.934
7	0.0444	95.479	4.521	0.521	96.742	3.258
8	0.0445	95.364	4.636	0.635	96.597	3.403
9	0.0445	95.330	4.670	0.670	96.534	3.466
10	0.0445	95.329	4.671	0.670	96.484	3.516
11	0.0446	95.326	4.674	0.674	96.452	3.548
12	0.0446	95.327	4.673	0.672	96.423	3.577

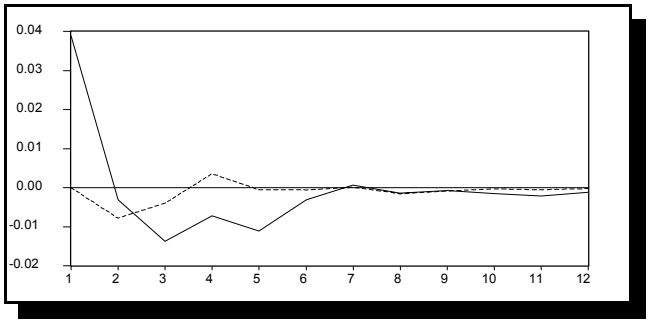
(4) The Impulse-Response Functions

The impulse-response function is another device of interest to forecasters that verifies the dynamic properties of VAR. Hence, they are reported in Figures 1 and 2.

Figure 1 shows impulse responses that trace out the responses of current and future values of real exchange rate changes to a one-unit increase in the current value of real and nominal shocks. In view of the fact that the reduced form VAR model is estimated in first differences of real exchange rates but at level of nominal exchange rates, a one-time shock to its first differences is a permanent shock to its level. A nominal shock to the real exchange rates seems to dissipate within 12 month forecast horizon while a real shock still causes fluctuations in changes in the real exchange rate. The finding indicates that even though initial responses of changes in the real exchange rate to real shocks have a strong positive effect, a negative effect can be observed within two months and thereafter. Figure 2 confirms that

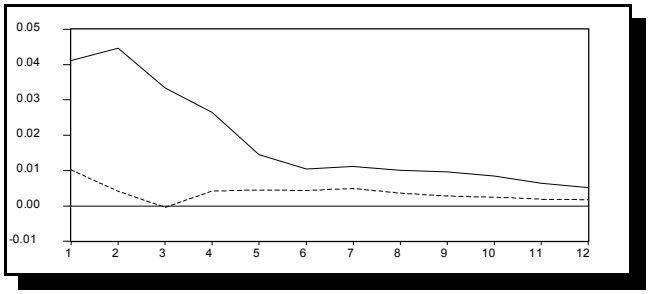
real shocks as compared with nominal shocks clearly cause more variations in the nominal exchange rate.

Figure1: Responses of Changes in Real Exchange Rate to Real and Nominal Shocks



Forecast Horizon (months)
_____ Real Shocks ------- Nominal Shocks

Figure 2: Responses in Level of Nominal Exchange Rate to Real and Nominal Shocks.



Forecast Horizon (months)
_____ Real Shocks ------- Nominal Shocks

(5) Integrated Autoregressive Moving Average

The result of fitted and actual first differences of real exchange rates is shown in Figure 3. Figure 3 shows that the fitted and actual first differences of the real exchange rate move closely in concert. The maximum variations vary from about 0.08 to -0.14.

In addition, using Beveridge and Nelson's (1981) technique, the ARIMA (6, 1, 0) is found to be the most suitable model for the first differences of the exchange rate series. Figure 4 shows the impulse-responses from the ARIMA (6, 1, 0) model. The response of changes in the real exchange rates to real shocks is quite similar to what depicted in Figure 1.

Figure 3: Actual, Fitted, and Residuals of Changes in Real Exchange Rate.

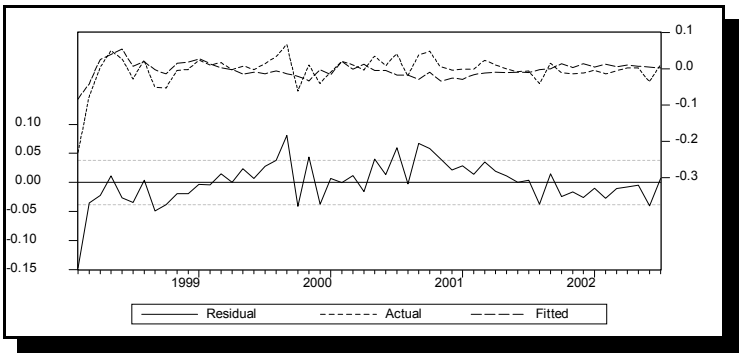
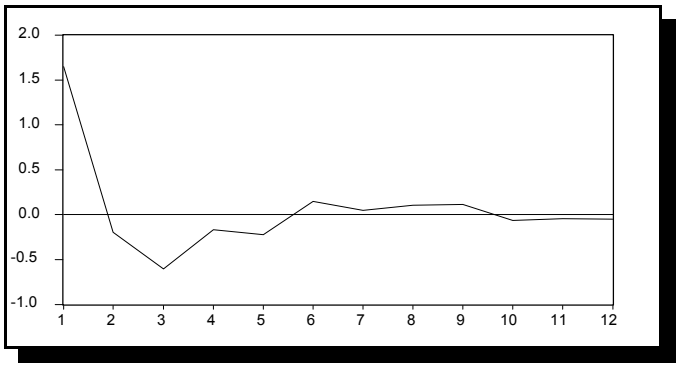


Figure 4: Impulse Response of Changes in Real Exchange Rate from ARIMA (6, 1, 0)



CONCLUSIONS

In retrospect, it has long been recognized in the international finance literature that the domestic currency should be pegged to the U.S. dollar or

to a basket of hard foreign currencies so as to avoid excessive instability and to attract foreign capital into the country. However, if the banking sector is poorly supervised, capital inflows for bank lending to business under the pegged exchange rate regime can be large and over-investment or over-consumption can be the consequences. Careless short term bank lending can essentially be problematic. When there are large outflows of capital, this can harm the country by depleting its international reserves, especially, the amount of U.S. dollars at the Bank of Thailand. Control on inflows can be fruitful in that it protects the country from the vulnerability to sudden reversals of capital flows and diminish vulnerability to speculative attack.

As one of the hardest hit countries from the Asian crisis, the real exchange rate had sharply depreciated during the last two quarters of 1997. This drastic depreciation of baht against U.S. dollar caused uncertainty in both exports and imports. Moreover, there is a large discrepancy between estimated and actual values of the balance of trade at that time. Exchange rate instability typically occurs as nation enters into the floating exchange rate regime as Thailand experienced in mid-1997. Therefore, the sources of exchange rate fluctuations should be identified and monitored.

Contributions

(1) The importance of identifying the sources of exchange rate fluctuations is that the validity of PPP can be established (Chen and Wu, 1997). The most appropriate approach to the estimation of exchange rate determination relies on the validity of the PPP theory. The PPP theory is valid when the real exchange rate series is stationary. Otherwise, cointegration between nominal exchange rate and the relative prices should be obtained. According to these tests performed, the level nominal exchange rate and the first difference of real exchange rate series yielded the best fit for VAR under this event study.

(2) Most research on sources of real exchange rate fluctuations finds mixed results of the role of nominal shocks compared to that of real shocks. This study confirms the crucial role of real shocks to real exchange rate.

According to the Purchasing Power Parity (PPP), real shocks have permanent effects on the observed real exchange rate in the long run. However, nominal shocks might be able to explain real exchange rate fluctuations in the short and intermediate terms. The crucial role of real shocks to changes in real exchange rate movement was observed.

(3) Moreover, this study represented a model of short-run exploration of the issue concerning shocks to real exchange rates because only data from mid-1997 to 2002 are available as a representation of floating regime.

(4) VAR model was used to investigate nominal and real shocks to changes in real and level nominal exchange rates measured in terms of U.S. dollar. The results concluded that changes in real exchange rate movements and the level nominal exchange rate were mainly caused by real shocks during the period under investigation.

Research Implications

Given these findings, yet there is room for future research to identify key sources and treatment of real shocks. There should also be more studies across national markets for generalization of these results. Such research will contribute significantly toward our understanding of how policy makers deal with a phenomenon of unstable exchange rates that comes with increased globalization.

Practical Implications

The results in this study also provide a clear policy implication. Like other developing countries, authorities in Thailand should not be complacent with exchange rate movements. The government in concert with the central bank should take certain measures to minimize the real exchange rate fluctuations that can disrupt economic decision-making, especially those in the foreign sector of the economy. Nevertheless, extra bank reserve could be accumulated by the central bank. In view of the fact that exercising monetary measures alone may not be adequate to maintain real exchange rate stability, attention to economic fundamentals such as changes in productivity,

inflation expectations and preference should also be included as part of the stabilization package.

ACKNOWLEDGMENT

The authors gratefully acknowledge the helpful suggestions received when an earlier version of this paper was presented at the Allied Academies International Conference, October 2002; Northeast Business & Economics Association 29th Annual Conference, September 2002; and Hong Kong Economics Association Conference, December 2002.

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SHOULD NAFTA EXPAND?: AN ANALYSIS OF EXPANSION

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ABSTRACT

The emerging global economy differs from the international economy in that resources are becoming more mobile and intra-industry trade is becoming more important. Evidence is presented that these developments require compatibility and harmonization of technical and policy standards. It is easier to harmonize standards on a regional level than globally; thus the rise of regional integration movements (Atkinson, 1998). This idea has led many to support the expansion of NAFTA to include other regions, such as South America. There are potential advantages and disadvantages to expanding free trade agreements. Therefore, several considerations must be taken into account before the U.S. enters such agreements. However, the U.S. must actively seek to expand its trade agreements with other countries or risk losing influence over decision-making processes in achieving globalization.

INTRODUCTION

The North American Free Trade Agreement (NAFTA) has raised several questions, since discussions began to establish the agreement. One heavily debated question was whether NAFTA would lead to the expansion of free trade agreements in other regions across the globe, and if this would be a viable prospect for the U.S. There are several reasons for establishing free trade agreements but several issues must be addressed before such agreements can be implemented.

The rationale for developing international trade is focused on economic developments and politics. The globalization of the world's economy establishes the need to form trade agreements with other countries. Today, economies are interdependent therefore; events in one country affect other countries in the world. For this reason, globalization is a desirable goal. NAFTA is a prime example of an integration technique used to achieve globalization. Proponents contend that regional trade agreements (RTAs) will enable a smoother transition into the globalization of trade policies. This argument has forced the U.S. to evaluate the expansion of its current trade agreements, such as NAFTA.

Developing free trade agreements involves numerous factors that must be taken into consideration. The understanding and identification of two specific factors is crucial for the success of expanding NAFTA and free trade agreements in general. First, the U.S. must gain an understanding of the economy and political environment of the country or region where expansion is proposed. Understanding these factors allows the U.S. to only enter into productive agreements. Identifying distinctive competencies is another element in target regions or countries and in the establishment of successful agreements. The distinctive competencies of a country's are the natural resources and/or processes that distinguish the country from others with the same resources or products available. Identifying these competencies helps the U.S determine how to best utilize strengths and implement successful strategies.

A major concern associated with expanding NAFTA arises from differences in economic, social, and political policies. These policies dictate the way countries conduct business operations, which alters the way partner countries conduct their business operations. NAFTA negotiations were prolonged because of these issues. During NAFTA negotiations, labor and environmental policy differences were addressed at great lengths. U.S. labor unions were concerned that labor policies in Mexico would eliminate jobs for Americans, and environmentalists were concerned that lower environmental standards and lack of enforcement of such policies would cause corporations to relocate. Another consideration the U.S. must take into account are

existing trade agreements in a region. Stipulations in existing agreements can make it difficult for the U.S. to expand its trade agreements.

The objective of this study is to determine if the expansion of NAFTA would be a viable prospect for the United States. This study will also provide a detailed investigation of factors associated with the level of success attained by such agreements.

LITERATURE REVIEW

The United States is one of the strongest economies in the world. Therefore, other countries often try to emulate the decisions made by the U.S. By expanding regional trade agreements, the U.S. sets the standard for such agreements and is viewed as a leader in globalization. Globalization can be achieved more efficiently through expansion of regional trade agreements such as NAFTA (Pasquero, 2000).

Proponents of international trade contend that nations should specialize in production and trade to take advantage of their different resource bases. The existence of an emerging global economy differs from the international economy for two main reasons. First, resources are becoming more mobile. Second, intra-industry trade is becoming more important. Furthermore, evidence suggests that harmonization of technical and policy standards are crucial to successful globalization of economies (Atkinson, 1998). RTAs provide a basis for harmonization of these policies.

Numerous areas for expansion of NAFTA have been considered. However, several factors have caused the U.S. to refrain from expanding into any other regions. The U.S. loses valuable opportunities to influence developing countries by not expanding NAFTA into other regions (Balze, 2001). The lack of U.S. involvement in these agreements has caused several countries to seek other agreements (Beerman, 1996). This causes another potential problem for the U.S. because of lost trade opportunities that could have aided in the development of more efficient markets.

