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Carlos I. García-Jiménez¹ and Ashok K. Mishra

Abstract

The relationship between appreciation of the exchange rate and employment is investigated in the period 1980-2008 for the United States. Previous literature has found a negative relationship, studying as channels of transmission the role of exports, substitution of factors of production, terms of trade, openness, and productivity. This study endeavors to shed some light on the role of government debt on determining the level of employment through the exchange rate. The mechanism of transmission is defined. The model is derived from a standard Cobb Douglas production function having government debt affecting the growth of productivity. Exchange rate appreciations and increasing public debt were found to be detrimental to employment.

JEL classification: F31, J01, E24, E62

Keywords: Unemployment rate, government, budget deficit, exchange rate, trade deficit, FDI

Introduction

The United States of America is increasingly relying on debt to promote growth in employment and put the economy out of a recessionary path. The new administration lead by President Barack Obama has sponsored new bills that will make this economy more reliant on public debt and government spending; in addition, the economic stimulus package cuts taxes.

¹ This work is part of the author's dissertation.

Although the gross domestic product (GDP) has risen overtime, in 2000 prices, it has increased from \$5.16 in 1980 to \$11.63 trillion in 2008. The Public Debt in the US has risen too, from \$1.21 trillion in 1980 to \$8.98 trillion in 2008 (Figure 1); implying a 6.59% per year rate of growth. In comparison, the growth of GDP has been less than half (3.05%) during the same period.

The reliance of the US government on debt to expand the economy can be corroborated by the gross debt to GDP ratio which changed from 43.57% in 1980 to 63.25% in 2008 (Figure 2); evidently, this ratio increased constantly in the period 1980-1992. Thereafter, however it should be pointed out that the gross debt/ GDP ratio decreased from 69.8% in 1993 to 53.7% in 2001, since then the reliance on debt has been increasing steadily; in the period 1980-2008, the gross debt/ GDP ratio has increased at approximately 1% per year.

A visual inspection of Figure 2 shows that periods of higher unemployment rate are accompanied with periods of higher reliance on public debt as measured by the gross debt/GDP ratio (years 1982, 2000 & 2007). Giving the current debate on the efficacy of public debt to restore growth in the US economy, a dynamic labor demand function is estimated, using a system approach. By using a VECM model, a labor demand function is estimated from a standard Cobb Douglas production function having government debt affecting the growth of productivity; the short run and long run effects of debt are investigated. Exchange rate is included in the model to absorb currency shocks that arise from monetary and fiscal policies that have effects on the level of employment.

Movements in real exchange rates cause adjustment of labor demand due to the effect on profits, especially to those firms with high share revenue from exports or costs of imported production

inputs; consequently, changing relative prices produces job creation and job reduction, see for example Hua (2007), Klein, Schuh, and Triest (2003), Frenkel and Ros (2006) and Ngandu (2008).

In the case of the United States, Blecker (2007) found empirical evidence that there is a significant negative effect of real dollar appreciation on aggregate investment in the US manufacturing industry, the effect is transmitted through liquidity rather than changes in the desired capital stock by firms. If we assume this negative relationship coupled with the fact that increasing government expenditures and government debt increases the competition for funds with the private sector. Previous studies have neglected the implications of government debt as a channel of transmission of exchange rate in labor demand; even Ngandu (2008) who made a thorough analysis of the channels of transmission of exchange rate.

This study seeks to analyze government debt as a channel of transmission of exchange rate to affect employment demand. Government debt enters into the economic model affecting the growth of productivity, i.e., using standard Solow models would imply that government debt affects total factor productivity (TFP), e.g., if $Q = A^\gamma K^\alpha N^\beta$, a Cobb Douglas production function, government debt would have effects on the coefficient A. This specification has been used by Greenaway, Hine, and Wright 1999; Hua 2007; Fu and Balasubramanyam 2005.

This research article presents a literature review which also includes the derivation of the model that aids the specification of the econometric model. A brief review of the process of setting the dynamic model is presented. Causality tests are discussed along with the dynamic effects of shocks to debt and exchange rate on employment. The final section of this paper presents the conclusions and policy implications.

