EMPIRICAL INVESTIGATION OF THE RELATIONSHIP BETWEEN LONG TERM INTEREST RATE AND GOVERNMENT DEBT AND DEFICIT SPENDING

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ABSTRACT

In this study, the authors apply time series analysis using data on government spending, debt and long term interest rate in order to determine if government spending or debt has any significant effect on interest rate in the US, England, France, Germany and Japan. In the time series model, 10 year bond rate (a commonly used measure of long term interest rate) was the dependent variable and unemployment rate, inflation rate, GDP and one of the variables (deficit, percent deficit, debt, or percent debt) as the independent variables. Unemployment rate, inflation, and GDP were used as control variables for deficit spending and debt.

On the other hand, unemployment rate and inflation rate were the control variables when percent deficit or percent debt of the GDP was used in the model. Results did show clearly that there was no positive effect of deficit spending, percent deficit, debt, or percent debt on long term interest rate in any of the five countries. These findings lend support to the argument that government borrowing has no crowding effect in the sense that it does not lead to reduced availability of funds for lending and its consequence of higher long term interest rate.

Keywords: Time series analysis, long term interest rate, government debt, deficit spending

INTRODUCTION

Of importance for the economy of a country is the role government spending plays in influencing long term interest rate and hence investment and growth. It is generally recognized that the central bank has a direct influence on short term interest rate, which is the main reason that studies in the literature focus on long term interest rate, as measured by 10-year bond rate, and how it may be affected by government debt and deficit spending. It is argued that debt and deficit spending leads to an increase in long term interest rate which negatively influences investment by the public sector and therefore economic growth. This is explained as being due to reduced availability of funds (caused by government excessive borrowing) for the private sector. However, it is not clear from the literature if debt or deficit spending leads to an increase in long term interest rate and thus curbs investment and economic growth. Hence, more empirical studies are needed in this regard.

How to induce economic growth at the time of a depression or recession is of fundamental importance for the economy of a country. Economists are mixed on this issue. There are those that argue that government borrowing and spending would create jobs and induce economic growth which would lead us out of the recession. Conservative economists on the other hand argue that government spending causes high interest rates which in turn curbs investment and economic growth. Those that argue that government spending induces growth point out that in a depressed economy the private sector is saving more than investing and hence when the government borrows, it is not competing with the private sector for money. Therefore, borrowing under such a circumstance does not cause an increase in interest rate and can only stimulate the economy by increasing employment and demand. Because of the importance of this contrasting economic points of views on policy making by a government, it is essential to determine empirically if government spending has an effect on long term interest rate.

In this study, the authors test this hypothesis by using time series analysis to determine if there is a functional relationship between deficit spending and interest rate in five industrialized countries, namely, the United States, the United Kingdom, Germany, France, and Japan.

RELEVANT LITERATURE

In a study on determinants of long-term interest rate yields in the US, Cebula (2008) using an error correction model reported that there was a possible bidirectional relationship between budget deficit and interest rate yield on tax-free municipal bonds. Also, short term interest rate had a positive effect on long-term rates. Krueger (2003), Cebula (1991), MacAvoy (2003), Friedman (1978), and Meyer (1975) among others have suggested that government budget deficit can lead to what is termed “crowding out” of private investment due to an increase in long-term interest rate. On the other hand, Krugman (2012) argued that government borrowing and budget deficit during an economic downturn or recession has no effect on long-term interest rate and crowding out of private investment. This is so since in a depression the private sector is not borrowing to invest.

Hoelscher (1986), based on an empirical study, reported that government deficits caused long-tem interest rate (measured as yield on 10-year treasury bonds) to rise. An earlier study by Hoelscher (1983) showed no association between budget deficit and long term interest rate for the United States. Other studies in the literature (Making (1983), Motley (1983), Canto and Rapp (1982), Dewald (1983)) reported that deficits had no effect on short-term interest rates as measured by one-year or less treasury bills. Dewald (1983) and Mascaro and Meltzer (1983) reported that there was no relationship between deficit spending and long-term interest rates.

Keith (2005) argued that usually less developed countries show a link between high deficit spending and high inflation. This link, however, was not evident in developed countries like the US. To the extent that high inflation may lead to high interest rate, this implies that in less developed nations a large budget deficit may lead to higher interest rate.