Free trade agreements if not carefully managed can cause numerous problems for the countries involved. NAFTA was strongly opposed by many environmentalists and labor unions before its inception. Many felt that

NAFTA would hurt workers and U.S. firms and would be detrimental to the environment. Proponents argued that the agreement would strengthen ties between the U.S. and Mexico and create jobs. After the inception of NAFTA several studies were conducted to determine the affects of the agreement.

Overall, estimates are that trade among the U.S., Mexico, and Canada has increased 75% since 1993, with total trade between the U.S. and Mexico at almost $175 billion and U.S. agricultural exports to NAFTA markets doubling between 1992 and 1998. An economist from Washington D.C., said, "NAFTA has more or less done what he and others expected." This group feels NAFTA has created more jobs than have been lost in the U.S.. However, as one study noted, "Five years after implementation the North American Free Trade Agreement remains a work in progress." (Summerour, 1999, p. 12).

WHY NAFTA WAS CREATED

NAFTA came into existence out of Mexico's desire to attract capital. Capital was needed to supplement the low level of national savings in the country. The trade agreement did this by changing international perceptions about Mexico's economy and by offering firms located in Mexico access to the U.S. market. NAFTA, also, helped cement the changes made by President Salinas to open the Mexican market. Canada, basically, did not want to be excluded from the free trade agreement because it granted greater access to the U.S. market (Gerber, 1999).

One unique characteristic of NAFTA is that it is an agreement between three countries, which are at very different levels of economic development, and since the inception of NAFTA there have been upward trends in trade between the U.S., Canada, and Mexico. Canada is the leading trading partner with the U.S. and Mexico is the second leading trading partner with the U.S. Furthermore, economic improvements have been great for both Mexico and Canada. When considering the effects of NAFTA it is important to bear in mind that Mexico's economy represents 4 to 5 percent of the U.S. The significance of this fact is that no matter what happens with NAFTA, the impact to the U.S. will be small. Another important factor is

that trade between the U.S. and Mexico and U.S. and Canada is as much market driven as institutionally driven. Indicators of economic interaction between these countries show that trade and investment were growing significantly before NAFTA. Even without NAFTA, many of the same trade and investment flows probably would have occurred anyway (Gerber, 1999).

ADVANTAGES OF EXPANSION

Although free trade agreements are not global agreements, they are developed and accepted under the General Agreement on Tariffs and Trade (GATT) and the World Trade Organization (WTO), as long as their general objective is to lower barriers to trade and competition. Therefore, trade agreements serve as an intermediary in the globalization of trade rules under GATT, the WTO, and domestic trade liberalization within member countries (Pasquero, 2000).

Market integration is the extension of free trade among neighboring countries, which is driven by powerful economic, ideological, and technological forces. Three advantages of market integration are achieved through free trade. First, free trade agreements lower and sometimes, eliminate trade barriers. This provides businesses easier access to new markets at no additional cost. The elimination of trade barriers can promote more efficient markets, which is a primary goal of any economy. Second, because the new rules are negotiated, widely published, and publicly enforced, they are made more transparent for both importing and exporting firms throughout the free trade area. This allows investors and businesses to make better decisions regarding market strategy. Finally, free trade agreements normally come with agreed-upon, and often jointly managed dispute resolution mechanisms, reducing the potential for unilateral action by one member country against another. Each of these three advantages aid in the harmonization of policies on a global level.

The expansion of trade agreements results in expanded markets. Greater access to foreign markets requires aggressive trade policy to lower tariffs and eliminate distorting subsidies. Failure to provide strong leadership in global trade liberalization will result in our producers and exporters being

left behind. The potential impact the U.S. could have on various markets is significant, and the results of inaction could be harmful to the growth of the U.S. economy. Other nations are aggressively pursuing agreements, and the U.S. is falling behind in this area.

Regional and bilateral trade agreements create export opportunities, which can be important building blocks for trade liberalization. NAFTA has had promising results, especially in certain markets. Since the implementation of NAFTA, U.S. food and agricultural exports to Canada and Mexico have expanded by 59 percent, while corresponding exports to the rest of the world have grown by only 10% (Food & Agricultural Policy, 2000).

Unfortunately, the U.S. has fallen behind some of its competitors. Today, there are more than 130 preferential trade agreements throughout the world, and the U.S. is part of a small percentage of those agreements, with NAFTA being one. The European Union, alone, has 27 preferential agreements with other countries and is in the process of negotiating more (Food & Agricultural Policy, 2000), illustrating the importance of U.S. involvement in negotiations for free trade areas. Free trade agreements should supplement global trade liberalization. Expansion of free trade agreements, such as NAFTA, can accelerate the pace of liberalization and provide momentum for global reform, but they also have limitations. Trade distortions caused by export subsidies and domestic supports cannot be effectively addressed in free trade agreements (Food & Agricultural Policy, 2000).

The expansion of free trade agreements allows the U.S. to become a proactive leader in the globalization of the world's economy. The U.S. is referred to by many nations as a world leader, and it does not bode well with many nations that the U.S. has not expanded its trade agreements. This has forced many nations to engage in trade with other countries. Chile is a prime example of a target area for expansion abandoned because of political issues within the U.S., which forced Chile into other agreements. It is important for the U.S. to actively seek new areas of expansion for NAFTA, because it allows the U.S. to spread its views on national policy. Major factors in trade negotiations are the national policies in the target area. The U.S. has the ability to influence those policies when free trade is extended to an area. The

lack of our presence in free trade agreements hurts us in the harmonization of such policies, and eliminates any chance for U.S. views in such policies.

CONCERNS OF EXPANSION

Industrial labor unions are often in opposition to expanding free trade agreements. Differences in labor policies are of primary concern for U.S. labor unions. One fear is that competition with low wage countries will drive down wages at home and cause jobs to migrate overseas. In other words, high wage U.S. labor will be forced to compete for jobs against impoverished workers from third world countries. One problem with this view is that productivity differences account for differences in labor wages. For example, Mexican workers typically earn less than U.S. workers for three reasons: lower education and skills, less sophisticated capital, and the distribution channels are less reliable. During NAFTA negotiations, labor issues were of great concern for many opponents to the agreement. However, a labor side agreement was established to help alleviate differences in labor policies.

Differences in environmental policies are also a major concern. Environmental concerns linked to global trade expansion of NAFTA draw from many areas, starting with issues related to emerging patterns between current international trade and environment law and ending with a general view of sustainable development that sometimes conflicts with economic principles promoted by industry, governments and international economic institutions.

Environmental activists fear that companies will relocate to countries in which the economic policy has lower standards. Concerns are also expressed regarding the enforcement of existing environmental policies. Regions in which environmental policies are not enforced result in unfair advantages to firms in that region.

One advantage of the expansion of NAFTA, however, is the ability to identify and correct such discrepancies in policies. This is a much easier task at the regional level compared to the global level. Establishing trade relations can make differences smaller and less pervasive (Gerber, 1999).

The concerns of environmentalists cannot be ignored. Differences between the U.S. and other countries' environmental policies can cause large problems if not addressed. Negotiations between the U.S. and other countries tend to be difficult because of such differences. In fact, at times target regions for expansion may be unwilling or incapable to make the changes necessary to insure that the U.S. benefits from expanding free trade in the target area.

Companies choosing to relocate to areas of weaker environmental policy can give an advantage over companies located in the U.S.. Furthermore, even countries with established environmental policies may not enforce those policies. This would also provide an incentive for firms to relocate into that area, because current policy is not enforced. Firms are attracted to areas where environmental restrictions are not as tough as the U.S. because it lowers their costs. This allows them to produce more efficiently in the short-run, but long-term it is detrimental to the environment.

Another potential disadvantage of free trade agreements is the terms of agreements can result in low cost external suppliers being replaced with higher cost regional suppliers (Sargent & Matthews, 2001). Some economists feel that trade agreements reap inefficient markets, because the agreements cause trade between countries that may not be the most effective route of production. This could actually increase the costs of transactions between the U.S. and partner countries. However, the successful identification of strengths and weaknesses during the planning phase of negotiations can reduce or eliminate problem areas.

The expansion of NAFTA is not a simple process. In order for all trade partners to reap benefits from the agreement, it must create value for U.S. firms. In most cases, developing or undeveloped countries will derive benefit from their association with the U.S.. However, the U.S. may not. The natural resources in a country or their processes that are more efficient than current processes are the main attraction for free trade. If expansion into a country or area diverts more trade than it creates the U.S. should not expand into that area.

The U.S. cannot simply expand NAFTA to follow the practice of other nations. Rather a real benefit must be derived from the association of the U.S. with a particular region. However, the U.S. is currently not actively

seeking to establish such agreements, while the rest of the world is. The U.S. is, therefore, left out of an important element in the steps toward globalization of the world's economy. The U.S. must actively seek areas of potential expansion and act on the distinctive competencies of other regions.

FACTORS AFFECTING FREE TRADE

Before the expansion of free trade agreements in the U.S. can be effectively negotiated, it is important for the President to have fast tracking authority. Fast tracking authority allows the President to bypass approval of Congress of negotiations, which speeds the process tremendously. The expansion of free trade agreements slowed greatly when President Clinton failed to obtain renewal of fast track negotiating authority from Congress that hammering out new pacts requires (Balze, 2001). Without such authority the technical and bureaucratic issues prolong and ultimately destroy the likelihood of designing effective free trade agreements between the U.S. and other countries.

Economic, political, and social policies in a particular region are key in expanding NAFTA. Differences in policies can create problems, which would cause trade between the regions to be fruitless. However, this is one advantage of expanding trade, because during negotiations these differences are targeted and steps are made to harmonize the policies. The U.S. can have a significant influence over the policies in other countries due to our attractive capital markets. These policies are key decision factors in expansion, but also provide opportunities for improvement of existing policies. As mentioned previously, harmonization of policies is a key element in successful globalization, and the expansion of NAFTA can alternatively reduce differences in policies.

AREAS OF EXPANSION

Since the inception of NAFTA, the debate of expanding NAFTA began. One of the first areas for expansion mentioned was Latin America; because the region represents a U.S. export market larger than Canada and

almost as large as China plus all of developing Asia. Furthermore, the International Monetary Fund (IMF) projected that Latin America would grow almost twice as fast as the major industrial countries in the near term, making trade opportunities huge. Latin America is currently involved in a complex set of overlapping regional trade agreements, like Mercosur. These regional pacts have led to trade, particularly in locally produced capital equipment, that does not reflect comparative advantage and is wasteful. Some feel that growth in Latin America will be faster if it is based on open trade policies that encourage efficient production. This is one of the goals of expansion of NAFTA, to effectively and efficiently combine markets. From a U.S. perspective our exporters suffer by being excluded from these growing markets (Little, 1997).

Chile also represents an area that various interest groups advocate is suitable for expansion following the implementation of NAFTA. Chile was one of the biggest success stories of the 1990s. The annual growth rate for Chile was over seven percent a year, which caught the attention of businesses around the world including the United States, European Union, Asia, Canada, and Mexico. Furthermore, Chile has been a principal trading partner with the U.S. for most of the twentieth century (Beerman, 1996). However, the U.S. has not locked into a trade agreement (such as NAFTA) with Chile. Several negotiations have been underway to establish trade agreements between Chile and various markets, but Chile did not commit to any of them because it considered the U.S. a primary target for an agreement. However, the protectionist leaning U.S. government struck down Chile's bid to enter the North American Free Trade Agreement and put off further debate until later. This action was not greeted warmly.

In the wake of these incidents, Chileans have become frustrated. They strongly wished to become apart of NAFTA; joining NAFTA would grant them access to North American services and high technology products, opening an already profitable market. Many businessmen in Chile expressed anger towards the U.S. for their refusal to grant access into the North American market. Lavreano Gili, director of P.M. Chile S.A., a textile importer in Santiago, refers to the NAFTA pledge, "as merely another example of the United States talking about free trade and then not acting on

it" (Beerman, 1996). However, pressure against Chile's entry into the NAFTA has come from several sources. Church groups, Amnesty International, Greenpeace, and other organizations argue that Chile ought to be denied entry in NAFTA as punishment for Chile's questionable human rights and environmental records. These issues will be discussed later in the paper.

Some cited South America as the best area for expansion. The appeal for South American countries is easier access to capital (Clarke, 1995). Furthermore, expansion into the Southern Cone would offer great advantages to all its participants, helping to stabilize and enrich the Americas, and further the process of hemispheric integration (Balze, 2001). Clearly the region of expansion is uncertain, but the predominate element is the expansion of free trade to enable globalization which is inherent in all of these areas.

NAFTA EXPANSION

Table 1 (Appendix A) is a comparison of trade flows to U.S. domestic shipments by SIC codes. The table provides potential trade creation and trade diversion effects associated with the expansion of NAFTA into various markets. The most recent data available when the study was conducted is from 1991. Table 1 presents the results from four different scenarios, the accession to NAFTA of, Chile, the Andean Pact (Ecuador, Peru, Venezuela, Colombia, and Bolivia), Mercosur (Brazil, Argentina, Paraguay, and Uruguay), and a Western Hemisphere FTA including all countries in the first three groups. The largest six 2-digit SIC codes (in terms of trade creation) for each region are presented. These codes represent more than 75 percent of the total trade effect under each given scenario (Anderson & Smith, 1997).

