Is Exchange Rate Variability Fueling Inflation and Reducing Growth? Evidence from Developing Countries

M. Kandil[1]
International Monetary Fund, Washington D.C.

Abstract
Purpose - The paper examines the asymmetric effects of exchange rate fluctuations on real output and price in developing countries.
Design/methodology/approach - Unanticipated currency fluctuations determine aggregate demand through exports, imports, and the demand for domestic currency and determine aggregate supply through the cost of imported intermediate goods.
Findings - The evidence indicates that the supply channel leads to output contraction and price inflation in the face of unanticipated currency depreciation. In contrast, the reduction in net exports determines output contraction and reduces price inflation in the face of unanticipated currency appreciation.
Implications - Given asymmetry, an increase in price inflation relative to deflation, correlates with an increase in output contraction relative to expansion across countries. Demand expansion in the face of currency depreciation correlates with an increase in price inflation and a reduction in output growth. Demand contraction in the face of currency appreciation correlates with a reduction in output growth and price inflation.
Originality/value - The variability of the exchange rate significantly reduces trend output growth and increases the trend and variability of price inflation across countries.

Keywords exchange rate fluctuations, inflationary and contractionary biases, developing countries

Introduction

Recent developments in the world economy have drawn attention to the appropriate exchange rate policy in developing countries. Many of these countries have opted to peg their domestic currency exchange rate to the US dollar to hedge against inflationary pressure in light of their exposure to external shocks and lack of monetary instruments for liquidity management. Faced with frequent variability, many developing countries have reconsidered revising their exchange rate policy to establish a weighted scheme for the peg, reflecting major shares of significant trading partners.

The analysis of this paper evaluates the pros and cons of fluctuations in the real effective exchange rate on determinants of macroeconomic performance, trends and variability of key economic indicators, in a sample of developing countries. A depreciation of the domestic currency increases the price of imports and boosts competitiveness. The net effect on the trade balance will depend on the elasticity of imports and exports with respect to changes in the exchange rate (see, e.g., Guitian (1976) and Dornbusch (1988)).

The traditional view has emphasized the expansionary effect of currency depreciation (see, e.g., Meade (1951)). The Marshall-Lerner condition states that devaluation will improve

[1] Currently, is a Senior Economist at the IMF. Previously, she held the position of the Executive Director and Director of Research of the Egyptian Center for Economic Studies (ECES).

the trade balance if the devaluing nation's demand elasticity for imports plus the foreign demand elasticity for the nation's exports exceed one. If the Marshall-Lerner condition is not satisfied, currency depreciation could produce contraction (see Hirschman (1949)). Hence, currency depreciation from an initial trade deficit could lead to further deterioration by reducing aggregate demand and, therefore, real national income. If trade is in balance and terms of trade are not changed these price changes offset each other (see Cooper (1971)).

Other studies have illustrated alternative channels for contraction following currency devaluation. By increasing relative competitiveness, depreciation my raise the windfall profits in export and import-competing industries. If money wages lag the price increase and if the marginal propensity to save from profits is higher than from wages, national savings would go up and real output would decrease (for illustration, see, e.g., Krugman and Taylor (1978) and Barbone and Rivera-Batiz (1987)).

Through the supply side channel, depreciation may result in higher cost of intermediate goods for production in developing countries (see, e.g., Bruno (1979) and van Wijnbergen (1989)). Domestic substitutes for imported production inputs, particularly capital goods, are not readily available in many developing countries. As a result, the output supply may shrink on account of a higher cost of imported inputs. The net result on real output and price will depend on the magnitudes by which the demand and supply curves shift following devaluation (for details, see Gylfason and Schmid (1983) and Lizondo and Montiel (1989)).[2]

Dorn and Egger (2011) provide evidence of heterogeneous treatment effects on trade from switching among three types of de-facto exchange rate regimes: freely floating, currency bands and pegs or currency unions. They conclude that risk-averse policy makers would not find any type of exchange rate regime, state, or transition desirable.

Crucini and Telmer (2012) provide three sets of variance decompositions on microeconomic international relative price data. Their results refute the popular notion that nominal exchange rate "noise" distorts the international flow of goods and capital. They affirm that nominal exchange rates seem disconnected in many ways from macroeconomic fundamentals.[3]

Choudhri and Hakura (2012) show that in the presence of significant wage-price stickiness, short-run changes in the exchange rate and trade prices are determined largely by current innovations to shocks. Accordingly, such shocks account for the pattern of pass-through elasticities from import and export prices and the observed exchange rate and inflation variability.