Evans (1985) reported that there was no evidence of a positive association between budget deficit and long term interest rate for the United States. Also, Evans (1987) showed no association for other countries: Canada, France, Germany, Japan, and the United Kingdom.

Pollin (2012) presented evidence which showed that the outstanding debt in the United States tied to the 2009 economic stimulus program had no effect on interest rate . Kiani (2009) showed that there was a significant positive relationship between budget deficit and the slope of the yield curve. Siklos (1988), in an empirical study, found that there was no association between deficit and long term interest rate for Canada.

The literature is mixed on the effect of debts and deficits on interest rates. Hence, more empirical studies are needed in order to shed more light on the situation.

METHODS

Economic data on unemployment rate (Uner), inflation rate (Pinf), debt, deficit, growth domestic product (GDP), and 10- year government bond yield (bond) were collected using the economic data source Gecodia.com for the United States, United Kingdom, Germany, France, and Japan. The data was validated using other data sources where possible.

The different variables for all countries were stationary after first differencing, except for deficit in the US and percent deficit in Japan which did not need to be differenced.

Since there was no significant problem with feedback between the dependent and independent variables, the time series transfer function approach was used where bond was the dependent series and the other variables (Unemployment, inflation, GDP, and debt , percent debt (of the GDP), deficit, or percent deficit (of the GDP) were the independent variables or input series. In addition, the Granger causation test was used in order to determine if any of the independent variables had any significant effect on bond rate.

Time Series Model

A transfer function model between an output series y and input series x_i (i = 1, 2, …,k) is expressed in general as

$$y_t = \sum_i^k v(B)_i \, x_{it} + a_t \qquad (1)$$

Here, $v(B) = \sum v_j B^j$, where B is the backshift operator, $Bx = x_{t-1}$.

The function $v(B)_i$ is determined from the cross correlation between x_{it} and y_t (Wei, 2006).

Once $v(B)_i$ is identified, one can express a_t in Eq. (1) as

$$a_t = y_t - \sum_i^k v(B)_i \, x_{it} \qquad (2)$$

and identify the appropriate model for Eq. (2) from which one can determine the final model in Eq. (1).

In this analysis, Eq. (1) was identified to be of the form

$$y_t = \sum_i^k w_{oi} \, x_{it} + a_t \qquad (3)$$

Our interest here was to estimate the coefficients w_{0i} (i=1,2,..,k) and test for their significance or non-significance in order to determine the effect each x_{it} may have on y_t .

RESULTS

The authors present in the Appendix figures of trends over years for the economic variables (bond rate, percent deficit, percent debt, GDP, unemployment, and inflation) for each of the US, UK, France, Germany, and Japan. It is interesting to see the similarity in trends for the five countries with regard to these variables. This can be attributed to the fact that the economy is global, which leads to interdependence among the economies of different countries.

United States (U.S.)

It is seen from Table 1 that percent inflation is significant with the correct sign, which means that as inflation increases so does the interest rate. Debt was also significant, but had a negative effect, which is contrary to the argument that debt could increase long term interest rate. A negative effect would have no adverse effect on investment and economic growth. GDP and unemployment were not significantly related to bond rate.

Table 1
Parameter Estimates and their Significance for the Model in Eq. (3) for the U.S.

Variable	Parameter	Estimate	t-value	Pr
Uner	w_{01}	0.06299	1.26	0.2167
Pinf	w_{02}	0.223	3.33	0.0020
GDP	w_{03}	-.0008446	-1.24	.2246
Debt	w_{04}	- 0.0009235	-2.12	0.0409

When Gdp was dropped from the equation, the debt estimate became -0.0007875 with a probability of 0.0726, not significant at the 0.05 level. The sign of the estimate is again negative. Results with regard to pinf and debt did not change when, in addition to Gdp, Uner were dropped from the model. It is seen from Table 2 that deficit had no significant effect on bond. Only inflation had a significant positive effect as seen from the parameter estimate and the p- value of 0.0054.

Table 2
Parameter Estimates and their Significance for the Model in Eq. (3) for the U. S.