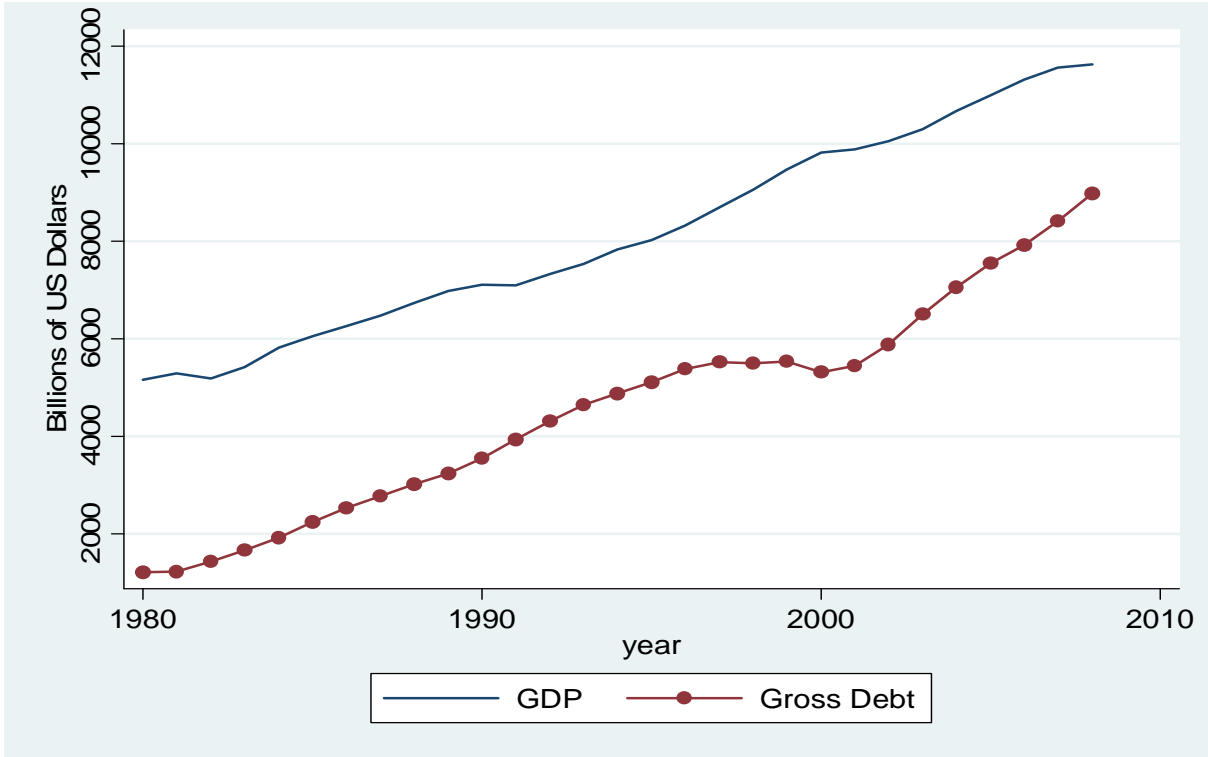


Figure 1 GDP and Gross Debt of the United States, 1980-2008.

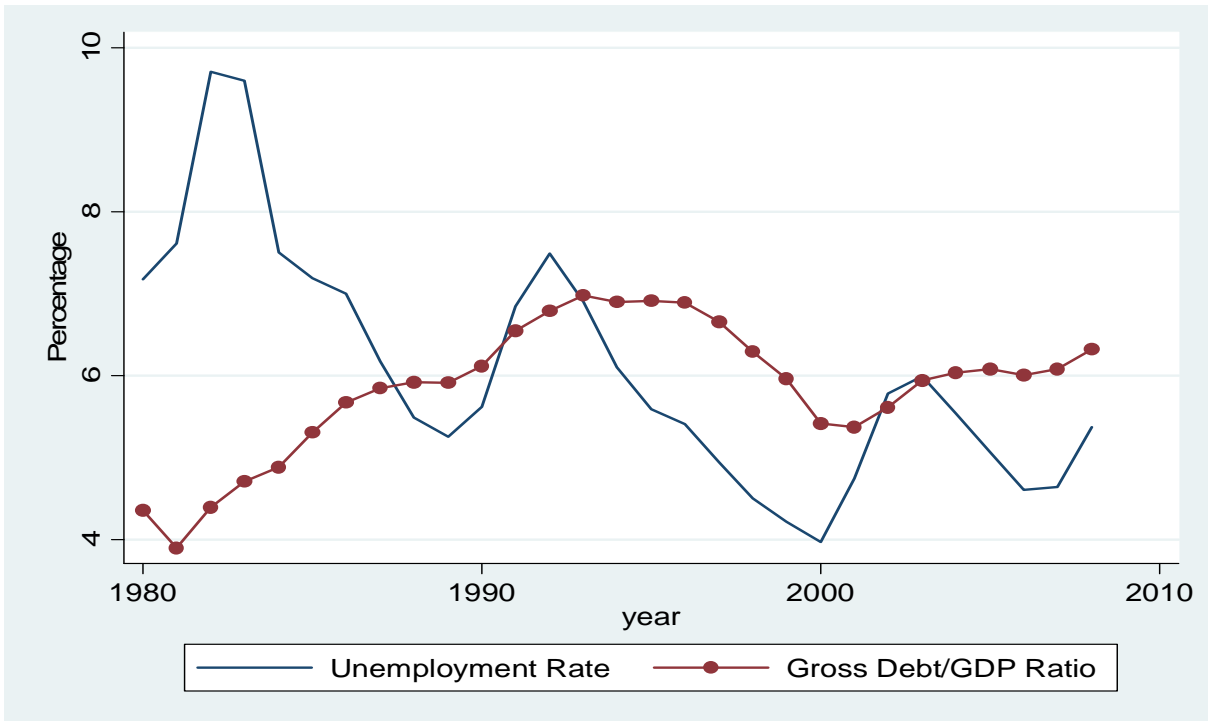


Figure 2 Unemployment Rate and Gross Debt/GDP Ratio for the United States, 1980-2008.

Literature Review

Hua (2007) exposes the negative relationship between real exchange rate² and manufacturing employment in China for selected provinces during the period 1978-2003. Hua states that in the 1993-2002 period the average rate of Chinese currency appreciation was 4.1% per year, while job creation was at the average rate of -2.3%, essentially increasing unemployment occurred. This phenomenon coincided with lower exports compared during the 1981-1993.

Hua states that in Fujian, Guangdong, and Zhejiang provinces employment increased at an annual average rate of 2.9%, 1.4% and 1% respectively, despite an annual average real appreciation of the Chinese currency of 4%, 3.2% and 4.4% respectively. This fact shows how job creation and job losses occur due to exchange rate, suggesting that it is very likely that switching of sectoral employment in the Chinese economy occurred; this phenomenon has been observed by Campa and Goldberg (2001) and Ngandu (2008).