Under the first scenario of a U.S. and Chile free trade agreement the trade creation is $34.52 million. The estimates for trade diversion associated with expansion of NAFTA to include Chile are $51.88 million. Considering these two factors, the overall impact of expansion into Chile is modest. Special attention should be paid to textiles and apparel imports because they represent 57 percent of all predicted trade effects (Anderson & Smith, 1997).

The trade creation that would result from expansion of NAFTA with the Andean Pact is $206 million, while trade diversion is $327 million. Total trade effect of the Andean Pact's accession to NAFTA is estimated at $312 million. As with Chile, the expansion of NAFTA into this region would create only modest benefits (Anderson & Smith, 1997).

Under the third scenario, expansion of NAFTA to include Mercosur would result in trade creation of $477 million. Trade diversion under this scenario totals to $838 million. The total trade effect of Mercosur's accession to NAFTA is estimate at $796 million, representing nine percent of the regions total merchandise trade with the U.S..

The presence of Brazil creates large predicted increases in exports for Mercosur, much larger than the combined effects of Chile and the Andean Pact. In this combination industrial products and industrial machinery are among the leaders in trade creation and trade diversion. However, from the U.S. perspective the increase of less than $800 million is relatively small compared to total imports of more than $500 billion.

The fourth scenario illustrates expansion into the Western Hemisphere. Total trade creation in this situation is estimated to be $720 million, while trade diversion estimates are $1.277 billion. The total effect of Latin America's accession into NAFTA is estimated at $1.15 billion. Apparel, textiles, and leather products account for 62 percent of the total trade effect. However, the effects on import competing U.S. industries will be small, as it is only trade creation not trade diversion which comes at the expense of the domestic industry (Anderson & Smith, 1997).

Under each scenario discussed, the trade creation was less than trade diversion. This makes it difficult to determine the best area for expansion. However, some would argue the U.S. should not expect a tremendous impact on trade because of expansion of trade agreements in any particular region. The rationale behind this argument is that, most of these areas represent a small percentage of the U.S., and therefore their impact should not be considered individually, but as a whole. NAFTA is an illustration of this very point. Regardless of the outcome of the agreement when it was originated, the impact to the U.S. economy would be negligible.

The information from Table 1 may cause the reader to believe that the U.S. will not benefit significantly from the expansion of NAFTA, however the opposite is true. It is important to bear in mind that each of these target areas for expansion represents varying levels of economic, social, and political development. The benefits associated with trade agreements in these areas may be difficult to see in the beginning, but will increase significantly as the country begins to develop new policies. The U.S. has the ability to influence the policies of these countries through trade agreements, which is beneficial for the globalization of the economy. Simply stated, the U.S. must expand existing free trade agreements in order to sustain its position as a world leader.

CONCLUSION

The expansion of NAFTA or regional free trade agreements with the U.S. and other countries is inevitable. In order to sustain economic and political growth, the U.S. must increase its free trade agreements. Free trade agreements are vital elements in the goal of globalization. The advances made in political, economic, and social policy through RTAs aid in harmonizing the global economy. However, this does not mean the U.S. should enter into free trade agreements merely to aid in the development of world trade. It does insist that the U.S. play an active role in the development of those ultimate goals to ensure the U.S. maintains its position as an economic powerhouse.

The U.S. benefits through improved relations and strengthening of political ties, as well as by improved efficiency of markets. Underdeveloped and developed countries are also able to improve current policies and better prepare themselves for a global market. These countries can also benchmark American processes and, as a result, improve trade efficiency within their country.

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Appendix A

Table I: Summary of Trade Creation and Trade Diversion by Region

(Top six SIC categories ranked by TC; figures in U.S.$ millions; estimating equation From Technical Appendix in parentheses)

					Total Trade Effect	
Region/SIC	TC (1)	TD (2)	TD (3)	TD (5)	(1) + (2)	% Share Of Imports
Chile						
23 Apparel	17.0	8.1	0.0	17.0	25.1	76.0
20 Food	4.1	0.3	0.1	4.1	4.4	1.7
22 Textiles	3.5	0.6	0.0	3.5	4.1	31.2
31 Leather	2.9	5.8	0.0	2.9	8.7	40.2
33 Prim. Met	1.8	0.6	0.1	1.8	2.4	0.6
01 Crops	1.7	0.4	0.1	1.7	2.1	0.5
Other	3.5	1.1	0.0	3.5	4.6	1.5
Total	34.5	16.9	0.4	34.5	51.4	3.5
Andean Pact						
23 Apparel	108.2	56.2	1.6	107.4	164.4	57.7
13 Oil & Gas	25.1	12.3	3.4	25.1	37.4	0.6
29 Pet/Coat	20.1	10.9	6.2	20.1	31.0	0.6
01 Crops	14.1	9.7	5.0	13.7	23.8	2.9
22 Textiles	12.6	2.8	0.2	12.6	15.4	15.9
31 Leather	8.7	14.1	0.1	8.7	22.8	25.4
Other	17.5	9.2	0.4	17.5	26.7	0.8
Total	206.3	105.3	16.9	205.1	311.6	2.2
Mercosur						
31 Leather	143.7	242.6	19.8	140.8	386.3	30.3
33 Prim Met	62.1	10.7	4.5	61.7	72.8	6.4
20 Food	59.5	4.3	5.5	58.8	63.8	4.8

Table I: Summary of Trade Creation and Trade Diversion by Region

(Top six SIC categories ranked by TC; figures in U.S.$ millions; estimating equation From Technical Appendix in parentheses)

					Total Trade Effect	
Region/SIC	TC (1)	TD (2)	TD (3)	TD (5)	(1) + (2)	% Share Of Imports
23 Apparel	45.8	25.6	0.7	45.7	71.4	36.0
35 Ind. Mach	44.4	5.4	5.6	43.5	49.8	6.7
37 Trans. Eq	21.3	7.7	0.1	21.3	29.0	4.3
Other	99.9	23.3	6.9	102.8	123.2	3.6
Total	476.7	319.6	43.1	474.6	796.3	9.1
Western Hemisphere						
23 Apparel	165.8	87.0	3.7	164.1	252.8	48.9
31 Leather	155.3	258.0	22.1	152.0	413.3	29.8
20 Food	71.8	4.3	17.9	70.6	76.1	3.0
33 Prim. Met	68.2	11.8	5.9	67.7	80.0	3.7
35 Ind. Mach	44.8	5.4	5.6	43.9	50.2	6.6
22 Textiles	37.3	6.8	2.5	36.5	44.1	14.0
Other	177.3	59.5	25.2	176.1	236.8	1.4
Total	720.5	432.8	82.9	710.9	1,153.3	4.7

Source: Anderson and Smith (1997)

STATE RULES AND POPULATION HETEROGENEITY ON THE FORMATION OF NEW JURISDICTIONS IN MAJOR U.S. METROPOLITAN AREAS

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ABSTRACT

There are relatively few empirical studies examining the determinants of local government structure and how voters sort themselves into various local governments. These studies have concluded that greater fiscal decentralization occurs when demands for government services of residents within a metropolitan area are more heterogeneous. These findings support the fiscal decentralization hypothesis. However, in a more recent panel study utilizing fixed effects model, I find no evidence of Tiebout-sorting process. There is some evidence of greater decentralization of local government structure, similar to the past studies, if the fixed-effects are not controlled. I find that the state rules have significant impact on the formation of new jurisdictions.

INTRODUCTION

Since the early work of Borcherding & Deacon (1972) and Bergstrom & Goodman (1973), empirical studies of the determinants of demand for government spending typically find that demand is a function of socio-economic variables such as income, age, and race. Another strand of the local public finance literature examines the determinants of local government structure and attempts to explain how voters sort themselves into various local governments according to these population characteristics. This paper is motivated by a relatively small number of recent empirical studies that attempt to explain variation in local government structure across

metropolitan areas by examining the relationship between population characteristics and the number and size of local governments within a metropolitan area. Specifically, studies by Nelson (1990), Kenny and Schmidt (1994), Martinez Vazquez et al. (1997), Wassmer and Fisher (1997), and Fisher and Wassmer (1998) have investigated the relationship between measures of population heterogeneity and the number and size of local governments in U.S. metropolitan areas.

A common theoretical framework underlying these studies is the "fiscal decentralization" hypothesis. As suggested by the work of Tiebout (1956) and as explained by Oates (1972, p. 35), a system of decentralized local governments can achieve allocative efficiency in the provision of local public goods by allowing consumers with different preferences for government spending to reside in different communities. Instead of having many heterogeneous consumers who are dissatisfied with the quantity of government services offered by a single centralized government, decentralized provision can increase consumer welfare by improving the match between consumers' demands and the services provided. Proponents of the fiscal decentralization theorem predict that there will be a positive relationship between the variation in demands for government services across consumers within a metropolitan area (or state or country) and the degree of government decentralization or fragmentation.

This paper investigates whether or not a more diverse population will be associated with a greater number of relatively smaller local governments within a metropolitan area. In an extension of the previous studies, this study will make use of the availability of repeated observations on local government structure and metropolitan population characteristics over time to investigate the observed and unobserved determinants of local government structure. Unlike the previous studies, this study pays close attention to certain methodological issues such as the appropriateness of using pooled data from different years in panel data analysis and use of the appropriate econometric methods when the dependent variable is based on counts. Importantly, this paper improves upon past research by attempting to avoid spurious estimated relationships between government structure and population characteristics by restricting the analysis to those metropolitan

areas that have not had their definitions or boundaries changed over time by the U.S. Census Bureau.

CHANGES IN LOCAL GOVERNMENT STRUCTURE

Table 1 summarizes the changes in local government structure[1] between 1952 and 1992. The Census of Governments (1992) reported that there were 81,912 units of local governments (excluding county governments) in 1992 compared to 79,249 units in 1982, an overall increase of 3.4%. Virtually all of the increase is in special district governments, which increased 10.4% over the ten-year period. There is a decrease in the number of independent school districts, which reflects a continued decline over the past forty years, primarily as a result of state-imposed school district consolidation and reorganization. Consolidation mainly occurs in the rural districts (Census of Governments, 1992).

Table 1: Number of units of different types of local governments between 1952 and 1992

Structure of local governments	1992	1982	1952
Total Governments	81,912	79,249	113,704
Municipalities & Townships	35,935	35,810	34,009
Independent School Districts	14,422	14,851	67,355
Special Districts	31,555	28,588	12,340

The rapid increase in the special district governments needs careful examination. From 1952 to 1992, the number of units of special district governments increased dramatically from 12,340 to 31,555, an increase of 156%. Borcherding and Deacon (1972) noted that the increase in the number of single-function units of government was in response to shifting population patterns and demands for specific additional services. The Census of Governments (1992) also reported that the rapid increase in the special

district governments reflects the increased citizen's demand for the provision of services, which are very specific to their tastes and preferences and not offered by the existing governments. Also, the debt and tax limits imposed on cities may be further stimulants for creating special districts.

Against this background, it is very surprising to find only a few empirical studies investigating the role of population heterogeneity in creating more units of local governments. There are more normative and conceptual viewpoints about how governments are more or less centralized at international, national, and state level (Oates, 1972). These studies also look at efficiency of the various layers of government.

Only five empirical studies (Nelson, 1990; Kenny & Schmidt, 1994; Martinez-Vazquez, Rider, and Walker, 1997; Fisher & Wassmer, 1998; Wassmer & Fisher, 1997) have investigated the change in the number of local government units that focus on the decentralization hypothesis. These studies have found that increases in the variations of tastes and income factors may be associated with greater decentralization of local government structure. Only two of those studies used repeated cross-sections observed over at least two points in time (Martinez-Vazquez et al., 1997; Wassmer and Fisher, 1997). However, these studies do not exploit the usefulness of the panel data by taking full account of the possibilities for controlling for unobserved metropolitan characteristics that are fixed over time. While Wassmer and Fisher are careful to distinguish between metropolitan areas that change their boundaries over time and metropolitan areas that maintain the same boundaries, the metropolitan results in Martinez-Vazquez (1997) appear to be based on a sample that contains a mixture of both stable and changing metropolitan areas.

EMPIRICAL MODEL AND DATA

The fiscal decentralization hypothesis and Tiebout-sorting mechanism imply that the optimal level of utility of an individual from the consumption of a local public bundle increases as the number of jurisdictions increases within a metropolitan area, in the presence of population heterogeneity. It also implied that as the level of population heterogeneity increases due to

increasing population, the optimal level of utility decreases if the number of jurisdictions remains unchanged. Thus, if there is an increase in population heterogeneity, the optimal level of utility of an individual will be unchanged only if the number of jurisdictions increases. Therefore, the underlying hypothesis for my empirical analysis is that the optimal number of governments within a metropolitan area will be directly related to population heterogeneity.

I examine both the total number of governments and the number of governments in each type of government structure within a metropolitan area to see how they are influenced by population heterogeneity during the period between 1980 and 1990. Since the literature review suggests that the optimal structure of a local government depends both on demand and supply factors of a local public bundle, my general empirical model will take into account factors such as income, tastes and preferences, and economies of scale. In addition, past studies have indicated that geographical constraints, and political and institutional factors, may influence the number of local governments in a metropolitan area. Even though population heterogeneity may favor an increase in the number of local governments, a metropolitan area may be geographically and/or institutionally constrained so as to prevent an increase in the number of local governments. Alternatively, a more homogenous population may still have more units of local governments if these constraints do not allow required changes in the composition of the local public bundle. Therefore, to examine empirically the underlying hypothesis that the optimal number of local governments will be directly related to population heterogeneity, ceteris paribus, my empirical model must control for the factors just described.

