EFFECTS OF EXCHANGE RATE MOVEMENTS ON AGGREGATE OUTPUT IN PERU

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ABSTRACT

Using a quarterly sample during 1997.Q1-2017.Q1, this paper finds that real depreciation raised aggregate output during 1997.Q1-2005.Q3 whereas real appreciation increased aggregate output during 2005.Q4-2017.Q1. In addition, a higher government debt-to-GDP ratio, a lower U.S. real lending rate, a higher real stock market index, a lower real oil price and a lower expected inflation rate would increase aggregate output. Hence, the conventional wisdom of pursuing real depreciation to stimulate exports and aggregate output did not apply to Peru during 2005. Q4-2017. Q1. **JEL Classification:** F41, E62

INTRODUCTION

Peru's economy showed both progress and concerns in recent years. According to the International Monetary Fund, Peru registered a 3.5% growth rate of real GDP in 2017. Even during the global financial crisis, it still recorded a positive growth rate of 1.049% in 2009. Peru pursued a relatively prudent fiscal policy as evidenced by a net borrowing of 2.162% of GDP and a relatively low government debt-to-GDP ratio of 25.932% in 2017, which was much lower than the 60% threshold of the European Union.

Recently, the Peruvian sol depreciated 26.46% against the U.S. dollar from 2.57 in 2013.Q1 to 3.25 in 2017.Q4. Whether depreciation or appreciation of the Peruvian sol would help or hurt aggregate output is the main focus of the paper. Its unemployment rate of 6.71% in 2017 was higher than the U.S. unemployment rate of 4.1%, suggesting that the labor market was somewhat slack. Peru went through hyperinflation during 1983-1985 and 1988-1991 mainly because of the external debt crisis and mismanagement of macroeconomic policy. However, inflation rates have been below 4% since 2009, suggesting that monetary policy has been relatively effective in containing inflation. The prime lending rate of 16.5% as of December 2017 suggests that getting loans from banks was relatively expensive and that consumers and businesses were discouraged from borrowing. Mainly due to trade deficits, Peru has continued to experience current account deficits, reaching 1.852% of GDP in 2017,

though it has improved from 4.449% in 2013.

In comparison, in 2017, Peru's growth rate of real GDP was higher than those in Argentina, Brazil, Chile, Colombia and Mexico; Peru's unemployment rate was lower than those in Argentina, Brazil, Chile and Colombia and slightly higher than that in Mexico; Peru's inflation rate was lower than those in Argentina, Brazil, Colombia and Mexico and slightly higher than that in Chile; and Peru's government debt-to-GDP ratio was lower than those in Argentina, Brazil, Chile and Mexico and slightly higher than that in Chile.

The purpose of this paper is to focus on the impacts of real depreciation or appreciation of the Peruvian sol on aggregate output. Other relevant global and macroeconomic variables will be incorporated in the model as well. This paper has several different aspects from most previous studies. An extended IS-MP-AS model (Romer, 2000) is employed in formulating the theoretical framework. The incorporation of the monetary policy function (Taylor, 1993, 1999) is appropriate for Peru as it has adopted inflation targeting since 2002. The generalized autoregressive conditional heteroscedasticity (GARCH) model is used in empirical estimation. The sample period covers the latest available data from the International Monetary Fund.

This manuscript is organized into four sections. The first section puts forth a literature review. The second section discusses the theoretical model. The third section presents estimation results. The fourth section provides the conclusion.

LITERATURE REVIEW

There have been several studies of the impact of real depreciation/appreciation on aggregate output or international trade based on samples of developing and developed economies including Peru or related countries.

Using a sample of 42 countries including Peru, Nunnenkamp and Schweickert (1990) reveal that there is no evidence of contractionary impact of exchange rate devaluation and that exchange rate volatility affects output growth negatively.

Based on a sample of 24 developing countries including Peru, Morley (1992) finds that real depreciation is contractionary mainly due to decreased investment spending. Macroeconomic policies play minor roles whereas capacity to import and terms of trade have positive effects.

Working with a sample of 27 countries including eight Latin American countries during 1970-1996, Kamin and Klau (1998) show that empirical results vary with regions and methodologies. When the OLS method with controlled variables is employed, real appreciation has a positive impact on real output in Latin American countries in the short run and no impact on real output in Latin American countries in the long run.