Variable	Parameter	Estimate	t-value	Pr	Lag
Uner	w_{01}	0.03178	0.68	0.5010	0
Pinf	w_{02}	0.20931	2.96	0.0054	0
GDP	w_{03}	-0.0014521	-1.53	0.1340	0
Debt	w_{04}	0.0015637	1.43	0.1607	0

The results were the same when GDP and Uner were deleted from the model for not being significant. In this case deficit was not significant (Pr=.5370) and Pinf remained significant with Pr = .0054 and a w_o estimate of 0.07307. These above results agree with the Granger causation test where deficit had no significant relationship with bond rate (pr = 0.5985). Also debt had no significant effect on bond rate (pr= 0.4851).

Percent Deficit and Percent Debt

When percent deficit was used in the model in place of deficit, the parameter estimate was not significant (0.03071, pr = 0.7191). Also, when percent debt was used instead of debt, results showed that it had negative effect on bond rate, but not significant at the 0.05 level (-.08314, pr =0.0755). The Granger causation test also showed that there was no significant relationship between bond rate and percent deficit or percent debt (pr = 0.5 and 0.26, respectively).

United Kingdom (UK)

Results in Table 3 show that debt had a significant negative effect on bond rate which is contrary to the argument that debt can increase long term interest rate. Both GDP and unemployment had no significant effect on bond rate.

Table 3
Parameter Estimates and their Significance for the Model in Eq. (3) for the UK

Variable	Parameter	Estimate	t-value	Pr
Uner	w_{01}	-0.12811	-0.51	0.6101
Pinf	w_{02}	-0.01590	-0.59	0.5579
GDP	w_{03}	-0.02953	-2.11	0.0415

When Gdp and Uner were deleted from the model, debt was still significant with W_{03} = -0.03254 (pr = 0.0164). The Granger test did not show any significant relationship between Bond rate and debt (pr = 0.3425). Table 4 gives the estimates of the model when deficit is used. Deficit is not significant, showing no relationship to bond rate. Also, the Granger test did not show any relationship between deficit and bond rate (pr = 0.5393).

Table 4
Parameter Estimates and their Significance for the Model in Eq. (3) for the UK

Variable	Parameter	Estimate	t-value	Pr
Uner	w_{01}	-0.30887	-1.07	0.2918
GDP	w_{02}	-0.02895	-1.03	0.3091
Deficit	w_{03}	-0.01580	-0.41	0.6822

Percent Deficit and Percent Debt

Percent deficit, when used instead of deficit, had no significant effect on bond rate (-0.1074, pr = 0.217) . Also, percent debt had no significant effect on bond rate (-.0539, pr = 0.159). These results were in agreement with the Granger causation test which showed no significant relationship between bond rate and percent deficit or percent debt (pr = 0.26 and 0.107, respectively).

Germany

Table 5 shows that only Pinf had a significant positive effect on bond rate (pr = 0.0001). Debt, in particular, had no effect on bond rate. When Uner and Gdp were deleted from the model, Debt still had no significant effect on bond rate (W_{04} = -.00796, pr = .2047) while the effect of pinf was still significant (W_{02} = 0.5415, pr = 0.0001).

Table 5
Parameter Estimates and their Significance for the Model in Eq. (3) for Germany

Variable	Parameter	Estimate	t-value	Pr
Uner	w_{01}	-0.0057240	-0.04	0.9651
Pinf	w_{02}	0.52118	4.27	<0.0001
GDP	w_{03}	0.0055773	0.48	0.6372
Debt	w_{04}	-0.01053	-1.20	0.2386

It is seen from Table 6 that only percent inflation had a significant effect on bond rate. The deficit effect was not significant at the 0.05 level. When Uner and Gdp were deleted from the model, results showed that inflation was still significant (W_{02} = 0.5446, pr = <0.0001) and deficit not significant (W_{03} = 0.0107, pr = 0.1368) . The Granger test showed that there was no significant relationship between deficit and bond rate (pr= 0.1320) or debt and bond rate (pr = 0.2051).

Table 6
Parameter Estimates and their Significance for the Model in Eq. (3) for Germany

Variable	Parameter	Estimate	t-value	Pr > |t|
Uner	w_{01}	0.08586	0.62	0.5407
Pinf	w_{02}	0.51710	4.38	<0.0001
GDP	w_{03}	0.01328	1.02	0.3154
Deficit	w_{04}	0.02028	1.73	0.0923

Percent Deficit and Percent Debt

Analysis using percent deficit and percent debt instead of deficit and debt showed that there was no effect of either one on long term interest rate. Estimates of coefficients for percent deficit and percent debt were 0.044 (pr = 0.2479) and -0.0456 (pr = 0.3201). The Granger test showed a

relationship between bond rate and percent deficit as well as percent debt. However, these relationships were not quite significant at the 0.05 level (pr = 0.075 for percent deficit and 0.065 for percent debt).