McGettigan et al. (2013) study the impact of the exchange rate system on the stance of monetary policy and its effectiveness. The study concludes that only deep financial markets allow emerging markets with flexible exchange rates to run countercyclical policies.

[2]Hanson (1983) provides theoretical evidence that the effect of currency depreciation on output depends on the assumptions regarding the labor market. Solimano (1986) studies the effect of devaluation by focusing on the structure of the trade sector. Agenor (1991) introduces a theoretical model for a small open economy and distinguishes between anticipated and unanticipated movement in the exchange rate. Examples of empirical investigations include Edwards (1986), Gylfason and Radetzki (1991), Roger and Wang (1995), Hoffmaister and Vegh (1996), Bahmani (1998), and Kamin and Rogers (2000).

[3]Other channels could be relevant to the impact of exchange rate movements on economic activity. Recently, a growing body of literature has focused on the financial channels of exchange rate volatility, specifically the balance sheet effects (see, e.g., Bleakey and Cowan (2002), Crespedes, Chang and Velasco (2004), Galindo, Panizza and Schiantarelli (2003), Berganza and Garcia-Herrero (2004), Gertler, Gilchrist and Natalucci (2003), and Galindo, Izquierdo and Mantero (2007). When a significant portion of debt is dominated in foreign currency, depreciation can lead to a larger financial burden, posing two problems: (i) higher debt services and liquidity shortfall, and (ii) a net worth reduction due to currency mismatch (see, e.g., Gertler, Gilchrist and Natalucci (2001)). Due to data constraints, exploring these channels was not feasible in the context of this investigation.

This investigation studies the effects of demand and supply channels on the response of output and price to positive and negative exchange rate shocks. The investigation will focus on the implications of the asymmetric effects of exchange rate fluctuations on indicators of macroeconomic performance, namely trends of output growth and price inflation.

The remainder of the paper is organized as follows. Section II presents the theoretical implications. Section III outlines the empirical models. Section IV presents empirical results. Section V discusses the implications. The summary and conclusion are presented in Section VI.

Theoretical Background

Supply and demand channels may establish determinants of asymmetry in the effects of unanticipated currency appreciation and depreciation on real output and price.[4] The complexity of demand and supply channels may determine asymmetry in the face of exchange rate fluctuations as follows:

1. In the goods market, a positive shock to the exchange rate of the domestic currency (an unexpected depreciation) will make exports less expensive and imports more expensive. As a result, the competition from foreign markets will increase the demand for domestic products, increasing domestic output and price.
2. In the money market, a positive shock to the domestic currency (an unexpected temporary depreciation) relative to anticipated value, prompts agents to hold more domestic currency and increases the interest rate. This channel moderates the expansion of aggregate demand and, therefore, the increase in output and price in the face of a positive exchange rate shock.
3. On the supply side, a positive shock to the exchange rate (unanticipated depreciation) increases the cost of imported intermediate goods, decreasing domestic output and increasing the cost of production and, hence, the aggregate price level.

If any of the above channels is different in the face of unanticipated currency appreciation relative to depreciation, the effects of currency fluctuations are likely to be non-linear, i.e., asymmetric.[5]

Empirical Models

The empirical investigation analyzes annual time-series data of real output and price in 112 developing countries. The sample period for investigation is 1966-2006 (see Appendix A for details). The paper analyzes variation in the effects of exchange rate fluctuations across diverse countries.[6]

Exchange rate shocks are assumed to be symmetrically distributed around an anticipated stochastic steady-state trend. This trend varies with agents' observations of macroeconomic

[4]For theoretical details, see Kandil and Mirzaie (2002).

[5]Asymmetry is likely to be reinforced by the extent of oligopolistic competition in the markets for the developing countries' products. For instance, some commodity exporters are usually quasi-monopolies and, therefore, less affected in their pricing decision by a given depreciation. Dornbusch (1987) studies pricing decisions in a context of monopolistic competition. Unanticipated currency depreciation and appreciation may affect the economy differently because the exit-entry decisions and price-setting behaviors of export-oriented firms may vary with the currency movements in different directions so as to avoid a decrease in their profits.