Output and capital/labor intensities are expected to be positively and negatively correlated with employment demand, the greater the output the greater the employment level, while expansion of use of capital reduces employment. Hua (2007) found that 1% output expansion increases employment by 0.74%; and 1% increase in capital intensity reduces employment by 0.5%. Appreciation of the real exchange rate is detrimental to employment, Hua (2007) states that higher international competition and higher wages occur. He found that for 1% increase in the

² The real effective exchange rate is defined as the nominal effective exchange rate multiplied by the ratio of consumer prices between domestic prices and foreign partners; thus, an increase in the real exchange rate implies appreciation of the domestic currency, the US dollar.

real exchange rate, employment decreases by 0.69; but exchange rate also has effects on capital/labor intensity, exports and thus the exports/GPD ratio.

The research work of Hua (2007) can be improved by analyzing other sectors, like the work of Ngandu (2008). Ngandu analyzed the effect of exchange rate on employment level of different sectors in the South African economy. Different levels of aggregation of the different sectors of the economy can be used, taking into consideration demand and supply factors as was done by Branson and Love (1986). Another possible route of improvement is to analyze the impact of the exchange rate on different measures of labor market activity, Campa and Goldberg (2001) used wages, employment (number of jobs and hours), overtime employment, and overtime wages. Also, a VAR analysis of the variables in the model can be done, to see the short and long term live effects of exchange rate on employment.

According to the theory of trade, industries with high (low) openness are likely to show positive (negative) response in employment demand due to a depreciation of exchange rates (Kim 2005). Exchange rate has effects on the trade deficit. Zhenhui (2008) found a long term relationship between real exchange rate and trade deficit. Exchange rate movements have effects on the short run economic activity and economic growth and then on unemployment, refer to Frenkel and Ros (2006).

Financial activity also plays a role on how exchange rate is determined, a measure of financial markets activity needs to be included because it has effects on the flows of money and trade, and thus on the employment level. For example, in the case of the Mexican economy in the period 1971 through 1988, De La Cruz (1999) found a long term relationship between domestic credit, real exchange rate and international reserves. According to this monetary approach, an

exogenous increase in domestic credit is likely to cause losses in international reserves that cause exchange rate depreciations; but, the balance of payments will be in a sustainable path if exports and imports are cointegrated to counteract the loss of reserves; refer to Wu, Chen, and Le (2001).

By means of bi-variate vector autoregressive model, Zhenhui (2008) evaluated the relationship between the value of the Chinese currency, Renminbi (RMB), and the trade deficit with the United States. Although the Chinese government has been criticized by The United States for manipulation of the exchange rate, the author did not find a short run relation between the mentioned variables; but there was a significant relationship in the long run. So, an appreciation of the RMB/\$ was likely to reduce the US trade deficit with China.

Branson and Love (1986) found that real appreciation of the US dollar reduces the competitiveness of output in the manufacturing sector that is directly or indirectly substitutable for foreign output. Since the appreciation of the currency reduces demand for domestic output due to changes on relative prices, and therefore demand for labor is reduced. Branson and Love found that the largest exchange rate effects are in the mining and manufacturing sectors, as one would expect, with durable goods showing larger effects than non durable goods. Capital goods that are produced domestically are increasingly substituted with cheaper imports due to appreciation of the exchange rate.

Increases in trade volumes, both in terms of imports and exports, cause reductions in the level of derived labor demand, this is consistent with the view that increased openness serves to increase the efficiency with which labor is utilized in the firm (Greenaway, Hine, and Wright 1999). The authors state that between 1979 and 1991 the UK industry became increasingly integrated into the international economy through trade and foreign direct investment. By analyzing 167

manufacturing industries, the authors found that the simultaneous phenomenon of increasing unemployment and stable production in those industries necessarily imply that output per person has been rising; although, they found high variation in productivity. This suggest that trade promotes efficiency in domestic industries, this is what Hua (2007) refers as the efficiency transmission channel of exchange rate and Frenkel and Ros (2006) as the labor intensity channel.

If there are costs associated with employment adjustment then the level of employment may deviate from its steady state as adjustment to equilibrium takes place. This leads to the introduction of a lag on employment into the employment function, a longer lag structure may also be necessary if serially correlated technology shocks are present (Greenaway, Hine, and Wright 1999).

Lags may also be introduced into the labor demand function once bargaining considerations are taken into account such as sequences of bargains or expectations formation about future wage and output levels. Specifying the dynamics in terms of lags of the dependent variable implicitly imposes a common evolution for employment following a change in an explanatory variable, this restriction may be relaxed by additionally introducing a distributed lag structure for the independent variables (Greenaway, Hine, and Wright 1999).

Movements in the exchange rate change the relative prices of domestic goods, exports and imports, and with these changes in prices there is a new allocation of resources depending on the degree of persistence of the variability of the exchange rate. Lastrapes and Koray (1990) studied the relationship between exchange rate volatility and real activity denoted by output; using a VAR model, it was determined that the relationship is weak. Exchange rate volatility is not Granger-independent of the variables in the system, and the state of the economy strongly effects

volatility (Lastrapes and Koray 1990); so, exchange rate variability is a signal of the overall health of the state of the economy.

By using the same measures of exchange rate volatility, Koray and Lastrapes (1989) established that it does not affect trade flows; but permanent shocks decrease imports, even more on flexible regimes compared to fixed exchange. These results are aligned with those of Campa and Goldberg (2001), who found that transitory exchange rate movements have statistically significant greater effects on overtime hours worked and overtime wages.

Some industry features that are strongly correlated with the relative importance of exchange rates for labor markets include the industry competitive structure, the skill level of an industry's labor force, and various forms of trade orientation (Campa and Goldberg 2001). They state that labor demand is less responsive to exchange rates when production is labor intensive, it has higher import penetration and when export orientation raises the sensitivity of labor demand to exchange rates; they also mentioned that depreciation of the exchange rate causes labor demand to decrease when the industry relies on imported inputs due to higher production costs in domestic currency.