France

Results for France (Table 7) showed that inflation had a positive and significant effect on bond rate. Debt was almost significant at the 0.05 level. However, its effect on bond rate was negative rather than positive, which is contrary to the argument in the literature.

Table 7
Parameter Estimates and their Significance for the Model in Eq. (3) for France

Variable	Parameter	Estimate	t-value	Pr > |t|
Uner	w_{01}	0.2849	1.10	0.2792
Pinf	w_{02}	0.5331	4.26	0.0002
GDP	w_{03}	0.02158	1.02	0.3135
Debt	w_{04}	-0.02176	-1.91	0.0656

When GDP and Uner were deleted from the model, results showed that inflation was still significant (W_{02} = 0.389, pr < 0.0001), but not debt (W_{04} = -.01399, pr = 0.1263). Table 8 shows that only Pinf was significant and had a positive effect on bond rate. Deficit spending had no effect on bond rate.

When the model was reduced by deleting Uner and Gdp, results still showed that pinf was significant (W_{02} = 0.6326, pr <0.0001), but not deficit (W_{04} = -0.0423, pr = 0.2477). Granger analysis showed that there was no significant relationship between deficit and bond rate (pr = 0.2591) or between debt and bond rate (pr = 0.3532).

Table 8
Parameter Estimates and their Significance for the Model in Eq. (3) for France

Variable	Parameter	Estimate	t-value	Pr > |t|
Uner	w_{01}	-0.14042	-0.51	0.6133
Pinf	w_{02}	0.62751	4.37	0.0002
GDP	w_{03}	0.0032236	0.15	0.8841
Deficit	w_{04}	-0.05629	-1.29	0.2090

Percent Deficit and Percent Debt

Percent deficit, when included in the model, had no significant effect on bond rate (-0.230, pr = 0.159). However, percent debt was almost significant at the .05 level (-0.08843, pr = 0.0544), but had a negative sign, which is contrary to the argument that debt could increase long term interest rate. The Granger test results showed that both percent deficit and percent debt were not related to bond rate (pr = 0.164 and 0.175, respectively).

Japan

It is seen from the probability column in Table 9 that none of the independent variables is significantly related to bond rate. When Uner, Pinf, and Gdp were dropped from the model, results showed a negative effect of debt on bond rate which was significant with probability 0.0667 (W_{04} = -0.007223, pr = 0.0667). This was, however, the wrong sign in the sense that increased deficit causes a reduction rather than an increase in long term interest rate. On the other hand, the Granger causation test showed no relationship between bond rate and debt (pr = 0.597).

Table 9
Parameter Estimates and their Significance for the Model in Eq. (3) for Japan

Variable	Parameter	Estimate	t-value	Pr > |t|
Uner	w_{01}	-0.17932	-0.44	0.1587
Pinf	w_{02}	0.05436	1.44	0.6413
GDP	w_{03}	0.0036737	0.47	0.6413
Debt	w_{04}	-0.0058186	-1.28	0.2081

Results in Table 10 show that there was no significant effect of deficit on bond rate. Also, unemployment, inflation, and GDP had no effect on bond rate. When unemployment, inflation, and Gdp were dropped from the model, deficit showed an effect on bond rate, but was not significant at the 0.05 level (W_{04} = 0.01893, pr = 0.088). This effect, however, is negative since deficit as used in the analysis was negative in value. A negative effect implies that as deficit increases bond rate decreases, which is contrary to the argument in the literature. The Granger causation test did not show any significant effect of deficit on bond rate (pr = 0.7991).

Table 10
Parameter Estimates and their Significance for the Model in Eq. (3) for Japan

Variable	Parameter	Estimate	t-value	Pr > |t|
Uner	w_{01}	-0.25536	-0.67	0.5058
Pinf	w_{02}	0.05507	1.46	0.1538
GDP	w_{03}	-0.0002957	-0.04	0.9682
Deficit	w_{04}	0.01348	1.14	0.2630

Percent Deficit and Percent Debt

Analysis using percent deficit and percent debt in the time series model showed that there was no significant effect of either variable on bond rate. Estimates of coefficients were -.0228 (pr = 0.275) for percent debt and 0.0261 (pr = 0.315) for percent deficit. Also, the Granger test did not show any significant relationship between bond rate and percent deficit (pr = 0.553) or percent debt (pr = 0.655).