[6]This approach is preferred to a panel estimation (see, e.g., Shin and Smith (1999)) that would disguise the specific features of country coefficients given the diverse sample of countries under investigation. To a great extent, the estimated model captures major determinants of macro performance, while allowing for different responses due to some country-specific features, such as fixed vs. floating exchange rate regimes, and/or commodity vs. non-commodity exporters.

fundamentals that are likely to determine the exchange rate. Positive shocks to the domestic currency price of foreign currency represent unanticipated depreciation around this trend. Negative shocks represent unanticipated appreciation of the domestic currency around its steady-state trend. Detailed description and sources of all data are described in Appendix A.

The model specification is based on the results of the test for non-stationarity of real output.[7] The test results are consistent with non-stationary real output for all countries under investigation.

$$Dy_t = \beta_{0y} + \beta_{1y}E_{t-1}g_t + \beta_{2y}E_{t-1}m_t + \beta_{3y}E_{t-1}h_t + \beta_{4yp}posg_t + \beta_{4yn}negg_t + \beta_{5yp}posm_t + \beta_{5yn}negm_t + \beta_{6yp}posh_t + \beta_{6yn}negh_t + \eta_{1t} \quad (1)$$

Here, *D(.)* is the first-difference operator. Accordingly, all variables in the model enter in first-difference form. The unexplained residual of the model is denoted by η_t.

Agents are expected to negotiate higher wages in anticipation of demand expansion. In turn, anticipated demand shifts are neutral in theory, but may determine real output in practice.[8] Consequently, anticipated growth in government spending and the money supply may increase real output growth. Accordingly, β_{1y} and $\beta_{2y} > 0$.

Unanticipated growth in government spending and the money supply increase aggregate demand, creating positive price surprises. Cyclical fluctuations in the face of expansionary and contractionary government spending shocks are denoted by *posg* and *negg*. Accordingly, β_{4yp} and $\beta_{4yn} > 0$ and β_{1y} and $\beta_{2y} > 0$. Output fluctuations in the face of expansionary and contractionary monetary shocks are denoted by *posm* and *negm*. Hence, β_{5yp} and $\beta_{5yn} > 0$.

Finally, anticipated depreciation of the real exchange rate determines the cost of the output supplied. Let h_t be the log value of the real effective exchange rate (a weighted average of the real domestic currency price of foreign currencies for major trading partners).[9] As producers anticipate a higher cost of imported intermediate goods, they decrease the output supplied. Accordingly, $\beta_{3y} < 0$.

Unanticipated change in the exchange rate is likely, however, to determine both aggregate demand and supply. Unanticipated currency depreciation, a positive shock to the exchange rate, pos_{ht}, increases the cost of buying intermediate goods, decreasing the output supplied. Concurrently, pos_{ht} increases net exports and the demand for domestic currency. The final effect of exchange rate shocks remains indeterminate on output.

To demonstrate fluctuations in the output price, an empirical model is specified as follows:

[7]For details, see Kwiatkowski *et.al.* (1992). That is, real output follows a random-walk process. Upon first-differencing, the resulting series is stationary, which is the domain of demand and supply shifts, as specified in theory.

[8] In the real world, institutional rigidity may interfere with agents' ability to adjust fully to anticipated demand shifts. In the labor market, contracts may be longer than one year, preventing wages at time *t* from adjusting fully to anticipated demand shifts at time *t-1*. Accordingly, anticipated demand shifts are not absorbed fully in price. Alternatively, institutional rigidity may be attributed to price rigidity in the product market. To reduce menu costs, producers may resort to adjusting prices at specific intervals over time. Given price rigidity, anticipated demand shifts at time *t-1* may determine real output growth in the short-run. For a discussion of the implications of sticky-wage and sticky-price models, see Kandil (1996).

[9] Empirically, the exchange rate is measured by the real effective exchange rate (see Appendix A), following Bahmani (1995).

$$Dp_t = \beta_{0p} + \beta_{1p}E_{t-1}g_t + \beta_{2p}E_{t-1}m_t + \beta_{3p}E_{t-1}h_t + \beta_{4pp}posg_t + \beta_{4pn}negg_t + \beta_{5pp}posm_t + \beta_{5pn}negm_t + \beta_{6pp}posh_t + \beta_{6pn}negh_t + \eta_{2t} \quad (2)$$

Given the effect of anticipated currency depreciation in decreasing the output supplied, price inflation increases and $\beta_{3p} > 0$. An unanticipated depreciation of the domestic currency (a positive shock to the exchange rate) decreases the output supplied and may expand (net exports effect) or contract (money demand effect) aggregate demand. The former two channels are inflationary while the latter decreases price inflation. Similarly, demand and supply channels render the effects of neg_{ht} indeterminate on price inflation.