My empirical model is that in a metropolitan area, the optimal local government structure, as given by the number of local governments, J of type g is given by:

$$J_g = J \text{ [(population heterogeneity), (environmental factors), (institutional factors)]}$$

where g total governments, municipalities and townships, independent school districts, and special districts.

DATA

I have selected metropolitan areas with population of at least 200,000 and with at least one central city being the same in both 1980 and 1990. The Census of Population is done every ten years and therefore the data on population characteristics for 1982 and 1992 come from 1980 and 1990 Census of Population data, respectively. Since the Tiebout process requires that residents have a wide choice of government services with a large number of competing governments trying to attract residents, larger metropolitan areas will allow residents more options of jurisdictional locations given their tastes and preferences for public goods. This resulted in an initial sample of 162 metropolitan areas.

Also, since I am looking at changes in local government structure for two time-periods, 1982 and 1992, the metropolitan areas selected must meet some requirements for meaningful comparisons of data from those periods. Therefore, my final sample includes only those metropolitan areas that have retained the same physical boundaries. It consists of 95 metropolitan areas that have the same counties both in 1982 and 1992. Previous studies failed to investigate the importance of changing official definitions of metropolitan areas. Since this sample consists of metropolitan areas that have not changed the physical boundaries, the average population and land area of these metropolitan areas were found to be less than the average population and land area of the metropolitan areas in the initial sample. Therefore, the final sample consists of relatively smaller metropolitan areas compared to those in the initial sample.

LOCAL GOVERNMENT STRUCTURE

The Census of Governments records data on the different types of local governments. These are: municipal governments, township governments, school districts (including independent school districts), and

special districts. The 1982 and 1992 Census of Governments data were used. This paper investigates the effect of population heterogeneity variables on each type of local government structure as well as on the total number of governments (excluding county governments). To look at the change in number of governments of each type of government, the difference between the number of governments of type "g" between 1992 and 1982 was used.

POPULATION HETEROGENEITY VARIABLES

According to the fiscal decentralization hypothesis, I expect that population heterogeneity is directly influencing the number of local governments. Since variation in the economic and demographic characteristics of population give rise to heterogeneous demand for local public goods within a metropolitan area, I collected data on three key variables: income, age, and race. Income heterogeneity is measured using the coefficient of income variation measure that is consistent with the past studies (Fisher and Wassmer, 1998; Martinez-Vazquez, et al., 1997) on this topic. But for age and race heterogeneity, I have used Leik Index (Leik, 1966). Leik Index measures dispersion for ordinal variables or categorical data. It ranges from zero to one, with one representing least homogenous or greatest dispersion. Leik Index is used for age and race because data on all those ordinal variables are either recorded in uneven intervals or they are mainly categorical data. I would like to note that Martinez-Vazquez, et al. (1997) have used Leik Index for measuring both age and race heterogeneity while Fisher and Wassmer (1998) have used Leik to measure only racial heterogeneity.

ENVIRONMENTAL VARIABLES

Several environmental variables may influence local government structure. I have included population, land area, and regional dummies. Population and land area are expected to positively influence the number of local governments within a metropolitan area because with either larger population or larger area, the population is expected to get more diverse.

Therefore, with congestion, the cost of providing government services will go up as discussed in the theoretical model. So, more governments are created to avoid a higher tax price for the same government services. I have also included regional dummies, northeast, south, midwest, and west.

INSTITUTIONAL VARIABLES

State laws and constitutional mandates may also influence residents' choice regarding the structure of local governments. The U.S. Advisory Commission on Intergovernmental Relations (U.S. ACIR) was created by the Congress in 1959 to monitor the operations and practices of federal, state, and local governments and to recommend improvements for achieving equitable allocation of resources, increased efficiency and equity, and better coordination and cooperation. U.S. ACIR reports data on various statewide restrictions. From a whole range of these restrictions (Hill, 1978), I have selected only a few that in the past studies (Nelson, 1990 and Wassmer & Fisher, 1997) were found to be significant in influencing the local government structure. These are debt and property tax limitations, functional home-rule authority, population limit, referendum and majority approval for consolidation.

Debt and property tax limitations will positively influence the number of governments because when a metropolitan area has these limits and there is a need to overcome these limits due to different demands for government services, residents will create more governments to satisfy their needs.

Home-rule authority gives the residents more discretion in carrying out various local functions. Therefore there is less need for creating more governments to meet those demands for government services. Also, if a minimum population is required to incorporate local units then that would negatively influence the number of local governments.

If it were more difficult to consolidate existing units because of law requiring referendum and majority approval then existence of such law would require creation of more governments to meet the needs rather than consolidate those existing units.

ESTIMATION STRATEGY

Past empirical studies on local government structure have used either linear or non-linear specification of the ordinary least square estimation. In general terms, the ordinary least squares model (OLS) is of the form:

$$J_i = \beta_0 + \beta_1 H_Y + \beta_2 H_E + \beta_3 H_A + \beta_4 H_R + u_i$$

where J_i is the number of local governments in metropolitan area *i* and H_k represents variations of population heterogeneity variables, k ϵ Y, E, A, and R

The OLS model assumes that the data is normally distributed and that the dependent variable, J_i, is continuous. In my data, the dependent variable J_i is a count of the number of local governments in metropolitan area *i*. Therefore, the use of OLS model for count variables may result in inefficient, inconsistent, and biased estimates (Hausman et al., 1984; Cameron and Trivedi, 1986).

Count data models are more appropriate than the OLS model when the dependent variable is a non-negative integer valued random variable. For example, if the dependent variable is the number of patents applied for and received by firms in a given year (Hausman et al., 1984) or how frequently a person visited the doctor (Cameron and Trivedi, 1986) or number of derogatory reports in an individual's credit history, count data models have been used.

The simplest form of a count data model is the Poisson regression model. It is the oldest parametric count model with a tight distributional and parametric structure. The discrete non-negative nature of the dependent count variable generates non-linearities that make the usual linear regression models inappropriate. Using the OLS model, therefore, may result in biased estimates, and OLS might predict a negative number of governments.

In practice, count variables often have the presence of overdispersion, i.e., the conditional variance is greater than the conditional mean. If overdispersion is present the Poisson estimates will be inefficient and biased

(Cameron & Trivedi, 1986). Overdispersion can arise for reasons such as unobserved heterogeneity.

In order to account for overdispersion, one possible extension of the Poisson regression model is to include an unobserved metropolitan specific effect, which allows the conditional variance to exceed the conditional mean, and is called the negative binomial regression model. A log-likelihood ratio test will determine the overdispersion and therefore the appropriateness of the Poisson versus negative binomial (Cameron & Trivedi, 1986, 1990). If ln LPRM is the log-likelihood from the Poisson regression model and ln LNBRM is the likelihood from the negative binomial regression model, the likelihood ratio test statistic is given by:

$$\textit{Likelihood ratio test statistic (LR)} = 2\,(ln_{NBRM} - ln_{PRM})$$

In the next section, I discuss the appropriateness of using the negative binomial regression model in this study based on the likelihood ratio test.

EMPIRICAL RESULTS

In this section, the empirical results of how variations in population characteristics among residents influence the local government structure are discussed using the final sample of 95 metropolitan areas that have the same counties both in 1982 and 1992. Previous studies failed to investigate the importance of comparing metropolitan areas over time by retaining the same physical boundaries. First, I will discuss the pooled cross-sectional results between 1982 and 1992. Then, results from panel fixed effects that control for unobserved metropolitan area fixed effects will be analyzed.

POOLED CROSS-SECTIONAL RESULTS

In this study, I examine whether a positive relationship between population heterogeneity variables and the number of local governments exists across the metropolitan areas over two time periods, 1982 and 1992. Table 2 reports the pooled results for total governments, municipalities,

school districts, and special districts respectively. Before I could pool the two years of cross-section data I conducted likelihood ratio test for structural change to see if the two sets of coefficients of the explanatory variables were statistically the same in 1982 and 1992. The joint test[2] for structural change at a 99% level of confidence could not reject the null hypothesis that the coefficients were same. Therefore, pooling the cross-sectional data was appropriate.

The findings of the influence of population heterogeneity variables on local government structure from pooled regression results provide some interesting implications. Even though the individual population heterogeneity variables do not strongly support the decentralization hypothesis, my results clearly demonstrate that the interactive population heterogeneity variables are more significant. Each of the population heterogeneity variables may not be significantly affecting the number of local governments directly, but through their interaction the local government structures across metropolitan areas are affected.

Income heterogeneity was positive and significant for special districts and total governments. Age heterogeneity directly affected the special districts too. Also, population diversity in both income and age led to a statistically significant increase in the number of municipalities.

Race heterogeneity was found to be negative for all types of local governments but only significant for special districts and total number of local governments. However, the coefficient of age-race heterogeneity has a positive significant effect on all types of governments. Income-race heterogeneity has a significant negative effect on school districts, special districts and total governments when age heterogeneity is controlled. The positive age-race heterogeneity coefficient lends some support to the heterogeneous demand argument rather than the "taste for association" argument provided by Martinez-Vazquez, et al (1997). Taste factors such as age and race do affect demand for public education and special services. Therefore, it is not surprising to find that metropolitan areas with greater diversity with respect to both age and race will have more school districts and special districts.

Table 2: Pooled Cross-sectional Negative Binomial Regression Estimates for the Number of Local Governments in 95 Major U.S. Metropolitan Areas during 1982-1992

Explanatory variable	Total Governments	Municipalities	School Districts	Special Districts
State Rules				
Home rule	-11.46 (-1.82)*	-4.84 (-1.57)	6.86 (3.79)***	-15.79 (-4.66)***
Min pop limit	-23.16 (-3.12)***	-3.98 (-1.00)	-3.82 (-1.84)*	-16.60 (-3.76)***
Consolidation limit	-0.32 (-0.04)	0.84 (0.19)	5.77 (2.41)**	-5.75 (-1.32)
Debt limits on cities	27.30 (2.88)***	8.73 (1.65)*	7.65 (2.73)***	12.02 (2.16)**
Tax limits on cities	-11.66 (-1.36)	-4.16 (-1.04)	3.48 (1.45)	-8.45 (-1.76)*
Metro Characteristics				
Northeast	73.39 (5.42)***	27.87 (4.16)***	24.03 (7.00)***	18.70 (1.96)**
Midwest	76.58 (5.98)***	36.18 (5.76)***	28.02 (8.75)***	2.78 (0.40)
West	23.28 (2.07)**	-34.40 (-5.33)***	22.05 (8.27)***	16.68 (2.55)**
Land area	0.53E-02 (3.25)***	0.27E-02 (4.57)***	0.49E-03 (1.08)	0.25E-02 (2.72)***
Population	0.56E-03 (4.51)***	0.16E-03 (3.36)***	0.86E-04 (3.13)***	0.30E-03 (3.64)***
Heterogeneity measures				
Income	14.32 (1.97)**	3.38 (0.98)	0.32 (0.16)	9.12 (1.95)*
Income-squared	-0.15 (-2.94)***	-0.86E-01 (-3.26)***	-0.12E-01 (-0.81)	-0.47E-01 (-1.41)
Income * Population	-0.41E-07 (-0.08)	-0.16E-06 (-0.65)	-0.14E-06 (-1.07)	-0.61E-07 (-0.20)
Age	3253.58 (1.56)	679.17 (0.62)	812.39 (1.25)	1920.65 (2.00)**
Age-squared	-5133.90 (-2.00)**	-2494.54 (-1.98)**	-1448.93 (-1.71)*	-1606.00 (-1.20)
Age * Population	-0.13E-02 (-4.00)***	-0.39E-03 (-2.97)***	-0.15E-03 (-1.97)**	-0.70E-03 (-3.31)***

Table 2: Pooled Cross-sectional Negative Binomial Regression Estimates for the Number of Local Governments in 95 Major U.S. Metropolitan Areas during 1982-1992

Explanatory variable	Total Governments	Municipalities	School Districts	Special Districts
Race	-865.91 (-2.75)***	-72.81 (-0.48)	-117.49 (-1.13)	-481.12 (-2.67)***
Race-squared	111.44 (0.85)	78.53 (1.23)	3.45 (0.10)	-23.05 (-0.33)
Race * Population	-0.11E-03 (-4.34)***	-0.31E-04 (-2.59)***	-0.24E-04 (-3.57)***	-0.48E-04 (-2.93)***
Income * Age	18.09 (1.32)	21.81 (3.11)***	4.96 (1.04)	-5.64 (0.57)
Income * Race	-5.50 (-2.21)**	-0.18 (-0.12)	-1.52 (-1.88)*	-3.14 (-1.88)*
Age * Race	3170.22 (3.90)***	8.82 (0.02)**	630.08 (2.28)**	1945.88 (4.69)***
Constant	-804.25 (-1.66)*	-157.29 (-0.64)	-171.81 (-1.21)	-585.86 (-2.28)**
Log -L	-1012.08	-760.50	-727.74	-891.50

N=190. All coefficients are expressed as marginal effects; t-statistics in parentheses with *** (99%), ** (95%), and *(90%) confidence, respectively.