DISCUSSION AND CONCLUSION

Results of the time series analysis and the Granger causation test for the 5 countries showed an overwhelming support for the argument that debt and deficit have no effect on increasing the long term interest rate. It is seen that when debt or deficit had a significant effect on long term interest rate it was to decrease the rate rather than to increase it. In all the results, except for Japan, there was as expected, a positive and significant effect of inflation on bond rate.

The results of this study do not lend support to the argument that increased debt or deficit through borrowing by the government leads to an increase in interest rate which can have an adverse effect on economic growth by curbing investment by the private sector. These results seem to imply that when governments borrow, especially in times of economic recessions or slow down, they do not seem to compete for money with the private sector and hence do not cause any shortage of money which can lead to an increase in interest rate which can curb investment and economic growth. This is in essence the arguments of many Kensyian economists, especially during recession time. Our results support this argument and could mean that government debt and deficit spending, at least at the level seen in the present data, can stimulate economic growth and do not lead to an increase in interest rate and reduced investment by the private sector.

Inflation in this analysis is, as expected, positively related to bond rate. The few cases in this analysis which indicated that debt or government spending has a negative effect on long term interest rate, could be due to an indirect effect related to the central bank outlook on inflation.

The present analysis is with regard to five industrialized countries with relatively large and strong economies. This could be a reason why deficit spending and debt have no influence on long term interest rate. In smaller countries with smaller economies excess government borrowing, especially in a currency not of their own, can be expensive in that it can lead to higher interest rates due to the fact that investors demand higher rates because they may fear government default on their investment. In the future, it would be of interest to study the relationship between government spending and long term interest rate for such countries.

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APPENDIX

Figure 1
Trends over years of bond rate for the US (----), Japan (----), Germany (----), France (----), and UK (----).

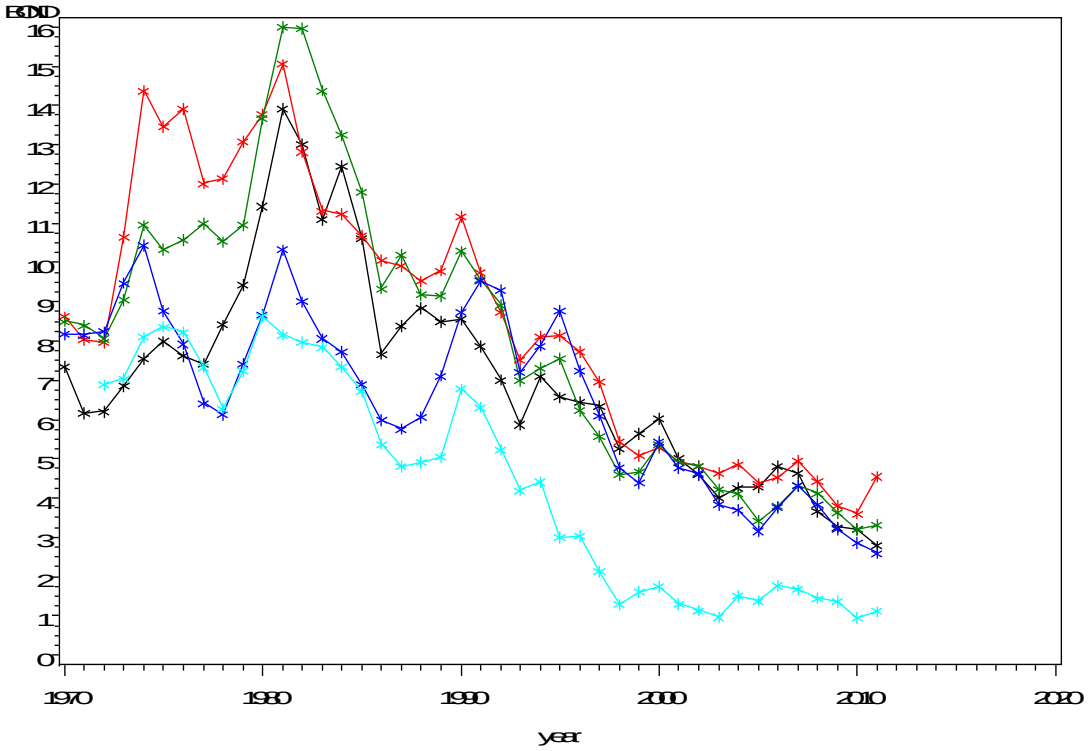

Figure 2
Trends over Years of Percent Deficit for the US (----), Japan (----), Germany (----), France (----), and UK (----).