Both anticipated growth in government spending and the money supply stimulate aggregate demand and increase price inflation. Hence, β_{1p} and $\beta_{2p} > 0$. Short-term inflationary fluctuations in the face of expansionary and contractionary government spending shocks are measured by the positive parameters (β_{4pp}, $\beta_{4pn} > 0$). Similarly, the inflationary effects of monetary expansion and contraction are measured by the positive parameters, β_{5pp} and β_{5pn}.

The size of aggregate demand shocks is likely to be an important factor in determining cyclical fluctuations in the product market. To capture parameters underlying the interaction between aggregate demand and specific shocks, the following empirical model is estimated:

$$Dds_t = \delta_0 + \delta_{1p}posg_t + \delta_{1n}negg_t + \delta_{2p}posm_t + \delta_{2n}negm_t + \delta_{3p}posh_t + \delta_{3n}negh_t + \eta_{3t} \quad (3)$$

Unanticipated aggregate demand shifts are measured by Dds_t, unanticipated growth in a broad measure of aggregate demand (nominal GDP). Expansionary and contractionary shifts in the face of government spending shocks are measured by δ_{1p} and $\delta_{1n} > 0$. Unanticipated demand shifts in the face of monetary expansion and contraction are measured by δ_{2p} and $\delta_{2n} > 0$. Demand fluctuations in the face of currency depreciation and appreciation are measured by δ_{3p} and δ_{3n}.

Empirical Results

Description of variables and data sources is provided in Appendix A. The empirical models (1) through (3) are estimated jointly with the equations that determine agents' forecasts of variables that enter the empirical model.[10]

The results of estimating the empirical models (1) and (2) are available upon request. Anticipated depreciation increases the cost of imported goods and decreases real output growth. The evidence is consistent with a reduction in real output growth in 72 countries, which is statistically significant in 23 countries. The inflationary effect is even more pervasive across countries. Anticipated exchange rate depreciation increases price inflation in 85 countries, which is statistically significant in 40 countries.

Consistent with the supply channel, unanticipated currency depreciation decreases output growth in 73 countries, which is statistically significant in 21 countries. The evidence is consistent with an increase in price inflation in 89 countries, which is statistically significant in 38 countries.

Consistent with the demand channel, currency appreciation decreases real output growth in 53 countries, which is statistically significant in nine countries. Consistent with the supply channel, unanticipated currency appreciation increases real output growth in 53 countries,

[10] For detailed econometric methodology, see Kandil and Mirzaie (2003).

which is statistically significant in 10 countries. In support of the demand and supply channels, currency appreciation is consistent with a reduction in price inflation in 62 countries, which is statistically significant in 24 countries.

Asymmetry is measured by the difference between the response of real output growth to positive and negative exchange rate shocks. This difference is negative in 67 countries and statistically significant in 26 countries. In contrast, where the asymmetry coefficient is positive, it is significant in 16 countries. The combined evidence suggests that output contraction in the face of currency depreciation generally exceeds output expansion. Hence, the supply channel dominates the demand channel in determining the response of output growth to currency depreciation.

The difference between the price response to positive and negative currency shocks formalizes asymmetry. This difference is positive in 65 countries, which is statistically significant in 32 countries. The negative difference is statistically significant in 19 countries. Currency depreciation generally raises price inflation. This effect is consistent with both demand and supply channels. In contrast, the reduction in price inflation appears less pronounced in the face of currency appreciation.

Given the importance of demand fluctuations in the face of exchange rate movements, the empirical model includes an equation that measures the size of demand shifts. The parameter δ_{3p} approximates demand shifts in the face of unanticipated currency depreciation. The demand shift is positive in 82 countries, which is statistically significant in 35 countries. Demand shifts in the face of currency depreciation are negative and statistically significant in four countries. Hence, demand expansion appears prevalent in the face of currency depreciation.