From a Keynesian perspective, it is well known that there is a positive relationship between depreciation and exports. Given other determinants of aggregate demand, a depreciated RER leads to higher net exports and consequently, higher demand on domestic activities and higher levels of output and employment (Frenkel and Ros 2006).

Consequently, exports have a positive effect on the employment level and economic growth. Fu and Balasubramanyam (2005), for the case of China over the time period 1987–1998 in 29 provinces, found that foreign direct investments and exports provided an effective demand not

only for the surplus capacity of their capital stock but also for the surplus of labor. As a result, a depreciated exchange rate not only stimulates exports but also FDI. In the case of the United States, Blecker (2007) found empirical evidence that there is a significant negative effect of real dollar appreciation on aggregate investment in the US manufacturing industry, the effect is transmitted through liquidity rather than changes in the desired capital stock by firms.

In the case of Vietnam, Xuan and Xing (2008) found that exports are influenced by not only the exchange rate but also by foreign direct investment. The FDI export elasticity was 0.13 while exchange rate export elasticity was 0.47, implying that depreciation of the exchange rate stimulated exports. The drawback of the research is that FDI was measured by approved FDI rather than FDI stocks. So, financial market activity plays a role in the determination of exchange rate, see Vargas-Silva (2009).

FDI stimulates growth in exports depending on foreign aggregate demand. The increased demand of labor by FDI and the added value of exports by domestic and foreign firms will depend on the share of inputs that are imported in the production process. Arndt (2006) refers to this as production sharing; therefore, production sharing affects the trade balance due to fluctuations in the exchange rate. But, the effects will depend on the mobility of capital and labor, the degree of price rigidity and the level of unionization in the labor market.

According to previous research, industries with high (low) openness are likely to show positive (negative) response in employment demand due to a depreciation of exchange rates. Industries with low (high) imported input ratio are likely to respond positively (negatively) in employment to exchange rate shocks relative to industries with high (low) imported input ratio (Kim 2005).

Kim analyzed the relationship between exchange rate and employment for Korea in 28 industries.

For Korea, based on actual exchange rates, the average elasticity of employment to the depreciation of exchange rates is 0.09, with a standard deviation of 0.55. This estimate is not statistically significant. But the results based on permanent exchange rates, the average elasticity is 0.61, with a standard deviation of 2.68 (Kim 2005).

Klein and Triest (2000) based on panel data of the US labor data (annual (1973-1993)) at the 4-digit industry level, found that one percent appreciation of the exchange rate gives rise to 0.48 percentage point decrease in net employment, and a one percent depreciation increases net employment by 0.048 percentage point (cited by Kim 2005)

Movements in real exchange rates cause adjustment of labor demand due to the effect on profits, especially to those firms with high share revenue from exports or costs of imported production inputs; consequently, changing relative prices produces job creation and job destruction, see for example Hua (2007), Klein, Schuh, and Triest (2003), Frenkel and Ros (2006) and Ngandu (2008).

Klein, Schuh, and Triest (2003) implemented an economic model of gross job creation and losses applied to detailed U.S. manufacturing industries between 1973 and 1993 to elucidate the effects of real exchange rates (trend and cycle) on labor reallocation. He found that real exchange rates affected significantly job reallocation but not net employment; the cyclical component of the real exchange rates affected only net employment through job losses.

Movements in bilateral real exchange rates generate a wide range of responses within traded-goods industries because trade patterns differ markedly across industries (Klein, Schuh, and

Triest 2003). A study by Frenkel and Ros (2006) states that an increase in the labor intensity of traded goods due to an increase in the real exchange rate occurred through either the adoption of more labor-intensive techniques or the reallocation of labor and investments toward labor intensive tradable goods.

On average in four countries (Argentina, Brazil, Chile, and Mexico), a 10% appreciation (depreciation) of the RER is associated with a 5.6% increase (fall) in the unemployment rate two years later; a 10% increase in GDP is associated with a 14.9% unemployment rate decrease (Frenkel and Ros 2006).

Using a computable general equilibrium (CGE) model, Ngandu (2008) studied the relationship of exchange rate and employment in South Africa. Forty three aggregated sectors were analyzed. The response of employment to exchange rate shocks was significant, and varied depending upon the level of openness of the industry. Ngandu made a thorough analysis of the channels of transmission of exchange rate to employment demand by including developmental macroeconomic, factor intensity, external orientation, export orientation, imported input and import penetration, market structure, trade liberalization, and openness.

Existing models neglect the role of key elements that characterize changes in the RER of less developed economies, in particular foreign aid flows, export taxes, workers' remittances, concentration of exports on natural resources and, more importantly labor market characteristics such as persistent unemployment (Soto 2008). From a panel study of Italian firms, Nucci and Pozzolo (2008) determined that the number of jobs and worked hours are responsive to sales and imported inputs, wages are affected by the real exchange rates and they decline more when the firms' sector has lower monopoly power and higher foreign competition.