The negative income-race heterogeneity coefficient for school districts shows that demand for public education is expected to be similar within a metropolitan area with either a greater number of young children or more old people. So there is less desire to change school districts. If the coefficient of income-race heterogeneity was positive then "taste by association" might perhaps explain why a racially diverse population would like to create more school districts, as different races may not want to share the same public schools.

The state rule requiring a minimum population limit to create new governments plays a significant role in explaining why there are fewer school districts and special districts in the presence of increasing racial heterogeneity. Both for school districts and special districts, the coefficient of minimum population limit is negative and statistically significant. Therefore, the desire to create more governments because of heterogeneous

demands for government services is limited due to the existence of state rule requiring that there should be at least a minimum population to create a new government.

It is worth mentioning that the significant effects of the state rules in affecting the number of local governments can not be ignored, because most of the metropolitan areas experienced change in at least one or more state rules between 1982 and 1992. Home rule, minimum population limit, and debt limits significantly affected the total number of governments and special districts with the expected signs of their coefficient estimates. In addition, minimum population limit significantly reduced the number of school districts, whereas the consolidation limits and debt limits significantly increased the number of school districts.

From a regional perspective, the total number of local governments significantly increased in all the regions. Municipalities significantly increased in the Northeast and Midwest regions while they were reduced in the West. School districts significantly increased in the Northeast, Midwest, and Western regions but special districts mainly increased in the Northeast region. Population has a direct significant impact on all the governments while the land area has a positive significant effect on the municipalities, special districts, and the total number of governments.

So far, this pooled cross-sectional study seems to improve upon the past cross-sectional and pooled studies. I say this because of several reasons. First, it justifies the meaningful comparison of results across metropolitan areas that retained the same number of counties. Second, past pooled studies did not fully pay attention to all the population heterogeneity variables and their impact on all the different types of local governments at the metropolitan level. Kenny & Schmidt (1994) mainly focused on the state level data and examined how income impacted the number of school districts. Martinez-Vazquez et al. (1997) focused mainly on the impact of racial heterogeneity on school districts at the metropolitan level and both school and special districts at the state level. The third reason why my pooled study improves upon the past cross-sectional studies is that I have extended the time horizon and used the most recent data.

Examining the Tiebout-sorting process or the decentralization hypothesis through cross-section studies may not be appropriate, because it is expected that if the Tiebout process actually exists it might take time for residents to sort themselves in respective communities. Also, creating new governments because of changing residents' demand for government services is not an instantaneous process. It occurs gradually through time. Even in this case where I have a ten-year period, a decade is too short to observe sufficient change in the local government structure.

PANEL FIXED EFFECTS RESULTS

To control for unobserved metropolitan characteristics that are fixed over time, I employ a fixed-effects model. This fixed effects model is similar to Holtz-Eakin (1986). Previous studies that did not control for fixed effects may have led to biased estimates of the population heterogeneity variables. Therefore, the support of the Tiebout sorting process and the decentralization hypothesis may have been overemphasized through the past empirical studies. The significant coefficients of the population heterogeneity variables may have been overestimated.

It is important to mention that the panel fixed effects regression was conducted using the ordinary least squares estimation instead of the negative binomial estimation method. My panel data come from two years, 1982 and 1992, and to control for fixed effects I take the first difference of each variable like Holtz-Eakin (1986). The values of the first difference in the dependent variable range from negative to positive. Therefore, negative binomial estimation is not appropriate. Also, Levinson (1999) argues that non-linear fixed effects models yield biased estimates of the fixed effects, and this bias increases as the number of time period falls.

The panel fixed effects results are reported in Table 3. Almost all of the population heterogeneity variables are not significant. Except in a few cases where they are significant, they have signs contrary to what one would expect if the decentralization hypothesis is true.

Interestingly, the results also show that there is lack of significance of several of the state rules. Compared to the pooled results for 1982-92,

several characteristics of state rules become either much less significant (in the case of state-imposed debt limits and tax limits on cities) or completely insignificant (in the case of the limitation on minimum population size of local governments or the existence of broad home rule powers for local governments).

The changes in the estimated importance of state rules as I move from cross-sectional or the pooled estimates to the fixed effects results indicate either one of two things. First, the lack of statistically significant findings may be due to lack of variation over time in these state rules. Therefore, they may be considered as a part of the fixed effects influencing the local government structure. Surprisingly, however, there exists substantial variation over time in many of these state rules during the time 1982-92. During that time period, 18 metros had changes in home rule provision, 22 metros had changes in the minimum population limitation, and 13 metros experienced changes in the debt limits (U.S. ACIR, 1993). This amount of variation should have been enough for the fixed effects estimator to identify the effects of change in these state rules. It is more likely that changes in the importance of the state rules found in the fixed effects regressions may result from the fact that unlike the other estimation methods, the fixed effects results take into account unobserved metro-specific characteristics that may be correlated with both the state rules and the number of local governments.

By comparing the findings from the fixed effects estimation to the findings based on pooled data, the significance of the state rules appears to come primarily from the cross-sectional variation in the state rules across the different metropolitan areas and the fixed effects results suggest that the state rules do not affect local government structure, while the pooled results suggest otherwise. Because the latter results do not control for unobserved metropolitan specific characteristics, they likely suffer from omitted variable bias. A similar story can be told for the estimated relationship between special districts and the various state rules, although in this case one of the state rules (tax limits on cities) becomes more significant in the fixed effects analysis.

CONCLUSION

The fiscal decentralization hypothesis has been empirically tested by few researchers for both cross-sectional and panel data. These researchers have concluded that greater fiscal decentralization occurs when demands for government services of residents within a metropolitan area are more heterogeneous. In this study, my empirical findings suggest that if metropolitan area-specific fixed effects are controlled for, then there are no positive statistical significant effects of population heterogeneity variables on any type of local governments. Therefore, there is no evidence of Tiebout sorting due to heterogeneous demands for local government services in the panel fixed-effects model.

Examining the Tiebout-sorting process or the decentralization hypothesis through cross-sectional studies may not be appropriate because it is expected that if the Tiebout process actually exists it may take time for residents to sort themselves in respective communities. Also, creating new governments because of changing residents' demand for government services is not an instantaneous process. It occurs gradually through time. Even in this case where I have a ten-year period, a decade may be too short to observe sufficient change in the local government structure.

Table 3: Panel Fixed Effects Ordinary Least Squares Estimates for the Change in Number of Local Governments in 95 Major U.S. Metropolitan Areas during 1982-1992

Change in Explanatory variable	Change in Total Governments	Change in Municipalities	Change in School Districts	Change in Special Districts
State Rules				
Home rule	1.19 (0.40)	-0.29 (-0.50)	0.81 (2.19)**	0.67 (0.26)
Min pop limit	7.12 (1.80)*	0.63 (0.95)	0.44 (0.56)	6.05 (1.69)*
Consolidation limit	0.41 (0.13)	0.16 (0.37)	0.21E-02 (0.00)	0.25 (0.08)
Debt limits on cities	9.77 (2.43)**	1.57 (2.41)**	0.96 (1.53)	7.23 (2.13)**

Table 3: Panel Fixed Effects Ordinary Least Squares Estimates for the Change in Number of Local Governments in 95 Major U.S. Metropolitan Areas during 1982-1992

Change in Explanatory variable	Change in Total Governments	Change in Municipalities	Change in School Districts	Change in Special Districts
Tax limits on cities	-5.67 (-1.49)	-0.14 (-0.40)	0.75 (1.76)*	-6.28 (-1.71)*
Metro Characteristics Land area	0.11 (3.53)***	0.36E-01 (3.67)***	0.37E-01 (4.81)***	0.31E-01 (1.78)*
Population	0.31E-04 (0.68)	0.14E-04 (1.61)	-0.64E-05 (-1.02)	0.23E-04 (0.64)
Heterogeneity measures				
Income	-0.76 (-1.82)*	0.19E-01 (0.33)	0.36E-01 (0.43)	-0.82 (-2.19)**
Income-squared	-0.43E-01 (-1.68)*	-0.43E-03 (-0.13)	0.17E-02 (0.33)	-0.44E-01 (-1.88)*
Income * Population	0.25E-05 (0.87)	0.51E-06 (0.98)	-0.28E-06 (-0.58)	0.22E-05 (0.94)
Age	-116.73 (-2.12)**	-7.39 (-0.93)	-4.08 (-0.45)	-105.26 (-2.25)**
Age-squared	235.08 (0.92)	20.26 (0.47)	9.95 (0.39)	204.87 (0.96)
Age * Population	0.19E-03 (1.06)	-0.30E-04 (-0.85)	0.12E-04 (0.88)	0.20E-03 (1.43)
Race	14.76 (0.35)	-4.91 (-0.71)	-1.85 (-0.17)	21.52 (0.58)
Race-squared	-110.44 (-1.63)	-12.53 (-1.37)	-21.79 (-1.19)	-76.12 (-1.49)
Race * Population	0.17E-03 (1.36)	0.18E-04 (0.71)	0.89E-05 (0.80)	0.15E-03 (1.31)
Income * Age	-9.05 (-2.36)**	-0.94 (-1.78)*	-0.57 (-0.65)	-7.55 (-2.43)**
Income * Race	3.11 (1.06)	-0.11 (-0.26)	0.42E-01 (0.06)	3.17 (1.30)
Age * Race	-420.72 (-0.98)	-16.90 (-0.28)	-107.53 (-0.92)**	-296.29 (-0.84)
R-squared	0.48	0.66	0.56	0.42

N=95. t-statistics in parentheses with *** (99%), ** (95%), and *(90%) confidence, respectively.

The state rules and regional factors have a significant influence on the local government structure. The minimum population requirement limit mainly affected the formation of school districts and special districts while the consolidation limits, debt limits, and tax limits affected all types of local governments. There were significant regional influences on school districts and special districts. Most of the statistically significant increase in municipalities and school districts occurred in the Northeast and Midwest regions, as more decentralization took place in those regions. These regions have a relatively large number of communities compared to the national average.

Based on my empirical findings, there are two implications of the influences of population heterogeneity variables on the local government structure.

a) Changes in the local government structure are very complex and one has to be very careful in disentangling the individual effects of the explanatory variables. The significant or lack of significant population heterogeneity variables need careful examination before coming to any conclusion about their impacts on the local government structure.

b) Population heterogeneity variables may have differential impacts across the metropolitan areas. It is more likely that in some metropolitan areas local government structure may be significantly influenced by population heterogeneity variables, while other metropolitan areas may have less significant or no significant influence on population heterogeneity variables but changes in the local government structure may be mainly due to institutional and/or political factors. It is also quite likely that some metropolitan areas may go through changes in their local government structure due to a combination of several factors without being able to isolate the relative significance of each one of them. In this research, the estimation allowed for the possibility that the effect of each type of population heterogeneity might depend on the levels of other forms of population heterogeneity as well as on the size of the population.

ENDNOTES

[1] Changes in local government structure refer to the changes in the number of different types of local governments in U.S.. The Census of Governments recognizes five basic types of local governments. Of these five types, three are general-purpose governments. These are county and subcounty general-purpose governments (municipalities and townships). The other two are special purpose governments - independent school districts and special districts governments. Special district governments are mainly single-function units created to provide special services that are not supplied by existing general purpose governments due to state regulations

[2] A joint test for structural change was conducted. It was found that the likelihood ratio test statistic was greater than the (2) value at 19 degree of freedom and p-value=0.01.

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THE POTENTIAL OF BIOTECHNOLOGY: PROMISES, PERILS, PERPLEXITIES–A SURVEY OF IMPACTS ON RELEVANT ECONOMIC SECTORS

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ABSTRACT

Biotechnology is the latest scientific innovation that shows great economic promise but also raises many immediate as well as long term societal concerns. In the current state of the art, biotechnology has four broad areas of economic application: improving properties of plants (ag-biotech) and food (food-biotech), making industrial intermediates (industry-biotech), producing diagnostic materials and drugs from organisms (biopharmaceuticals), and mitigating pollution (environmental-biotech).

The deliverables today are only a miniscule proportion of the potential that has been mapped out. There are also environmental benefits in terms of avoided mitigation costs and intergenerational resource savings. Despite the obvious glitter and prosperity associated with biotechnology, the public and some industrial communities have been slow on the uptake. There are also pertinent concerns regarding safety, containment and segregation of transgenic produce.

Increasing the level of public awareness has to be a central objective for successful adoption of this technology, and this is a task that needs to be addressed by businesses, industry groups, professionals and regulators alike. The technology itself is powerful and transcends the bounds of the handful of industries that have adopted or experimented with biotechnology.

INTRODUCTION

In the broadest sense of the term, biotechnology implies anthropocentric interventions in the natural gene pool. This could take the simple form of favoring certain species over others, for example, by selecting the best seeds for replanting, or retaining the highest yielding animals for breeding, while slaughtering the rest. Hence, the advent of biotechnology can be traced to prehistoric times, with the first attempts to nurture only desirable plants and animals for consumption by human societies.