The parameter δ_{3n} approximates demand shift in the face of an unanticipated currency appreciation. This parameter is positive in 80 countries, which is statistically significant in 26 cases. This parameter is negative and statistically significant for two countries. Hence, demand contraction appears prevalent in the face of currency appreciation.

The difference between the parameters δ_{3p} and δ_{3n} measures asymmetry in the size of demand shifts in the face of currency fluctuations. This difference is negative in 55 countries, which is statistically significant in 26 cases. The difference is positive and statistically significant in 23 cases.

Cross-Section Analysis

In general, the time-series evidence indicates that the supply channel leads to output contraction and price inflation in the face of unanticipated currency depreciation. In contrast, the reduction in net exports determines output contraction without reducing price inflation in the face of unanticipated currency appreciation. Hence, output contraction exceeds expansion in the face of exchange rate fluctuations. Additionally, price inflation exceeds deflation in the face of exchange rate fluctuations.

To formalize this evidence, asymmetry is measured by the difference between the response of output growth to exchange rate depreciation and appreciation, $Asyy = (\beta_{6yp} - \beta_{6yn})$. $Asyp = (\beta_{6pp} - \beta_{6pn})$ measures asymmetry of the response of price inflation to unanticipated currency depreciation and appreciation. $Asyd = (\delta_{3p} - \delta_{3n})$ measures asymmetry in unanticipated demand shifts in response to unanticipated currency depreciation and appreciation. The variability of the exchange rate, σ_{hs}, is measured by the standard deviation of the real domestic currency price of foreign currency.

Cross-country regressions in Table 1 analyze the relationship between the output and price responses to exchange rate shocks, controlling for demand fluctuations and exchange

rate variability. In regression (1), *Asyy* is regressed on *Asyp*, *Asyd*, and σ_{hs}. *Asyy* varies negatively and significantly with *Asyp* in the face of exchange rate shocks across countries. That is, larger output contraction relative to expansion correlates with larger price inflation relative to deflation in the face of exchange rate shocks. Asymmetric output adjustment correlates positively with asymmetry in the size of demand shifts. That is, demand contraction (in the face of currency depreciation) exceeds expansion (in the face of currency appreciation) which correlates with larger output contraction relative to expansion.

To understand the relationship in (1), cross-country regressions evaluate variation in the output and price responses to each of currency appreciation and depreciation across countries. In regression (2), the output response to currency depreciation, β_{6yp}, is regressed on the size of demand shift, δ_{3p}, and the variability of exchange rate shocks, σ_{hs}. Output reduction in the face of currency depreciation appears to be pervasive despite evidence of demand expansion. This is consistent with the negative and significant response of output adjustment to demand shift in the face of exchange rate depreciation.

Regression (3) evaluates determinants of the price adjustment to currency depreciation across countries. The price response to currency depreciation, β_{6pp}, is regressed on the size of demand shift, δ_{3p}, and the variability of exchange rate shocks, σ_{hs}. Clearly, currency depreciation stimulates price inflation, which correlates positively with demand expansion. The larger the size of demand shift, the higher is price inflation, as evident by the positive and statistically significant coefficient across countries.

Table 1: Cross-Section Analysis

δ*3n*	Dependent Variable		Explanatory	Variables		
(1)	***Asyy***	**constant**	***Asyp***	***Asyd***	***σhs***	**R squared**
		0.025	-0.59*	1.046*	-0.13	0.73
		(0.29)	(-14.58)	(17.10)	(-0.35)	
(2)	**β*6yp***	**constant**		**δ*3p***	***σhs***	**R squared**
		-0.0084		-0.15*	-0.025	0.069
		(-0.11)		(-2.81)	(-0.08)	
(3)	**β*6pp***	**constant**		**δ*3p***	***σhs***	**R squared**
		0.085		2.017*	-0.97	0.67
		(0.46)		(14.80)	(-1.21)	
(4)	**β*6yn***	**constant**		**δ*3n***	***σhs***	**R squared**
		-0.13		0.37*	0.081	0.17
		(-0.87)		(4.67)	(0.13)	
(5)	**β*6pn***	**constant**		**δ*3n***	***σhs***	**R squared**
		0.077		0.11*	0.34	0.084