Theoretical Model

The employment demand function was derived from a Cobb-Douglas production function, where Q is real output, K is capital stock, N is labor input used; see equation 1. The coefficients α and β represent factor share coefficients and γ allows for efficiency growth in the use of labor in the production process. This specification has been used by Greenaway, Hine, and Wright 1999; Hua 2007; Fu and Balasubramanyam 2005.

$$Q = A^\gamma K^\alpha N^\beta \quad (1)$$

By assuming that economic agents are profit-maximizing, the marginal product of labor equals the wage (w) and the marginal product of capital equals its user cost (c);

$$\frac{\partial Q}{\partial N} = \beta A^\gamma K^\alpha N^{\beta-1} = MPL \quad (2)$$

$$\frac{\partial Q}{\partial K} = \alpha A^\gamma K^{\alpha-1} N^\beta = MPK \quad (3)$$

thus,

$$\beta A^\gamma K^\alpha N^{\beta-1} = w \quad (4)$$

$$\alpha A^\gamma K^{\alpha-1} N^\beta = c \quad (5)$$

rearranging equations (4) and (5) for K^α and $K^{\alpha-1}$ we get

$$K^\alpha = \frac{w}{\beta A^\gamma N^{\beta-1}} \quad (6)$$

$$K^{\alpha-1} = \frac{c}{\alpha A^\gamma N^\beta} \quad (7)$$

and given that $\frac{K^\alpha}{K} = K^{\alpha-1}$ we get

$$\frac{\frac{w}{\beta A^\gamma N^{\beta-1}}}{\frac{K}{1}} = \frac{w}{K \beta A^\gamma N^{\beta-1}} \quad (8)$$

$$\frac{w}{K \beta A^\gamma N^{\beta-1}} = \frac{c}{\alpha A^\gamma N^\beta} \quad (9)$$

thus,

$$K = \frac{w \alpha N}{c \beta} \quad (10)$$

and replacing K in equation (1) we get

$$Q = A^\gamma \left[\frac{w \alpha N}{c \beta} \right]^\alpha N^\beta \quad (11)$$

Applying logarithms and solving for N, the labor demand equation is derived as follow

$$N = \phi_0 + \phi_1 \ln Q + \phi_2 \left(\frac{c}{w} \right) \quad (12)$$

where $\phi_0 = \frac{-\gamma \ln A}{\alpha + \beta}$, $\phi_1 = -\frac{1}{\alpha + \beta}$, and $\phi_2 = \frac{\alpha}{\alpha + \beta}$. We assume that the efficiency parameter A is

affected by government debt (debt), so that $A = e^{\phi_3 T} Debt^{\phi_4} ER^{\phi_5}$ and the extended labor demand function is obtained as

$$N = \phi_0 + \phi_1 \ln Q + \phi_2 \left(\frac{c}{w} \right) + \phi_3 T + \phi_4 \ln Debt + \phi_5 \ln ER \quad (13)$$

Econometric Methods

The relationship between exchange rate and employment was investigated in the United States using a dynamic specification. GDP was used as a proxy measure for capital, refer to Frenkel and Ros (2006). According to the economic model GDP per unit of labor force used in the economy would measure substitution between labor and capital, because of colinearity in the estimation of the rank of the VECM model, the variable was dropped. Thus, the model is estimated in logarithms using employment, GDP, debt and a measure of the exchange rate.

The econometric model is specified in vector error correction form (VECM) due to integration of the variables and common trends found in the data. Thus,

$$\Delta \mathbf{y}_t = \boldsymbol{\alpha} (\boldsymbol{\beta} \mathbf{y}_{t-1} + \boldsymbol{\mu} + \boldsymbol{\rho} t) + \sum_{j=1}^{p-1} \boldsymbol{\Pi}_j \Delta \mathbf{y}_{t-j} + \boldsymbol{\gamma} + \boldsymbol{\tau} t + \mathbf{u}_t \quad (14)$$

where $\boldsymbol{\rho}$ and $\boldsymbol{\tau}$ are assumed to be zero, so that there is a trend in the undifferenced data and the cointegration equation is stationarity around a non zero mean³, see Enders (2004). The error term \mathbf{u} is assumed to be Gaussian with the usual properties. The parameters $\boldsymbol{\alpha}$ and $\boldsymbol{\beta}$ correspond to the error correction terms and the long run estimates from the cointegration equation.

In order to implement cointegration tests, the variables have to be integrated of order one, i.e. I(1); this research project used the ADF, ADF GLS, KPSS and the Phillips and Perron tests implemented in Stata. Lag selection for the cointegration tests and the estimation of the VECM model used LR tests, accompanied by other information criteria² such as AIC, BIC, HQ, and those suggested by Lütkepohl (2005). Cointegration was found using three lags, the cointegration rank was found to be 1 at 5% level of significance, determined by the trace² and the maximum eigenvalue statistic².

³ Stata manual

Data

A VECM model was estimated in logarithms with the following variables: employment (labor), deflated gross domestic product (gdp), deflated debt (debt), and the measure for exchange rate was the trade weighted average of major currencies (ertwi); see summary statistics in Table 1. The deflated variables used the GDP deflator (2000=100); the index for measuring the real exchange rate used 1973 prices as the benchmark for comparisons across years; an appreciation (depreciation) of the US dollar is captured by an increase (decrease) of the index.

The data were obtained from the World Economic Outlook Database (IMF) with the exception of the exchange rate which was obtained from the Federal Reserve Bank of St. Louis. Employment is measured in millions of persons, GDP and debt is measured in billions of US dollars.

Table 1 Summary Statistics of annual observations in the period 1980 – 2008.

Variable	Observations	Mean	Std. Dev.	Min	Max
labor	29	123.37	15.08	99.30	147.34
gdp	29	8143.65	2083.02	5161.68	11627.03
debt	29	4843.10	1523.30	2063.73	7353.83
ertwi	29	96.75	14.38	74.41	133.59

In the period we obtained 29 observations with labor and exchange rate having a coefficient of variation of 12.12% and 14.86%; while GDP and debt 25.58% and 31.45% respectively. Graphical inspection of the data suggests clear trends on all variables except exchange rate; most tests for unit roots fail to reject nonstationary in levels, suggesting that the variables were stationary in first differences (tests corroborated it). Cointegration was found for the variables using the Johansen test, according to the test, the rank of the VECM model is at most 1.