Bahmani-Oskooee and Miteza (2003) survey 33 previous studies and find that the effect of real depreciation or devaluation on aggregate output depends on the country under study, the specification of the theoretical model, and the methodology used in empirical work.

An, Kim and Ren (2014) analyze whether real deprecation would affect output or the current account based on a sample of 16 Latin American, Asian and non-G3 developed countries. After real depreciation, Latin American countries experience output decline but an improvement in the current account. The contractionary effect of

real depreciation could occur in the developing or developed countries.

Kim, An and Kim (2015) study the subject based on a sample of 13 countries including three Latin American countries. According to their findings, the contractionary effect of devaluation tends to occur in developing countries whereas expansionary devaluation is more common in developed countries. After devaluation, change in output is not correlated with change in the current account. Capital inflows tend to increase output in developing countries and do not affect output in developed countries.

Karadam (2015) analyzes the effect of real effective exchange rate on economic growth for 80 countries including Peru. He finds that real depreciation reduces growth in developing countries but has no impact on growth in industrialized countries. In addition, more trade openness and financial development would increase growth whereas government consumption and investment spending may or may not affect economic growth, depending upon which methodologies are employed.

Karadam and Özmen (2016) investigate the impact of exchange rate depreciation on economic growth for 91 advanced and developing countries including Peru during 1980-2014. They reveal that real depreciation is expansionary for advanced countries but contractionary for developing countries with relatively high external debt. A higher degree of trade openness increases the contractionary effect of real depreciation in both advanced and developing economies. Global monetary and financial factors strongly affect economic growth in developing economies.

Bussière, Gaulier and Steingress (2016) study the elasticity of exports and imports with respect to the exchange rate for 51 industrialized and emerging countries including Peru. They indicate that the quantity elasticity of the exchange rate is less than one and that the balance of trade responds to depreciation positively as the export and import prices adjust.

In studying whether we should fear currency depreciation for several selected countries including Peru, Loayza and Mendez-Ramos (2016) maintain that gradual and moderate changes in the real exchange rate would be helpful to an economy. Nonetheless, sharp and large depreciation tends to result in systemic crisis and insolvency and can be avoided by prudent macroeconomic policy and by averting fixed exchange rate systems. It is unrealistic for central banks to intervene to reverse a secular depreciation.

THEORETICAL MODEL

Romer (2000) proposes a macroeconomic model consisting of the IS function, the monetary policy (MP) function, and the aggregate supply (AS) function. Extending his work, we can express the IS-MP-AS model as:

$$GDP = w(GDP, GS, TX, LR(PR), SP, EX) \quad (1)$$
$$PR = x(IF\ --\ IT, GDP\ --\ PGDP, WR, EX) \quad (2)$$
$$IF = y(EI, GDP, --\ PGDP, OP, EX) \quad (3)$$

where

GDP = real GDP in Peru,
GS = government spending,

TX = government tax revenue,
LR = the lending rate,
PR = the real policy rate,
SP = the real stock price,
EX = the real effective exchange rate,
IF = the inflation rate,
IT = the inflation target,
PGDP = potential real GDP,
WR = the world real interest rate,
EI = the expected inflation rate, and
OP = the real oil price.

Suppose that IT and PGDP are constants in the short run. Solving for the three endogenous variables from equations (1), (2) and (3) simultaneously, we can find equilibrium real GDP as:

$$GDP^* = z(GS - TX, EX, WR, SP, OP, EI) \quad (4)$$

where GS – TX stands for government budget deficit. Because people are more concerned about government debt in the long run and because government debt is an accumulation of government budget deficit, GS – TX is replaced with government debt as a percent of GDP (DY).

$$GDP^* = f(EX, DY, WR, SP, OP, EI) \quad (5)$$
$$\quad\quad\quad\quad ?\quad ?\quad --\quad +\quad --\quad --$$

Real depreciation tends to make Peruvian-made goods cheaper, stimulate exports, and shift aggregate demand to the right. On the other hand, real depreciation tends to raise import prices and domestic inflation and shift short-run aggregate supply to the left. Hence, the net impact is unclear and needs to be answered empirically.