		(1.08)		(2.77)	(1.11)		
(6)	***Avg (Dy)***	**constant**	***Asyy***	**δ*3p***	**δ*3n***	***σhs***	**R squared**
		0.042* (23.61)	0.00032 (0.23)	-0.0021 (-1.62)	-0.00022 (-0.17)	-0.027* (-3.48)	0.14
(7)	***Avg (Dp)***	**constant**	***Asyp***	**δ*3p***	**δ*3n***	***σhs***	**R squared**
		0.039* (3.27)	0.0023 (0.31)	-0.0063 (-0.37)	0.0054 (0.65)	0.67* (13.12)	0.63
(8)	**σ*y***	**constant**	***Asyy***	**δ*3p***	**δ*3n***	***σhs***	**R squared**
		0.048* (13.57)	-0.003 (-1.05)	-0.00099 (-0.37)	-0.001 (-0.42)	0.023 (1.47)	0.032
(9)	**σp**	**constant**	***Asyp***	**δ*3p***	**δ*3n***	***σhs***	**R squared**
		-0.0062 (-0.42)	-0.0020 (-0.21)	-0.0041 (-0.19)	-0.0019 (-0.18)	1.20* (18.60)	0.77

Notes:
β*6yp and β6yn measure output expansion or contraction in the face of unanticipated currency depreciaton and appreciation.*
β*6p and β6pn measure price inflation or deflation in the face of unanticipated currency depreciaton and appreciation.*
δ*3p and δ3n measure unanticipated demand expansion or contraction in the face of unanticipated currency depreciation and appreciation.*
σhs: the standard deviation of the shock to the real domestic currency price of foreign currency.
Avg (Dy) and Avg (Dp): trend real output growth and price inflation.
σ*y and σp: standard deviation of real output growth and price inflation.*
Asyy=(β6yp-β6yn):asymmetry in the response of output growth to currency depreciation and appreciation.
Asyp=(β6pp-β6pn):asymmetry in the response of price inflation to currency depreciation and appreciation.
Asyd=(δ3p-δ3n): asymmetry in the size of aggregate demand shocks in response to currency depreciation and appreciation
t-ratios are in parentheses'.
** denotes statistical significance at the five percent level.*

In regression (4), the output response to currency appreciation, β_{6yn} is regressed on the size of demand shift, δ_{3n}, and the variability of exchange rate shocks, σ_{hs}. Output contraction is evident in the face of unanticipated currency appreciation. This appears to be dependent on demand contraction. Accordingly, output contraction varies positively with demand contraction, as evident by the positive and statistically significant parameter across countries.

In regression (5), the price response to currency appreciation, β_{6pn}, is regressed on the size of demand shift, δ_{3n}, and the variability of exchange rate shocks, σ_{hs}. There is evidence that price deflation is dependent on demand contraction in the face of currency appreciation. This is evident by the positive and statistically significant parameter across countries.

Trend output growth is measured by the time-series average of real output growth over time. In regression (6), trend output growth, *Avg (Dy)*, is regressed on asymmetry in the output response to currency depreciation and appreciation, $(\beta_{6yp} - \beta_{6yn})$, demand shifts, δ_{3p} and, and δ_{3n}, and the variability of the exchange rate, σ_{hs}. Trend output growth decreases significantly with the variability of the exchange rate across countries. Given asymmetry in the output adjustment to these shocks, the increased variability has a net negative contribution, decreasing trend output growth across countries.

Trend price inflation is measured by the time-series average of price inflation over time. In regression (7), trend price inflation is regressed on the variability of the exchange rate and the parameters measuring price asymmetry and demand adjustments in the face of currency fluctuations. Consistent with asymmetry, the variability of the exchange rate increases trend price inflation across countries.

The standard deviation of real output growth approximates output variability. In regression (8), output variability is regressed on asymmetry in the output response to currency fluctuations, $(\beta_{6yp} - \beta_{6yn})$, demand shifts, δ_{3p} and δ_{3n}, and the variability of the exchange rate, σ_{hs}. Output variability increases, although insignificantly, with the variability of the exchange rate across countries.

In regression (9), price variability is regressed on asymmetry in the price response to currency fluctuations, $(\beta_{6pp} - \beta_{6pn})$, demand shifts, δ_{3p} and δ_{3n}, and the variability of the exchange rate, σ_{hs}. The variability of price inflation increases significantly with the variability of the exchange rate across countries.

Summary and Conclusion

Exchange rate fluctuations are a key element of macroeconomic performance in developing countries. Currency fluctuations determine aggregate demand through the relative demand for domestic and foreign goods and adjustments of currency composition in the portfolio balance. Additionally, the exchange rate determines the cost of imported intermediate goods and, in turn, the output supplied.