Results

The long run relationship between employment, GDP, debt and the weighted exchange rate index for one cointegrating vector for the United States in the period 1980-2008 is displayed below (standard errors are displayed in parenthesis).

$$\text{Labor} = -0.392\text{GDP} - 0.0422 \text{ Debt} - 0.0148825 \text{ ERTWI} \quad (15)$$

$(.0130) \quad (.0144) \quad (-.0149)$

All the coefficients were significant with the exception for the exchange rate variable at 5% level of significance. According to the theory, appreciations of the exchange rate are related to increasing unemployment, thus, the estimated model was able to produce a consistent result. According to Søren (2005) when the variables are in logarithms and one cointegrating vector is estimated, the coefficients can be interpreted as long run elasticities. Thus, 1% appreciation of the US dollar is likely to reduce employment by 0.015%, but this estimate was insignificant.

Contrary to what is commonly believed; in the long run, debt was found to be detrimental to employment demand. For 1% increase in debt, employment is reduced by 0.042%, this coefficient was significant at 1% level of significance. Just as debt, GDP was also found to be detrimental to employment, despite the fact that overtime income and employment has increased in the United States; this is possibly due to job outsourcing and technological growth that reduces labor demand.

VECM models are able to compute long and short term effects. In the estimated system, the error correction terms capture how a variable reacts when there is not equilibrium. For the estimated system, it was found that in conditions of disequilibrium GDP, employment, and the value of the exchange rate index tend to decrease (depreciation of the US dollar) while debt tends to increase.

The estimated error correction terms were -1.199848, -1.582696, 1.09902 and -2.024661 for employment, GDP, debt and the trade weighted exchange rate index respectively.

In order to detect short term effects, the significance of the lags of the differenced data were evaluated by Wald tests. Debt was found to be a significant factor in the determination of employment at the 5% level of significance. GDP and exchange rate were found to have a significant effect on employment only at 7% level of significance. Separately, the lags of the variables including the error correction term were found jointly significant at 1%; implying that there are significant effects of GDP, debt and exchange rate in the level of employment.

Orthogonalized impulse response functions (OIRF) are used in order to see the dynamic effects of shocks of one variable to the other variables in the system. In particular, we are interested to see the effects of shocks to debt and exchange rate on employment. The graphical representation of the OIRFs represent the response overtime of variables in the system to one standard deviation shock.

When the system is not in equilibrium debt tends to increase according to the error correction term which was not significant; the cointegration equation (15) shows that in the long run, debt is detrimental to employment. Figure 4 displays shocks to debt on GDP, employment and exchange rate. It can be seen that up to year 4, shocks to debt have a negative effect on employment; it is not until year five that the shock of debt to labor becomes permanently positive.

The response of employment to currency shocks are displayed in Figure 3, the immediate response is positive until period 5, hereafter the effect declines in the positive side until period 8, thereafter increases, and after period 10 the effect is permanently positive.

In the long run, according to the cointegrating equation (15), GDP had a significant negative effect on employment. In the short run, GDP had a significant effect on employment at the 10% level of significance. According to Figure 5, shocks to GDP tend to have an immediate increase in labor demand, which tends to decrease from year four to ten; and the effect becomes permanent after that. In addition, shocks to GDP tend to appreciate the US currency and the effect becomes permanent after year 10.

Shocks to debt causes the US dollar to depreciate, the effect is not transitory; and contrary to what is expected, shocks of debt on GDP causes a permanent negative effect. This result is curious because the US Government is likely to increase debt in periods of recession, when GDP is not reaching its potential or GDP is decreasing (Figure 4); in the same figure, it can be seen that shocks to debt causes reduction in GDP, this finding is in accordance with growth theory principles which states that government involvement in the economy is detrimental to productivity. In Figure 6, it can be seen that increasing shocks to employment causes permanent reduction of debt and permanent appreciation of the US dollar.

Conclusion

In the long run, appreciation of the dollar tends to decrease employment in the US economy. Contrary to what most US policy makers believe that debt creates employment; it is concluded that in the short run increasing public debt is detrimental to employment, the positive effect is only seen after the fourth year, after that, permanent positive effects are observed. Due to limitations with the degrees of freedom; the significance of the OIRFs far away into the future does not make sense. Future research to be endeavor by the author is to understand the effects of public debt under different political regimes, due to differences on policies that generate employment by the political parties in the United States.