While early biotechnology involved creating product improvements by selection, cross-breeding and using whole organisms, the modern day version is based on the use of sub-cellular material. Recent advances in molecular biology has made it possible to transfer DNA from practically any source to create genetically modified organisms (GMOs) that display the desired functional traits (Nap et al., 2003). Thus, the process and ability to genetically transform organisms through recombinant DNA (rDNA) technology – thereby creating transgenics, or GMOs – is the theme of modern biotechnology.

Although there is amazing diversity in creation – ranging from a simple bacteria to the most complex human being – the cells of all organisms are composed of the same fundamental building material and speak the same genetic language. The astonishing ability of biotechnology to transfer genes across organisms is based on this universality of all organisms. Table 1 provides a brief glimpse of the development of biotechnology as viewed through important milestones. It is apparent that the developments vindicate the Tofflerian theory of the increasing rate of change in scientific discoveries (see, e.g., Toffler, 1971). The use of biotechnology can be broadly classified into 4 functional areas:

1. Agricultural, food and forestry products
2. Environmental uses
3. Industrial biotech
4. Biopharmaceuticals

Table 1. Important milestones in the evolution of biotechnology	
Dateline	Landmarks
8000 BC	Earliest record of human intervention in genetic selection – domestication of livestock and crops (potato).
4000 BC	First active use of organisms in production – cheese and wine (China, India), beer and bread (Egypt), selective pollination of dates (Babylon).
500 BC	First antibiotic – moldy tofu used to treat boils (China).
100s	First bio-pesticide – powdered chrysanthemum (China).
1300s	Arabs use artificial insemination for improving breed stocks of horses.
1700s	Viral vaccination for smallpox (Jenner).
Early 1800s	Proteins discovered, first enzyme isolated.
Late 1800s	Darwin propounds his theory of evolution by natural selection. Mendel proposes the law of heredity - the science of genetics is launched.
Early 1900s	Bacteria used to treat sewage in Manchester, UK. The Human Growth Hormone (HGH) is discovered (Evans and Long). Penicillin is discovered as a life-saving antibiotic (Alexander Fleming). First commercial bio-pesticide (Bt) to control the corn-borer (France). Genetic material from different viruses shown to combine into a new virus.
1950s	Structure of DNA is published – start of modern genetics (Watson, Crick).
	First synthetic antibiotic is produced.
1960s	Messenger RNA (carrying developmental information in cells) is discovered. Green revolution starts with the creation of high-yielding foodgrain seeds. Genetic code is cracked (nucleotide bases determined).
1970s	First complete synthesis of a gene. Also HGH is synthesized. Recombinant DNA (rDNA) technology applied to human inherited disorder. First transgenic expressions – yeast gene in bacteria, human gene in bacteria.
1980s	Gene synthesizing machines developed. Recombinant life forms patented. Transgenics produced – mice (Ohio U.); cloned golden carp (China). DNA fingerprinting, genetic marker, recombinant vaccine, transgenic tobacco
1990s	BtCorn (pest resistant), GM cow (human milk proteins), GM yeast, GM trout. Biotech foods – FlavrSavr tomato, bST beef. Industrial bio-enzymes. Biopharma - gene therapy, recombinant antibodies used for treating cancer. Biotech crops grown worldwide – BtCorn / Cotton, Roundup Ready Soybean.
2000s	Plants as factories for therapeutic proteins (plant made pharmaceuticals). Complete map of the Human Genome published. Progress in explaining the differentiation of stem cells. High yield biotech crops in 150m acres. (Solve 3rd world nutrition problem?)
Source: BIO 2003.	

The first relates to improving agronomic and environmental attributes of plants, such as yield, stress management skills, pest and disease resistance. This promises to generate huge benefits in terms of better harvests, lower production costs and less environmental damage from agrochemicals. In the food sector, the objective is to develop product attributes that have greater consumer appeal, and add nutritional value to food. The latter application somewhat overlaps those health supplements (also called *nutriceuticals*) that are derived or extracted from plants, since transgenic produce can be tailor made to supply many nutritional elements. This has given rise to the saying that there will soon be a fuzzy line between the pantry and the medicine cabinet (PEW, 2002).

The direct environmental application of biotechnology has been in developing GMOs that can mitigate pollution – transgenic bacteria that can assimilate oil spills, for instance. There are also indirect environmental benefits from most other functional uses of biotechnology: lower pesticide use through ag-biotech, faster growing trees that can sequester carbon, biopolymers, industrial bio-enzymes, are some examples.

Industrial biotech refers to using GMOs for producing industrial raw materials – for example, using transgenic bacteria to produce enzymes and acids.

Biopharmaceuticals is the fastest growing functional area since it can provide many diagnostic and therapeutic products that are beyond the scope of conventional treatment lines. A new branch of this functional area – known as plant-made-pharmaceuticals (PMPs) – appears to have great promise. Plants are extraordinary factories that have the ability to produce complex proteins, given the appropriate genetic signals. Growing therapeutic proteins in transgenic plants is the new technology for producing pharmaceuticals, and provides a cleaner, cheaper and more stable alternative to cell culture and fermentation (for example, producing insulin in corn, as opposed to porcine, bovine or human tissue).

There is a rigorous system of multi-agency – USDA, EPA, FDA – checks and approvals of biotechnology products in the US. This process takes place over multiple-stages – with oversight continuing through the stages of discovery, development, testing, clinical/ consumer trials and

marketing. The only current lacuna appears to be in post-market oversight – a critical area for measuring the long term impacts of GM products in enduse consumption, and use as productive factors, as well as in ensuring their safe handling and disposal (Taylor and Tick, 2003).

Despite the obvious glitter and prosperity associated with biotechnology, the public and some industrial communities have been slow on the uptake. Even after accounting for the usual rhetoric expected from activists, there are several pertinent concerns regarding the safety and containment aspects of transgenic produce. At this time, it is impossible to ascertain the complete package of impacts that an accidental leakage of GMOs can have on the ambient ecosystems. As well, it is difficult to predict the long term (unknown) health and environmental impacts of consuming GM products that are proven to be safe in the short term.

ECONOMIC IMPLICATIONS: AN EXAMPLE OF WELFARE GAINS FROM USING PLANT-BIOTECH TO COUNTER ENVIRONMENTAL STRESSES

Taking stock of the exciting scientific developments in biotechnology, the field seems to hold out tremendous economic value for society. Also, currently available applications are only a miniscule proportion of the possibilities. There are indirect benefits in terms of avoided environmental mitigation costs, as well as the intergenerational resource savings. Experts predict that biotechnology products and processes may extend average human lifespan by 10-15 years within the next 25 years. This not only adds the value of additional human productivity to society, but also the non-market value of human life.

Plants in all regions of the planet are subject to environmental stresses related to deviations from normal temperature, moisture and nutrient regimes. For the most part, these stresses are either benign or seasonal and are well tolerated. In fact, environmental stresses are sometimes beneficial, since they act as natural mechanisms for stimulating evolution. Stresses form an important part of the design toolbox of nature, forcing organisms to react and reorient, or be replaced.

Environmental stresses cause physiological and biochemical changes in plants. Just as the market price mechanism signals resource allocations in society, these changes cause resource reallocations in plants – for example, between the strategies of survival and propagation. Much of the distribution, domination and migration of plants depend on the stress management skills of individual species. The strategies of successful species are reflected in growth, reproduction, vegetative recovery and morphology, and vary from one plant species to another (Gehring and Whitham, 1995).

The most common universal stresses relate to temperature and moisture, while soil salinity is an important factor in some regions. A majority of plants can function within reasonable ranges of these factors, while some species develop great abilities to survive and reproduce under extreme weather and soil conditions. Given that natural changes to a landscape and climate is a slow process, the evolutionary mechanism in plants have historically been allowed adequate time and space for adaptation (Dunnett, Willis, Hunt, and Grime, 1998). The process of evolutionary adaptation is slow – taking place over thousands of years. However, when the stress is beyond tolerance levels and the pace of change is rapid, then plants can either lose productive abilities or get replaced by migratory species. This not only has implications for the structure, biodiversity and functional stability of ecosystems, but can also impact supply side economics where commercial species are concerned.

Moreover, environmental stresses associated with anthropogenic modifications of the atmosphere can be of greater than normal magnitudes (by evolutionary standards) and can exceed plant tolerances.

When exposed to atmospheric and soil related stresses that are beyond their adaptive abilities, plants may react with slower vegetative growths and stunted fruit and seed production. Scientists have determined that plants under environmental stress also develop weaker resistances to pests and parasites (Louda and Collinge, 1992). In economic terms this translates into one of the following 2 scenarios:

1. Lower harvestable quantities, or
2. Higher costs of production (cost of pesticides and other inputs).

Figure 1 is a diagrammatic representation of how environmental stresses can affect human societies, considering the impacts on only those plants that are economically relevant, that is, commercially grown crops, agroforestry, etc. This figure shows a schematic market with prices on the vertical axis and quantities produced / consumed on the horizontal axis. The usual $DEMAND_{NORMAL}$ and $SUPPLY_{NORMAL}$ curves result in a typical market equilibrium (at point A) generating the market clearing price P_A and quantity Q_A.

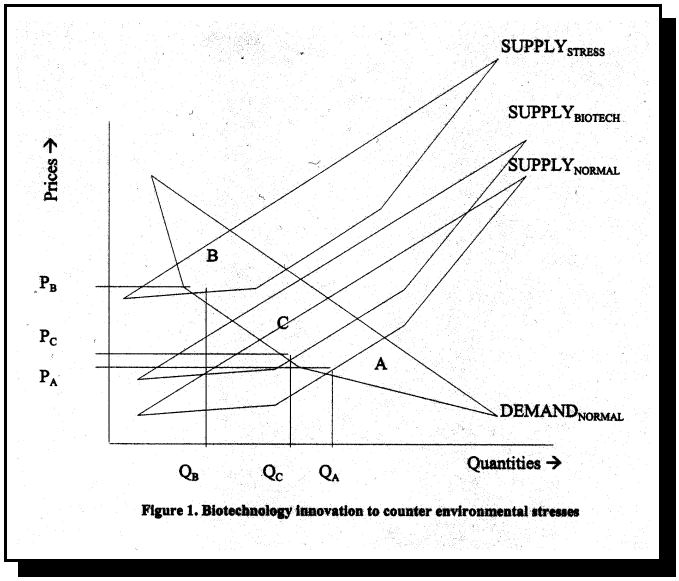

Figure 1. Biotechnology innovation to counter environmental stresses

Given the impact of environmental stresses, a producer has to either settle for low yields from her fields, or provide additional inputs to plants at additional costs. Even the first option places direct (lower profits) and indirect (alternate procurement costs to honor preseason contracts) economic burdens on the producer.

In case the producer opts for a strategy of maintaining yields, there is an additional cost that must be reflected in the supply curve. In the figure this is shown by a new supply curve called $SUPPLY_{STRESS}$. For any quantity point, the supplier would need to charge a higher price; hence this supply curve shifts upwards compared to the "normal" supply curve. In reality the

new supply curve would be steeper at higher quantity levels, since there would be input cost non-linearities. But, keeping them parallel does not take anything away from the analysis. Although there is no change to market demand, there is now a new equilibrium at point B – given the new supply curve. At the new equilibrium (point B), there is new set of market clearing price and quantity, where,

$P_B > P_A$ a new higher market price
$Q_B < Q_A$ a new lower market quantity.

In this event, social welfare suffers. Consumers are forced to cutback on their consumption good – which signifies a loss of welfare in any capitalist society. Producers charge a higher price – which run them the risk of product substitution, lower market shares, and possibly lower marginal revenues.

The objective of plant biotechnology is to reverse this eventuality to the maximum extent possible, that is:

$$\textit{Minimize } \frac{\partial W}{\partial S}$$

where, W is social welfare, and S is measurable environmental stress, given by:

$W = f(\text{Price, Yield})$

$S = f(\Delta \text{ temperature}, \Delta \text{ moisture}, D \text{ soil salinity})$

Therefore, biotechnology can minimize $\partial W / \partial S$ by accelerating the natural process of adaptation multiple times with genetic intervention by humans. Hence, plants are able to adapt to stresses within a few generations as opposed to thousands of generations if left to nature.

The effect this has on the market diagram is to push the supply curve down to $SUPPLY_{BIOTECH}$. Hence, the new market equilibrium shifts to point C and the market clearing price and quantity move to P_C and quantity Q_C, which lie closer to the normal case. Thus plant biotech represents a net welfare gain for any society that is suffering welfare losses resulting from environmental stresses, and is given by the area within the quadrangle P_BBCP_C.

BIOTECHNOLOGY IN AGRICULTURE AND FOOD

There have been limitless possibilities of application of biotechnology in the agricultural sector. Genetically modified (GM) plants and crops in the agriculture sector offer the potential to increase yields, lower costs and reduce the use of agrochemicals. The financial benefits of using biotechnology have been huge. There are also several environmental benefits. For example, worldwide sales of chemicals used in crop protection totaled about $ 30 billion in 1997. It is predicted that this may decrease by 50% within 13 years because of disease resistance varieties of grains and oilseeds (Lyseng, 1997).