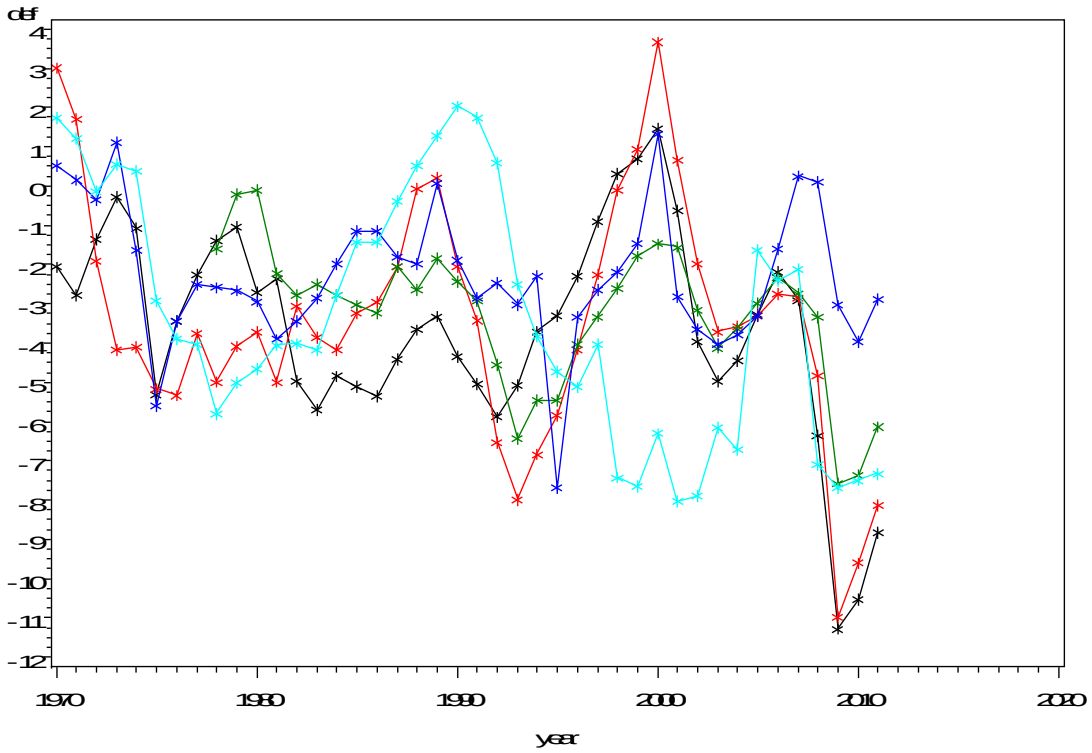

Figure 3
Trends over Years of Percent Debt for the US (----), Japan (----), Germany (----), France (----), and UK (----)