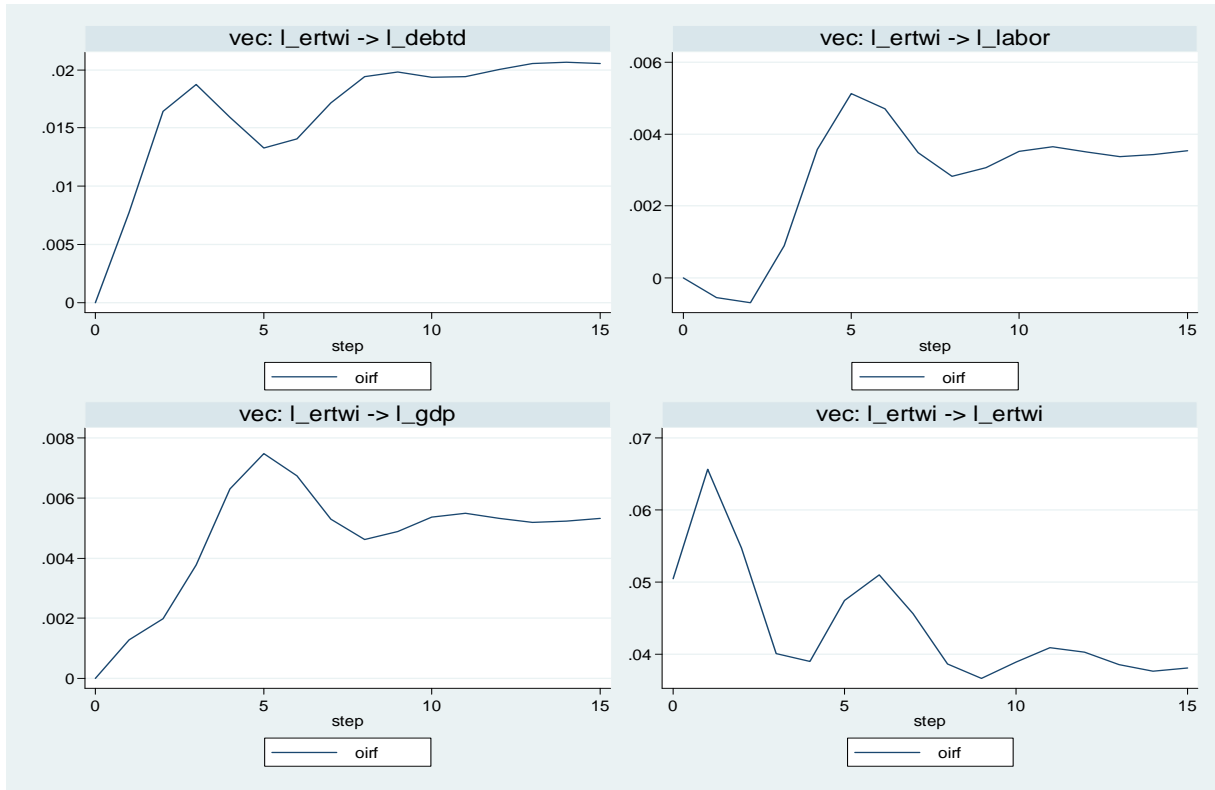


Figure 3 Response of Debt, Employment, GDP and Exchange Rate to shocks in Exchange Rate.

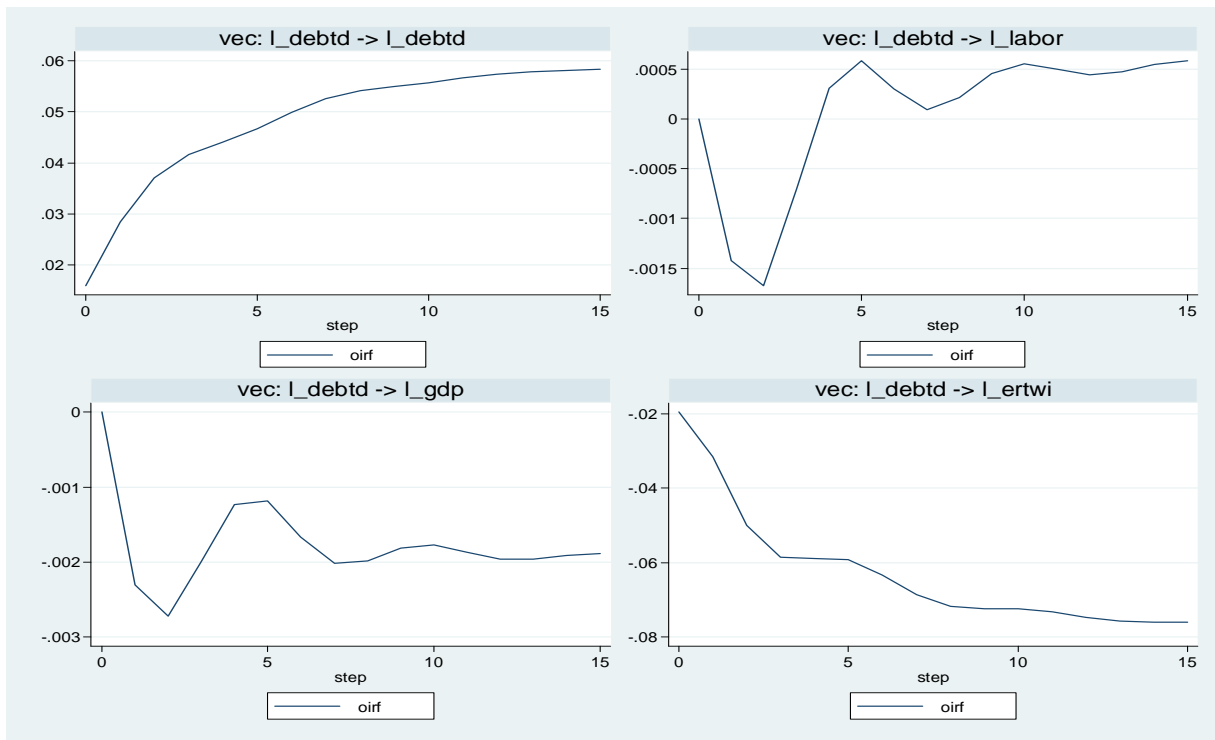


Figure 4 Response of Debt, Employment, GDP and Exchange Rate to shocks in Debt.