Whether more government debt would affect output growth depends on the level of government debt. When the government debt-to-GDP ratio is relatively low, a small increase in government debt to improve infrastructures or to stimulate a sluggish economy may not affect aggregate output adversely. When the government debt-to-GDP ratio is relatively high, a further increase in government debt may be unsustainable, raise the real interest rate, cause private spending to decline, and reduce output growth. Barro (1974, 1989) argues that debt-financed government spending has a neutral effect in the long run as households would save more and reduce consumption spending in anticipation of more future tax increases. Based on a sample of 44 advanced and developing countries including Peru, Reinhart and Rogoff (2010) present several major findings: The relationship between economic growth and the government debt/GDP ratio is weak if it is below the 90% threshold; if the government debt-to-GDP ratio is greater than 90%, the medium growth rate of real GDP would decline by 1%; and if the external debt/GDP ratio in developing countries is greater than 60%, the growth rate would fall by 2%.

The Central Reserve Bank of Peru is likely to respond to a change in the world real interest rate in the same direction in order to attract foreign investors and avoid capital outflows. Therefore, a higher world real interest rate tends to cause the Peruvian

policy rate and the lending rate to rise, reduce private spending, and shift aggregate demand to the left.

A higher stock price tends to increase household financial wealth, raise consumption and residential expenditures, and shift aggregate demand to the right through the wealth effect and the household liquidity effect (Mishkin, 2013). Furthermore, a higher stock price is likely to stimulate business investment spending through Tobin's q theory and the balance sheet channel (Mishkin, 2013). A higher real oil price would shift short-run aggregate supply to the left, raise the inflation rate, and reduce real GDP.

Figure 1 shows that real GDP and the real effective exchange rate seemed to exhibit a nonlinear relationship with a simple correlation coefficient of -0.3480 at the 5% significance level during 1997.Q1-2005.Q3 and a simple correlation coefficient of 0.7880 at the 1% significance level during 2005.Q4-2017.Q1. Figure 2 indicates that real GDP and the government debt-to-GDP ratio seemed to have a positive relationship during the sample period. An analysis of the data for real GDP reveals that there were some seasonal patterns.

Hence, an interactive binary variable for the real effective exchange rate (EX × B), an intercept binary variable (B), and three seasonal binary variables (S2, S3 and S4) are added to the estimated equation:

$$GDP^* = g(EX, EX\,x\,B, B, DY, WR, SP, OP, EI, S2, S3, S4) \qquad (6)$$

ESTIMATION RESULTS

The data were obtained from the St. Louis Federal Reserve Bank and International Financial Statistics, which is published by the International Monetary Fund. Real GDP is measured in million soles. The real effective exchange rate is a trade-weighted index, and an increase means real appreciation of the Peruvian sol. The world real interest rate is represented by the real prime lending rate in the U.S. The real stock price is represented by the equity index adjusted by the consumer price index. The nominal oil price per barrel is converted into the Peruvian sol and adjusted by the consumer price index to get the real value. The weighted inflation rate of the past four quarters is used as a proxy for the expected inflation rate. The weights are 0.4, 0.3, 0.2 and 0.1 for the respective quarters in t-1, t-2, t-3 and t-4. The sample ranges from 1997.Q1 to 2017.Q1. The data for government debt are unavailable before 1997.Q1, and the data for real GDP are unavailable after 2017.Q1.

Empirical results are presented in Table 1. As shown, 96.24% of the variation in real GDP can be explained by the eleven independent variables. All the independent variables are significant at the 1% level. Real GDP is positively affected by the real effective exchange rate during 2005.Q4-2017.Q1, the government debt-to-GDP ratio, the real stock price and the three seasonal variables, and it is negatively influenced by the real effective exchange rate during 1997.Q1-2005.Q3, the intercept binary variable, the U.S. real lending rate, the real oil price and the expected inflation rate.

Specifically, a 1% real appreciation of the Peruvian sol resulted in a 0.5638% decline in real GDP during 1997.Q1-2017.Q1 whereas a 1% real appreciation of the Peruvian sol caused real GDP to rise 1.7479% during 2005.Q1-2017.Q1. These results suggest that real depreciation would raise real GDP during 1997.Q1-2005.