A variety of agricultural products produced by GMOs (refer Table 2) has already been available in markets and more are pending federal approval. There were about 50 million hectares of GM crops grown worldwide in the year 2001 (James, 2001). The early emphasis of ag-biotech was on the reduction of farming costs and the increase of plant yields by developing insect / disease resistance, and herbicide tolerance crops. Insect resistant and herbicide tolerant crops constitute the majority of currently adopted bioengineered crops. In addition to reducing costs, this approach has been beneficial in reducing the amount of pesticide, insecticide, fungicide applications – thus minimizing human health risks and groundwater contamination.

Environmental benefits of reduced chemical pesticides may appeal to environmentalists. For example, eight GM crops improved crops yields by 4 billion lbs and resulted in savings of 1.2 billion as a result of lower production costs and reduction in pesticide use by 46 million lbs in the US (NCFAP, 2002).

These 8 crops are: insect-resistant corn and cotton; herbicide tolerant canola, corn, cotton and soybean; virus resistant papaya and squash. Of these eight crops, greatest yield increases have occurred for insect–resistant corn (3.5 billion lbs) and insect-resistant cotton (185 million lbs). Most cost savings have occurred in herbicide-tolerant soybeans ($133 million) followed by herbicide -tolerant cotton (58 million). The use of herbicide tolerant soybean resulted in the reduction of 28.7 million lbs of herbicide (NCFAP,

2002). It is predicted that the greatest increase in yield among GM crops is likely to occur with fungus-resistant barley (1.44 billion lbs).

Similarly, future yields have been projected to increase by 1.42 billion lbs with herbicide tolerant wheat, 1.4 billion lbs with herbicide tolerant sugarcane and 1 billion lbs with potatoes resistant to viruses and insects. As well, fungus-resistant potatoes could eliminate the use of 28 million lbs of soil fumigant. Likewise, it is estimated that rootworm resistant corn could reduce the application of 14 million lbs of pesticides. Overall, the adoption of biotech crops is expected to increase yields by 5.5 billion lbs, minimize the costs by $187 million and preclude pesticide use by more than 91 million lbs annually (NCFAP, 2002). In the food industry, biotechnology offers a multitude of new and challenging opportunities such as testing for pathogens using monoclonal antibodies, food processing enzymes, health promoting ingredients (also called *nutriceuticals*), and designer feedstocks with unique functional properties.

It has been argued that although pharmaceutical applications of biotechnology dominate the developments at present – as evidenced by the rising number of biotech drugs approved each year (Fig. 2) – they will soon be exceeded by the food and agricultural applications (Finely and Scheinbach, 1996). In the food sector, the obvious benefit of biotechnology has been the cost-effective production of valuable enzymes used in the food processing industry. For example, sales of chymosin were about 0.5 billion dollars (Finely and Scheinbach, 1996). Designer fats are another rapidly growing business. Lipases have shown the possibility producing low calorie fats such as caprenin or salatrim at lower costs.

Besides providing food products, plants are also rich sources of insecticides and anti-microbials. Importantly, most of these pesticides and microbials are biodegradable and many are not synthesized by plants until their production is triggered by the pest invading the plant. Scientists have been working to enhance the resistances of a wide range of plants of agronomic value against viruses, bacteria, insects, etc. Virus resistance has been successfully applied to crooked-neck squash.

The objective of this branch of plant-biotech is to replace the use of toxic chemical pesticides with biological compounds that are synthesized by

plants thereby reducing environmental degradation. Herbicide tolerant crops such as soy, corn, sugar beet, and rapeseed have already been developed. Hence, herbicides like glycophosphate can be applied to kill weeds without affecting these crops. Since glycophosphate is degraded by soil organism, the end result is a no residue pesticide (Finely and Scheinbach, 1996). Corn has been genetically modified to produce a toxin that kills the corn borer but not other insects or animals, and excluded the need to use insecticide.

It is important to develop stringent standards for this industry to ensure that toxin levels synthesized by plants do not exceed the levels harmful to living organisms in par with the conventional pesticides industry. Although the debate on toxicological risks of synthetic chemicals versus the pesticides produced by transgenic plants is unavoidable, the transgenic pesticide has an obvious advantage because it is produced only when needed and affect only a target pest population. While producers benefit by having lower labor and pesticides costs, consumers benefit through the lower cost of the product and better health and environmental safety. Consumers, however, may not initially realize the cost benefit since companies add monopoly premia to the products to recover investments in R&D (Finely and Scheinbach, 1996).

Table 2. Applications of ag / food biotechnology

Examples of current ag and food biotech products	Expected future products from biotechnology
Milk from cattle receiving BST	Rapid growing salmon
FlavrSavr tomatoes	Improved tomatoes
Improved cherry tomatoes	High solids tomatoes, potatoes
Carrots	High stearic rapeseed oils - shortening and frying
Sweet mini-red peppers	MCTs from rapeseed
Chymosin cheese	Low saturated fats from rapeseed
Aspire- natural fungicide	Pest resistant rice
Nisin - cheese protection	
Pest resistant corn, wheat, cotton, potato	

Plant-biotech is making major inroads in enhancing agronomic performance traits of plants. For example, genes associated with resistance to drought, cold, salinity and other environmental stresses, have been identified. Yields will be improved dramatically by transferring such genes

to other plants (transgenic plants) that lack the natural ability to withstand drought, cold, salinity, etc.

To realize the scope of biotechnology in the agriculture sector, investments in research and development are very crucial. Since biotechnological products are well suited to international trade and commerce, companies willing to invest in biotechnology always look to the international market to recover their investments. Therefore, the decisions on investments in biotechnology products are guided by considerations such as international trade barriers, regulatory constraints, etc. Existence of market imperfections can undermine the incentives for investment in ag-biotech (Klein et al., 1998).

There are four requirements for achieving the best return on investment in biotechnology research. First, the product should demonstrate profitability and easy access to farmers. The product must primarily be appealing to the consumer (e.g., *FlavrSavr* tomato has distinct commercial advantage since it improves shelf life and flavor), and environmental health is only a positive externality of this process. Second, there should not be long delays in governmental approval and testing requirements. Third, biotechnology products must be protected by intellectual property rights. In the face of a weak intellectual property rights regime, companies may find their investment risky. Fourth, biotechnology products must have a secure passage to international markets.

For biotech products to succeed in the market, end use benefits should be communicated to consumer. *FlavrSavr* tomato has been well accepted by consumers in California. In contrary, milk produced by using bST initially did not do well in the markets due to little perceived consumer benefits. Furthermore, scare tactics used by advocacy groups succeeded in dissuading the public in using the milk produced by cows receiving bST. To have a level playing field for biotech products, efforts must be made to communicate the benefits and safety to consumers.

Higher yields, higher quality, and lower cost of production notwithstanding, the promises of ag-biotech have been tempered by risks that come with genetic manipulation. There are serious concerns regarding the ultimate impact of biotechnology in food and agriculture. One major problem

with transgenic food products is the inability to assess the long-term effects of these products in the short-term. Little is known about the long-term toxic buildup and environmental effects of transgenic products.

The possibility of gene contamination due to genetic manipulation between and among species has worried consumers and many critics. It is a very complex task to keep genetically modified grains from natural seeds. It is also difficult to control mixing of different plant genotypes in large-scale agriculture. Although the possibility of cross- pollination generally decreases with distance, it is virtually impossible to estimate the distance that ensures zero pollination. Measuring and monitoring has been a major focus in recent years in European and North American agricultural system (Gates, 1996). There is international consensus for carrying out a comprehensive safety assessment before GM crops are released into the environment and grown commercially in agriculture (Dale and Kinderlerer, 1995). It has been argued that although gene transfer from transgenic groups to wild species is possible, this will not be considered sufficiently harmful on a local scale to prevent the release of genetically engineered crops in advanced Western agricultural systems (Rogers and Parkes, 1995).

Critics often argue that the benefits of biotechnology have been overemphasized while downplaying the associated risks. GM crops can aggravate or alleviate the impact of agriculture on the environment. They can aggravate the problem if they promote monoculture. On the other hand, they can alleviate the impact of agriculture on the environment by targeted genetic control of pest and disease (Dale, 2002). However, claims that GM crops such as herbicide resistant crops offer environmental benefits are rarely supported by a thorough cost-benefit analysis that takes into account all potential environmental impacts (Gates, 1996). Historically, an adversarial relationship has existed between the proponents of plant biotechnology who strive for rapid practical application and non-governmental organizations, consumers and pressure groups that advocate the precautionary principle and fight for more equitable use of new technology and more stringent safety measures (Lindsay, 1995).

There are unlimited opportunities of biotechnology in agricultural and food sector. However, in addition to the technical hurdles, some barriers must

be overcome: market imperfections, the issue of who bears the cost for development, and who has property rights for the products, public perception of costs and benefits, and the regulatory environment. The success of biotechnology in the agriculture and food sector will largely be determined by consumer confidence in the safety of biotech products and the capability of producers in dealing with the questions of containment and segregation of transgenic produce with scientific objectivity.

BIOTECHNOLOGY IN FORESTRY

With biotech developments occurring at an unprecedented scale, forestry today stands on the threshold of a promising change. Biotechnology applications in the forestry sector can be categorized into the broad areas of - vegetative reproduction, genetic markers, and genetically modified organisms (GMOs), or transgenic trees (Sedjo, 2001).

Currently, biotechnology research in forestry focuses on identifying genetically superior trees, propagating trees through tissue culture, improving trees through genetic engineering, protecting forests with biological pest-control methods, and assessing environmental impacts of biotechnology-derived products. Genetic engineering and advanced tissue cultures for cloned seedlings offer many benefits at a time when we depend on natural forests for wood products and other services and their destruction is occurring at a rapid rate. Basic techniques in tissue culture, genetic transformation, and molecular genetics have been applied to forest trees with varying degrees of success. Biotechnological innovations such as herbicide resistance, fiber modifications, lignin reduction and extraction, sterility have yielded unique benefits to the forestry sector. There are both economic benefits such as lower costs and increased availability of wood and wood products as well as environmental benefits such as rehabilitation of habitats, reduced pressure on natural forests from increased productivity, and restoration of habitats in previously unsuitable areas. The application of biotechnology to forestry holds the potential for trees that grow faster, require the use of fewer chemicals in pulp and paper production and thus has less of an impact on the environment.

Today, a majority of biotechnology applications in forestry relate to tissue culture and molecular marker applications. Nonetheless, there is enormous potential for the use of transgenic trees. Specific genes responsible for certain traits can be identified and introduced to the plant genome. For example, the lignin content, type, and form in wood can be altered to assist in papermaking by identifying and modifying lignin genes.

The primary economic advantage of introducing biotechnology in forestry is improved productivity. This can result either from yield increases or cost reduction or both. Wood products derived from plantation forestry have a competitive edge in the market over those derived from natural old-growth forests because of associated cost-reducing technology with plantation forestry. Economic advantages also result from improved traits such as straight trunks with little branching, disease resistance, low lignin content in wood, etc. Desired characteristics vary according to the enduse of the wood. For example, one set of fiber characteristics is desired for milling and carpentry whereas another set of fiber characteristics is desired for pulp making. Some characteristics are valued for their role in the production processes (Sedjo, 2001). In pulp making, easy breakdown of wood fiber and lignin removal is desirable. Wood value can be increased by customizing the raw materials for specific needs.

A multitude of environmental benefits can be realized from biotechnology (Table 3). The obvious one is the reduction of pressure on primary forests, which are prized for biodiversity and wildlife habitat, by substituting with genetically customized plantation wood. It has been argued by forest scientists that that biotechnology can enable fast growing plantation forests that would help the industry meet demands that have grown by as much as 300 percent in the last 25 years without having to harvest native forests (Roach, 1999).

Biotechnology also plays an important role in ecosystem restoration. For example, wild tree species such as the American Chestnut that has been eliminated by disease can be restored by introducing disease resistant transgenic varieties. Modified tree species with improved drought or cold resistance is useful in providing environmental services in areas where trees are difficult to grow. Carbon sequestration, which is an innovative strategy

to help mitigate the anthropogenic greenhouse effect, can be enhanced by afforestation of degraded lands using transgenic trees.

Table 3. Economic and environmental benefits of using biotechnology in forestry

Economic benefits	Environmental benefits
Increased productivity Production cost reduction Improved specific values such as tree form (straight trunks with minimal branching), diseases resistance, low lignin content	Reduced pressure to log primary forests due substitution of plantation wood for wood from natural forests Establishment to protection forests in degraded lands Establishment of carbon sequestrating forests on sites previously not suitable for forestry

However, the forestry sector is not immune to criticisms surrounding any transgenic technology. Biotechnology innovations raise concerns about bio-safety and effect of transgenic plants on the resistance of pathogens and genetic exchange between domestic and wild populations. For trees, which are not strictly food sources, the question of food safety is not usually raised. However, with increasing use of cellulosic material as filler in food products, the use of transgenic trees may start raising food safety issues. Another concern is the possible gene contamination of wild tree species from transgenic trees. If plantation trees are exotic, then the issue of migration to the natural environment would not arise. In cases where gene flow to natural environment is a concern, planting sterile trees or varieties with delayed flowering would minimize the likelihood of gene leakage (Sedjo, 2001). If the genes in question are not survival genes, the presence of modified genes, (e.g., genes that affect fiber characteristics, or tree form) in the natural environment will not pose a serious problem because they are unlikely to provide a competitive advantage in survival and therefore do not exert adverse consequences.