The major highlights of the time-series estimation in a sample of 112 developing countries indicate that output contraction and price inflation are pervasive in the face of anticipated exchange rate depreciation. This evidence supports the role of anticipated currency depreciation in increasing the cost of the output produced and decreasing supply. Consistent with the supply channel, the reduction in output growth and the increase in price inflation appear also pervasive in the face of unanticipated currency depreciation.

Across countries, larger output contraction relative to expansion correlates with larger price inflation relative to deflation in the face of exchange rate shocks. In support of the supply channel, output reduction in the face of currency depreciation appears to be pervasive despite evidence of demand expansion. In contrast, the larger the size of demand shift in the face of currency depreciation, the higher is price inflation. In support of the demand channel, output contraction indicates a reduction in net exports in the face of currency appreciation. There is also evidence that price deflation is more pronounced as the size of demand contraction increases in the face of currency appreciation.

Given asymmetry in the output adjustment to currency fluctuations the evidence

illustrates that trend output growth decreases significantly in response to higher variability of the exchange rate across countries. Similarly, the variability of the exchange rate increases trend price inflation, in consistency with asymmetric adjustments across countries. The variability of the exchange rate also increases the variability of price inflation across countries.

Depreciation forces a reduction in the output supplied and the added cost is passed on to consumers, accelerating price inflation. Firms attempt to hedge against anticipated depreciation, but they are mostly constrained absent an adequate scope for import substitution. Priorities should be attached to unlocking research and capacity potential to ease structural bottlenecks and reduce inelastic dependency on intermediate imported goods that exacerbates the adverse effects of currency fluctuations on the macro economy.

On the other hand, the evidence does not support the positive effect of depreciation in increasing competitiveness and the scope to mobilize exports. However, the potential of enhancing competitiveness following depreciation remains highly dependent on maintaining a competitive real exchange rate, increasing market access and investing in product quality and technological innovations.

A competitive real exchange rate requires aligning the nominal effective exchange rate with underlying fundamentals and maintaining prudent domestic macro policies in support of low inflation and high growth. Increasing market access requires opening new markets and pursuing bilateral and regional trade agreements. Upgrading product quality would require increasing investments in technological innovations, research and developments and human training and skill development.

In conclusion, it should be emphasized that policy makers have no control over currency substitution and speculative attacks. Minimizing confusion about the exchange rate should be at the top of the policy agenda in developing countries towards stabilizing expectations and sustaining a steady path of high growth and low inflation.

References

Agenor, Pierre-Richard (1991), “Output, Devaluation and the Real Exchange Rate in Developing Countries", *Weltwirtschaftliches Archive,* Band 127.

Bahmani, M. (1991), “Are Devaluation Contractionary in LDCs?", *Journal of Economic Development*, June.

Bahmani, M. (1991), “Real and Nominal Effective Exchange Rates for 22 LDCs: 1971:1-1990:4", *Applied Economics,* Vol. 27, pp. 591-604.

Bahmani, M., and Mirzaie, A. (2000), “Real and Nominal Effective Exchange Rates for Developing Countries: 1973.I-1997.III", *Applied Economics*.

Barbone, L. and Francisco Rivera-Batiz (1987), “Foreign Capital and the Contractionary Impact of Currency Devaluation, with an Application to Jamaica", *Journal of Development Economics,* Vol. 26, pp. 1-15.

Berganza and Garcia-Herroro (2004), “What makes Balance Sheet Effects Detrimental for the Country Risk Premium?", *Working Paper No. 0423*, Banco de Espana.

Bleakley and Cowan (2002), “Corporate Dollar Debt and Depreciations: Much Ado about Nothing?”, *Working Paper No. 02-5*, Federal Reserve Bank of Boston.

Bruno, M. (1979), “Stabilization and Stagflation in a Semi-Industrialized Economy", in R.

Dornbusch and J. Frankel, eds. *International Economic Policy,* John Hopkins University Press, Baltimore, MD.

Buiter, Willem H. (1990), *International Macroeconomics,* Oxford University Press.

Cespedes, Chang and Velasco (2004), "Balance Sheet Effects and Exchange Rate Policy", *American Economic Review,* Vol. 94 No. 4, pp. 1183-1193.