Q3 whereas real appreciation would increase real GDP during 2005.Q4-2017.Q1. If the government debt-to-GDP ratio rises 1%, real GDP would increase 0.5136%. The negative significant coefficient of the U.S. real prime lending rate implies that U.S. monetary policy influences Peru's monetary policy in the determination of the policy rate. The positive significant coefficient of the real stock price indicates that the wealth effect, the household liquidity effect, Tobin's q-theory or the balance sheet channel is expected to work. The negative significant coefficient of the real oil price shows that the negative supply shock of a higher real energy cost tends to shift short-run aggregate supply to the left, raise the inflation rate, and reduce aggregate output. The positive significant sign of the three seasonal binary variables suggests that aggregate economic activities pick up after the first quarter.

In comparison, our findings during 1997.Q1-2005.Q3 are in contrast with the results found by Morley (1992), Kamin and Klau (1998), An, Kim and Ren (2014), Kim, An and Kim (2015), Karadam (2015) and Karadam and Özmen (2016) whereas our findings during 2005.Q4-2017.Q1 are generally consistent with the results reported by these studies.

CONCLUSION

This paper has focused on the impacts of real appreciation/depreciation on aggregate output in Peru. Other relevant global and macroeconomic variables are considered as well. The well-known IS-MP-AS model is extended and applied. Real depreciation raised aggregate output during 1997.Q1-2005.Q3 whereas real appreciation helped increase aggregate output during 2005.Q4-2017.Q1. In addition, a higher government debt-to-GDP ratio, a lower U.S. real prime lending rate, a higher real stock price, a lower real oil price, and a lower expected inflation rate would raise aggregate output. The results for the real effective exchange rate imply that positive impacts of real appreciation such as lower import prices and domestic inflation and net capital inflows overwhelmed negative impacts such as less exports during 2005. Q4-2017.Q1.

In view of these results, the exchange rate policy may need to be reviewed periodically in order to determine whether real depreciation or real appreciation may be beneficial to aggregate output. Although the government debt-to-GDP ratio has a positive impact on aggregate output, fiscal prudence may need to be exercised as more government debt after a certain threshold may begin to cause negative impacts such as a higher real interest rate, less government services, declining consumption and investment spending, etc. The Peruvian economy is linked to the global economy as the world real interest rate and the real oil price are determined outside of Peru. Hence, Peru's government may need to monitor these global factors to determine whether any change may affect its aggregate output.

The paper has some limitations. The Central Reserve Bank of Peru may use other monetary policy tools such as the money supply in affecting economic activities. The exchange rate is an exogenous variable in this paper, and it may be treated as an endogenous variable. An extension of the paper is to apply the AD/AS model in examining real GDP for Peru. The conventional IS/LM model may be considered as well.

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FIGURE 1: SCATTER DIAGRAM BETWEEN REAL GDP (GDP) AND THE REAL EFFECTIVE EXCHANGE RATE (EX)