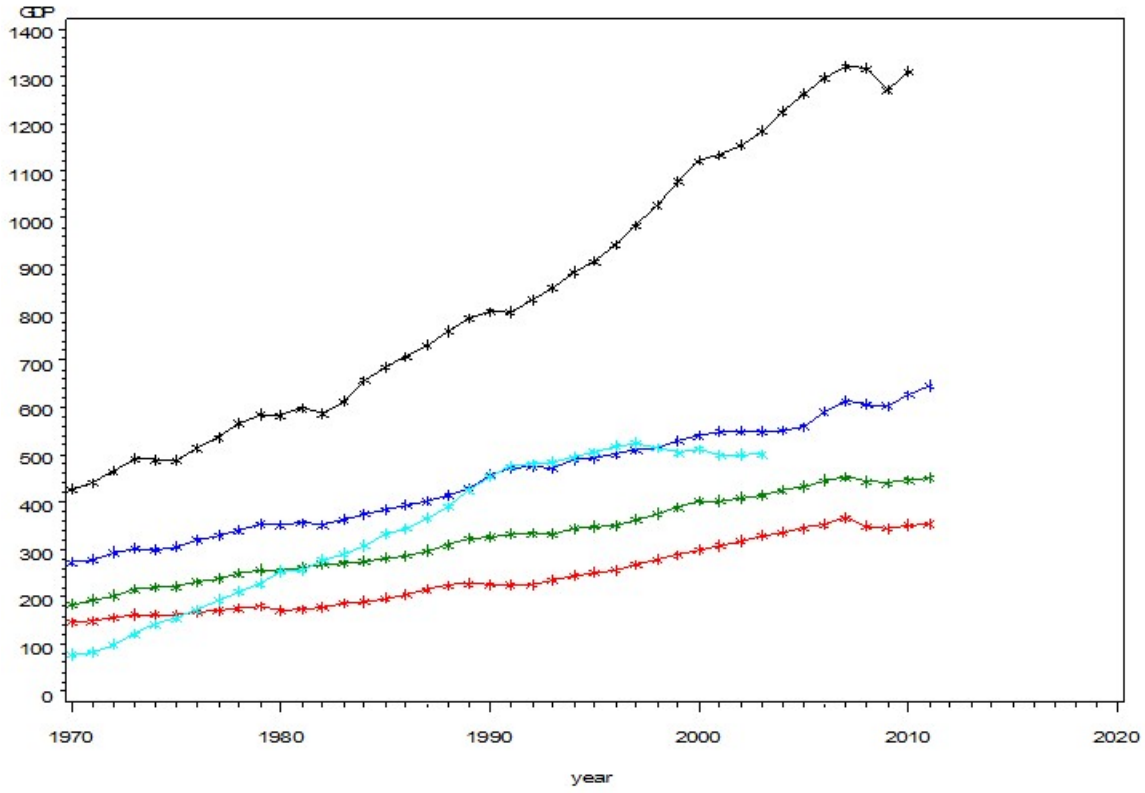

Figure 4
Trends over Years of GDP for the US (----), Japan (----), Germany (----), France (----), and UK (----). GDP for the US is in 10 Billion Dollars, Japan in jpy tr, UK in Billion Bunds, France in Billion Euros, and Germany in Billion Euros