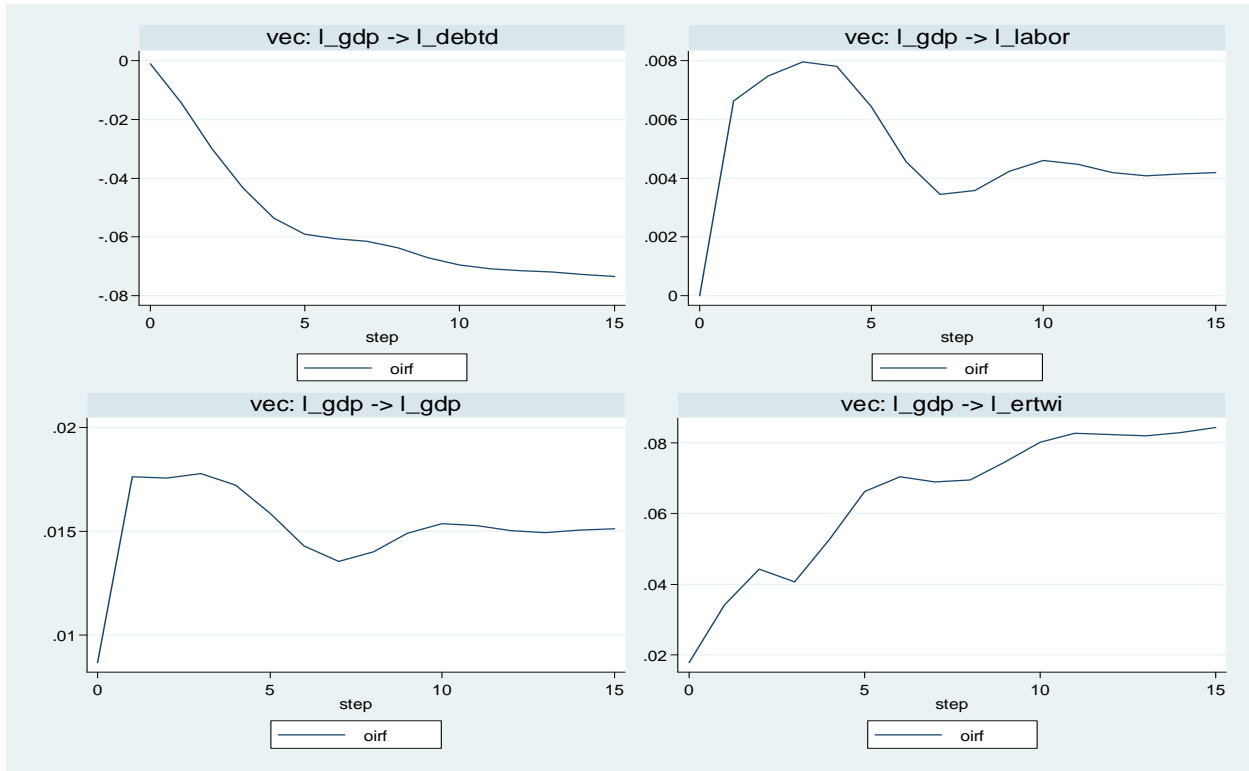


Figure 5 Response of Debt, Employment, GDP and Exchange Rate to shocks in GDP.

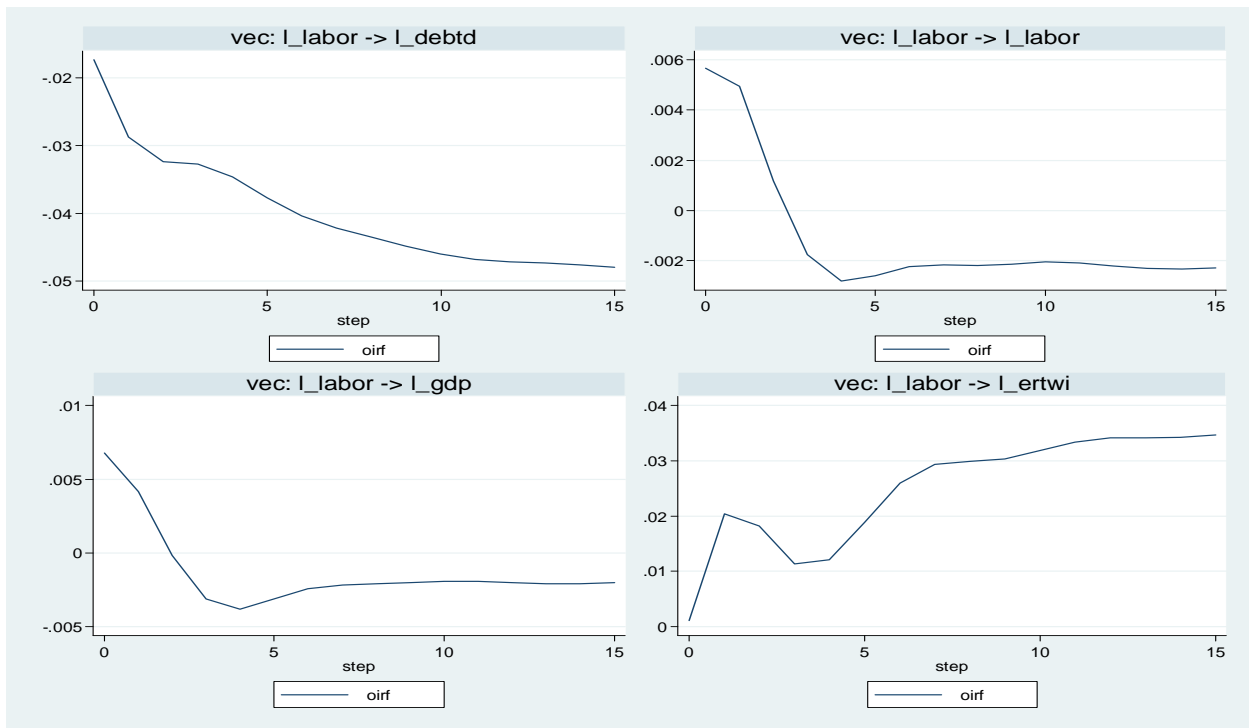


Figure 6 Response of Debt, Employment, GDP and Exchange Rate to shocks in Employment.

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Appendix: First Log Differences of the Variables