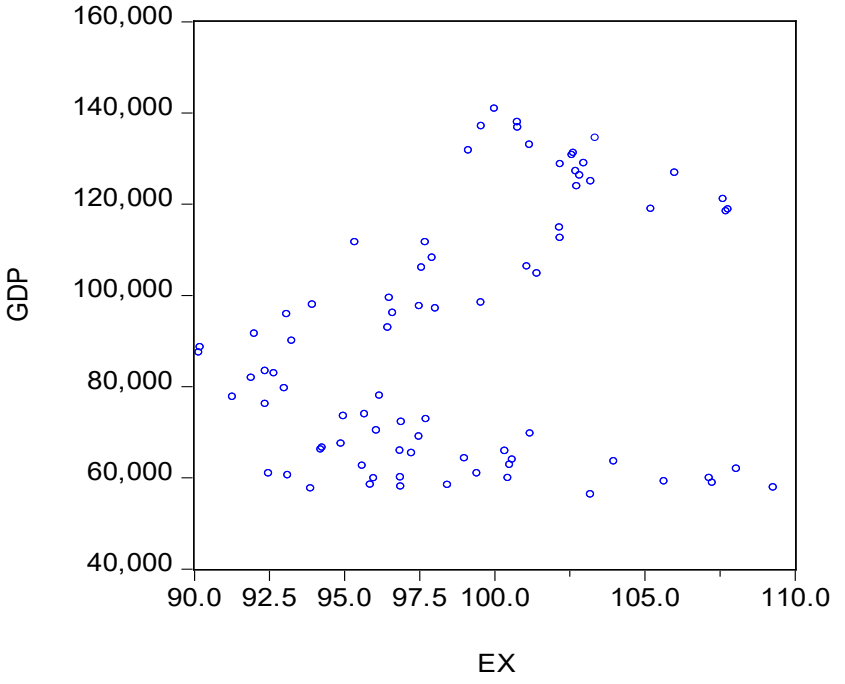

FIGURE 2: SCATTER DIAGRAM BETWEEN REAL GDP (GDP) AND THE GOVERNMENT DEBT-TO-GDP RATIO (DY)

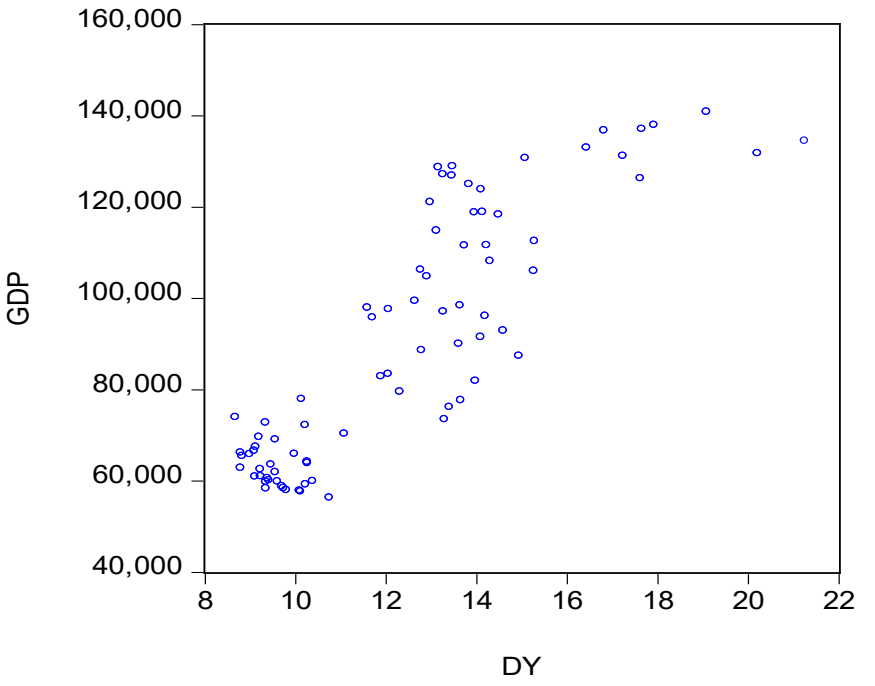

TABLE 1: ESTIMATED REGRESSION OF LOG(REAL GDP) IN PERU

Variable	Coefficient	z-Statistic	Probability
Constant	12.63668	862.6475	0.0000
Log(real effective exchange rate)	-0.563804	-799.0644	0.0000
Log(real effective exchange rate) x Binary variable	2.311670	123.2992	0.0000
Binary variable	-10.42405	-141.0028	0.0000
Log(government debt-to-GDP ratio)	0.513641	134.7664	0.0000
U.S. real prime lending rate	-0.022744	-12.33408	0.0000
Log(real stock market index)	0.053361	5.926871	0.0000
Log(real oil price)	-0.051018	-6.769835	0.0000
Expected inflation rate	-0.004718	-3.045966	0.0023
Second quarter	0.118174	16.40394	0.0000
Third quarter	0.067429	8.457920	0.0000
Fourth quarter	0.078474	11.40789	0.0000
R-squared	0.962435		
Log likelihood	138.5654		
Akaike information criterion	-3.075689		
Schwarz criterion	-2.661833		
Sample period	1997.Q1-2017.Q1		
Methodology	GARCH		
Number of Observations	81		

Notes: Binary variable = 0 during 1997.Q1-2005.Q3 and = 1 during 2005.Q4-2017.Q1.