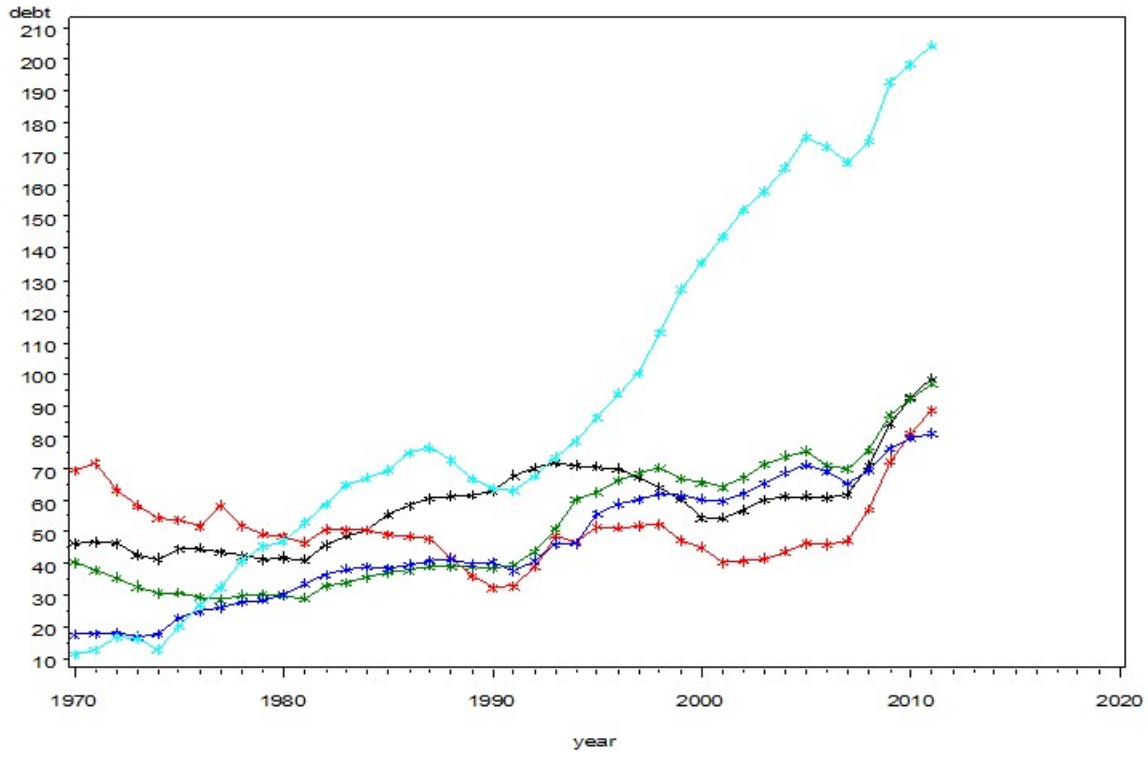

Figure 5
Trends over Years of Inflation Rate for the US (----), Japan (----), Germany (----), France (----), and UK (----)

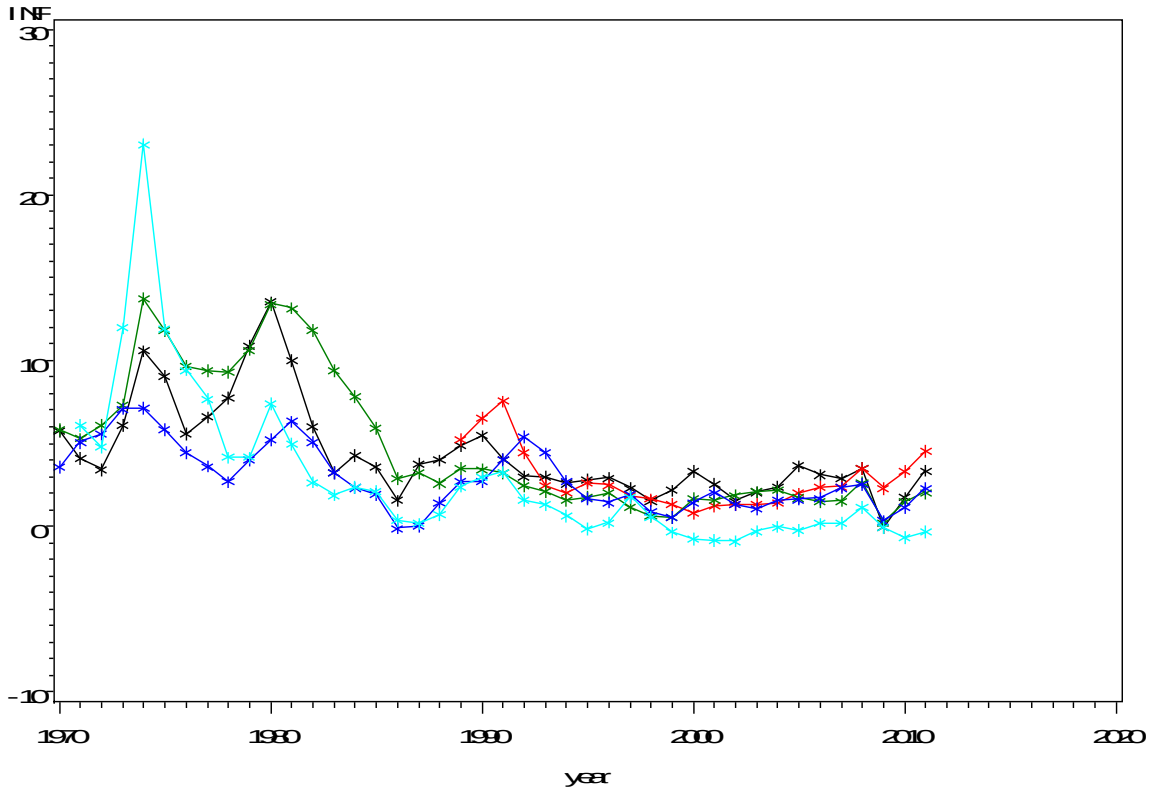

Figure 6
Trends over Years of Unemployment Rate for the US (----), Japan (----), Germany (----), France (----), and UK (----)