In cases where survival genes are involved, the consequences can be serious. The release of the *bacillus thuringeinsis (bt)* gene, which imparts pesticide resistance to plants, into the natural environment would cause a problem if it altered the comparative competitive position of wild vegetation in dealing with pests. Another concern is that pests may adapt to such genetic pest controls through natural selection thereby undermining the long-term effectiveness of the *bt* gene. Since trees generally have long growth periods,

it would allow insect populations many generations to develop resistance mechanisms. One strategy suggested to extend the life of transgenic pest control would be to establish "refugia" (places planted with trees without Bt gene) that undermine the ability of pests to develop resistance through natural selection (Sedjo, 2001).

Overall, the magnitude of the problem of transfer of survival genes into the environment is determined by the probability of transfer of a survival gene, the scale of transfer, and change in the comparative competitive position in the natural habitat. Considering that trees have long lives, largely undomesticated status, poorly understood biology and lifecycles, and the complexity and fragility of forest ecosystems, planting GM trees may create grave risks (WRM, 2002). One way to reduce the conflict between adversarial groups is to require environmental impact assessment, with full-disclosure of all potential benefits of bioengineered trees and risks including information gap and uncertainties that may have environmental consequences (Lindsay, 1995).

To sum up, biotechnology can address the challenge of meeting demand for wood and wood products with less environmental intrusion. Research done over the years have shown that it is practically possible to obtain trees with new growth characteristics, altered processing capabilities, improved resistance to external threats and commonly valuable traits. Given the far-reaching implications of impact biotechnology in forestry, societal, ecological and economical benefits must be ensured. The application of biotechnology in forest sector should be evaluated for safety and appropriateness. This can be done by bringing together issues related to science and research, industry and commercialization, ecology and environment, and policies and taking a holistic approach to tackle the problem (IFB, 2002).

ENVIRONMENTAL BIOTECHNOLOGY

The area of environmental biotechnology directly addresses specific issues relating to the mitigation of pollution, and extends to conservation including areas like supplying alternate environment-friendly bio-resources

and biosensors for assessing environmental health. Specifically, environmental biotechnology makes use of micro-organisms for treatment of toxic and hazardous wastes converting them into harmless substances.

It may be noted that the biotechnology also renders positive environmental externalities from a variety of other functional areas including food, forest and ag-biotech, by either reducing environmental damage or improving the productivity of an environmental resource. Biotechnology also supplies environmental benefits through sustainable industrial processes or improved industrial ecology. The direct application areas of environmental biotechnology are:

1. GMOs to assimilate pollution – e.g., oil eating bacteria, PCB reducing bacteria, etc.
2. Environmental monitoring – assess air / water qualities
3. MTBE assimilation – microbes that neutralize MTBE (gasoline additive)
4. Material and energy inputs – biomass used as energy inputs, biodiesel
5. Biocatalysts / bioenzymes – environment-friendly industrial processors
6. "Green" plastics – biodegradable materials and biopolymers

Environmental biotechnology also benefits several industries by providing alternate resources and processes, such that these industries can continue to grow while complying with the regulatory regimes.

INDUSTRIAL BIOTECHNOLOGY

To establish sustained growth in the chemical industry, interests in the pursuit of biotechnology has been growing with a view to develop materials with higher information content and improved economics. Many chemical companies such as Dupont, Dow, BASF and Monsanto are involved in creating high-value materials through biotechnology. In the early years of biotechnology development, most of the R&D funding ($10 billion) was devoted to pharmaceutical and agricultural products, like antibiotics, amino acids and enzymes, via fermentation. In the chemical industry, biotechnology has made its presence felt in three ways:

1. Created new molecular targets for the industry to manufacture;
2. Provided new catalysts for carrying out chemical unit processes ; and
3. Provided new and cheap raw materials, sometimes very complex ones which have potential to create new areas of chemistry (Bryant, 1994).

In recent years, industrial bulk enzymes produced by using recombinant microbes have become important input materials for the detergent, paper processing, diary, textile and feed industries. In 1990, the worldwide bulk enzyme production was valued at US $720 million (Nielsen, 1994). Many of these industries require a wide range of chemicals, therefore, it can be expected that the use of enzymes will continue to grow. Recently, superior strains of microorganisms have been isolated that provide higher productivity of a desired enzyme, greater thermal stability, or a speedier reaction time. Researchers have developed a fermentation process that avoids multi-step chemical synthesis and produces semi-synthetic L-amino acids. This process is more cost effective since it uses glucose, a relatively low-cost raw material (TI, 2003).

Research and development in the improvement of enzyme properties and function will lead to further displacement of chemicals in these industries. For some amino acids, the method of production has shifted from chemical processes to bioprocesses. For example, acrylamide has been produced commercially by using a third-generation biocatalyst (amino acid) since 1985 by Mitsubishi-Rayon (Yamada and Kobayashi, 1996).With the use of biotechnology it is possible to achieve large-scale commercial production of polymers from lactic acid, which in turn can be obtained from fermentation of renewable sources such as sugars. This shift from chemical to biotechnological processes can minimize potential environmental concerns associated with the disposal of chemical processing wastes while increasing product yield.

In the chemical and materials industry sector, a new opportunity has been opened with the possibility of integration of chemical and materials sciences with biotechnology. Chemists have produced a number of synthetic polymers with wide-ranging functionalities. Similarly, biologists have succeeded in engineering the production of proteins, polysaccharide, nucleic acid, polyhydroxy alkanoates, etc. Given the similarities between

biopolymers (e.g., protein) and synthetic polymers**,** a better understanding of the structure and function of synthetic polymers and biopolymers will make it possible to design biomimetics with characteristics derived from the structures of both types of polymers.

In essence, biotech products can have huge impact on materials technology in synthesizing high-information-content materials (Miller and Nagarajan, 2000). Bioprocess is suited to the economic production of such chemicals products. A single, large batch fermentor can be employed to manufacture a multitude of enzymes and antibiotics. Besides lower capital costs, the use of renewable raw materials is another advantage for bioprocessing.

The next phase of successful commercialization of large-scale monomers may involve the manipulation of multiple pathways and genes in a heterologous host, as is the case in the production of 1,3-propanediol (Laffend, 1997). Genomics and array technology can be applied for metabolic engineering thereby reducing the cycle time in the production of robust biocatalysts (Bailey, 1999). A major hurdle that remains in the successful commercialization of bioprocess is how to achieve efficient downstream processing. Since bioprocess is water-based, problems such as high hydraulic loads and biofouling are common. Material recovery will be expensive unless a new separation technology is developed. However, chemical engineering is responding with the development of necessary tools that have proven valuable in the development of biochemical engineering (Miller and Nagarajan, 2000). Emerging technologies such as *in situ* product-removal and molecular-imprinted polymers will provide novel solutions (Lye and Woodley, 1999). The integration of biotechnology with materials sciences is likely to generate a societal impact similar to that of information technology – since it promises to dramatically expand the scope of material use, both in terms of the size and nature of applications

BIOPHARMACEUTICALS

Advances in biotechnology now address the entire gamut of issues relating to the human body, including the requirements of a healthy body,

causalities of divergence, measuring the signals of dysfunction and innovative remedial strategies. Some of the sub-areas of this development are (BIO, 2003):

Diagnostics – early, accurate and sensitive detection of physiological change
Therapeutics – biological substances from nature's molecular production system
Nutriceuticals – naturally occurring compounds that have remedial potentials
Biopolymers – biological molecules as surgical aids, prosthetics and for drug-delivery
Protein replacement – like insulin (missing in diabetics), Factor VIII (hemophiliacs)
Genetic therapy – for treating hereditary disorders
Cell transplants – for regenerating organ tissues, cartilages, etc.
Immunology – stimulating or suppressing the immune system
Vaccines – production of antigen
Genomics and proteomics – molecular basis for disease, aging
Xenotransplantation – organ transplants from other species.

This is the fastest growing functional area in the field of biotechnology, and the prospect of biopharma drugs is evidenced from the steeply sloped graph (Figure 2) of approvals since 1995.

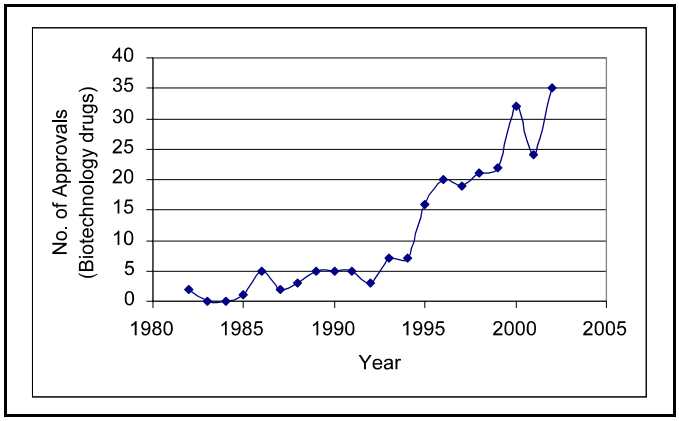

Figure 2. Growth of biotechnology drugs

While several new biopharmaceuticals have been developed recently (refer Table 4), there is an exciting new sub-field known as Plant-made-Pharmaceuticals (PMPs). Using plants as factories for growing therapeutic

proteins is a low-cost innovation that avoids many of the complications of mammalian cell-culture methods. PMPs are made by tapping the extraordinary ability of plants to manufacture complex proteins, given the appropriate genetic information (Monsanto Protein Technologies, 2003).

Production economics could also favor PMPs over other biopharma options. While classical chemical therapeutics cost about $5 per gram, it could cost between $100 to $500 per gram to make a protein therapeutic using bacterial cell culture, and the price tag could be upwards of $1,000 per gram if mammalian cell culture is used. Using PMPs could drive the cost down by at least 50% compared to bacterial cell cultures. Moreover, there are additional costs resulting from entire batches being rejected for any hint of contamination or minor deviations from strict regulatory standards for storage, etc. These costs are almost eliminated because of the inherent stability of the PMP process.

Table 4. Use of biotechnology in medical applications

Biopharmaceuticals in current development, testing, federal approval	Areas of future biopharmaceutical developments
Human insulin Human growth hormone Interferon TPA Clotting factor Serum Albumin Tumor Necrosis factor Nerve growth factor Relaxin Antigen only (microbe-free) vaccines for meningitis, hepatitis-B	Bio-diagnostics for a variety of applications DNA vaccines (HIV, malaria, flu, diabetes, Alzheimer's, hepatitis) Rheumatoid arthritis Gene treatment for cancer Delay aging, increase longevity

PROGNOSIS: PERILS, PERPLEXITIES AND ECONOMIC PROMISE

The biggest worry of transgenic production is containment and segregation. Although the magnitude of environmental costs, from accidental breaches of containment, is not clearly defined, it is easy to speculate on the irreversible damages that may be caused to ecosystems directly from a GMO

that possesses foreign genes (that it would never have acquired in the natural process) and also the indirect impacts of its interactions with other species. Hence, whatever the product, any breach of containment guidelines will result in a clear, present and future peril.

Adoption of any new technology at the consumer level is a slow process that is encouraged by demonstrations of benefits as well as obvious attention to safety issues by producers and regulatory authorities. The current state of biotechnology is that it neither enjoys a clear exposition of benefits by credible sources, nor is it favored by an unambiguous addressal of risks by producers and regulators. This, along with sensationalization of biotech accidents (e.g., StarLinx corn) – without adequate coverage of follow-up activities and research – has led to a buildup of perplexity in the public psyche. Important safety and containment initiatives have often gone unreported in the media. For example, the problem of gene leakage into the natural environment can be prevented, by the strategy of introducing only sterile species.

At this stage, it is important to increase the level of public awareness for wider adoption of this technology. This is a multi-dimensional task that needs to be addressed by businesses, industry groups, professionals and regulators alike.

The biggest adoption of biotechnology, so far, around the world has been in the crop sector where GMOs are attractive to producers for their enhanced agronomic properties. For example, GM acreages have gone from less than 5 million acres in 1996 to about 150 million in 2002 – a 30 fold growth in 6 years. There are at least 2 dozen other grain and vegetable crops (e.g., potato, rice, sugar beet, squash) that will be launched in the near future with attributes as diverse as insect resistance, better color, longer shelf-life and delayed ripening (Nap, 2003). There are several economic benefits of such adoptions, including, avoiding pre and post harvest losses to pests, higher value added due to better consumer features and avoided costs of environmental degradation from agrochemicals.

In addition, the rDNA technology is easily extended to biosensors and biomarkers which are bound to prove invaluable in the future. Biotechnology is a powerful tool that will not yield its true potential to society if it is limited

to the handful of industries that have currently adopted or experimented with it. Even as viewed from today's state of the art, it holds great promise for new lines of diagnosis and treatment for both genetic disorders and pathogenic ailments. Combined with parallel developments in nanotechnology, it can provide substantial social value from the standpoint of human health alone.

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