Choudhri, Ehsan U., and Dalia S. Hakura (2012), "The Exchange Rate Pass-Through to Import and Export Prices: The Role of Nominal Rigidities and Currency Choice", *IMF Working Paper,* Vol. 226.

Cooper, Richard N (1971), "Currency Devaluation in Developing Countries", *Essays in International Finance,* No. 86, International Finance Section, Princeton University.

Crucini, Mario J. and Christopher I (2012), Telmer "Microeconomic Sources of Real Exchange Rate Variability", *NBER* Working Paper 17978.

Diaz-Alejandro and Carlos F. (1963), "A Note on the Impact of Devaluation and Redistributive Effect", *Journal of Political Economy,* Vol. 71, pp. 577-580.

Dorn, S. and Egger, P. (2011), "On the Distribution of Exchange Rate Regime Treatment Effects on International Trade", *CEPR, Discussion Paper Series*, 8654.

Dornbusch, R. (1987), "Exchange Rates and Policies," *American Economic Review,* Vol. 77 No. 1, pp. 93-106.

Dornbusch, R. (1988), *Open Economy Macroeconomics,* 2nd edition, New York.

Edwards, S. (1986), "Are Devaluation Contractionary?", *The Review of Economics and Statistics.*

Engle, R. R. (1982), "A General Approach to Lagrange Multiplier Model Diagnostics", *Journal of Econometrics,* Vol. 20, pp. 83-104.

Galindo, I. and Montero (2007), "Real Exchange Rates, Dollarization and Industrial Employment in Latin America", *Emerging Markets Review,* Vol. 8, pp. 284-98.

Galindo, P. and Schiantarelli (2003), "Debt Composition and Balance Sheet Effects of Currency Depreciation: A Summary of the Micro Evidence", *Emerging Markets Review,* Vol. 4, pp. 330-339.

Gertler, G. and Natalucci (2003), "External Constraints on Monetary Policy and the Financial Accelerator", *mimeo.*

Guittian, M. (1976), "The Effects of Changes in the Exchange Rate on Output, Prices, and the Balance of Payments", *Journal of International Economics,* Vol. 6, pp. 65-74.

Gylfason, T. and Marian R. (1991), "Does Devaluation Make Sense in Least Development Countries?", *Economic Development and Cultural Change.*

Gylfason, T. and Schmid, M. (1983), "Does Devaluation Cause Stagflation?", *Canadian*

Journal of Economics, Vol. 16.

Hanson, James A. (1983), "Contractionary Devaluation, Substitution in Production and Consumption, and the Role of the Labor Market", *Journal of International Economics,* Vol. 14, pp. 179-89.

Hirschmann, Albert O. (1949), "Devaluation and the Trade Balance: A Note", *Review of Economics and Statistics,* Vol. 31, pp. 50-53.

Hoffmaister, A. and Vegh, C. (1996), "Disinflation and the Recession Now Versus Recession Later Hypothesis: Evidence from Uruguay", *IMF Staff Papers,* Vol. 43.

Kamin, S. and Rogers, J. (2000), "Output and the Real Exchange Rate in Developing Countries: An Applications to Mexico", *Journal of Development Economics,* Vol. 61.

Kandil, M. (1996), "Sticky Wage or Sticky Price? Analysis of the Cyclical Behavior of the Real Wage", *Southern Economic Journal*, pp. 440-459.

Kandil, M. and Mirzaie, A. (2002), "Exchange Rate Fluctuations and Disaggregated Economic Activity in the U.S.: Theory and Evidence", *Journal of International Money and Finance,* No. 1, pp. 1-31.

Kandil, M. and Mirzaie, A. (2003), "The Effects of Dollar Appreciation on Sectoral Labor Market Adjustments: Theory and Evidence", *Quarterly Review of Economics and Finance.*

Krugman, Paul R. and Taylor, L. (1987), "Contractionary Effects of Devaluation", *Journal of International Economics,* Vol. 8, pp. 445-456.

Kwiatkowski, D., Phillips, Peter C. B., Schmidt, P. and Shin, Y. (1992), "Testing the Null Hypothesis of Stationarity Against the Alternative of a Unit Root: How Sure Are We That Economic Time Series Have a Unit Root?", *Journal of Econometrics,* Vol. 54, pp. 159-78.

Lizondo, J. Saul and Montiel, Peter J. (1989), "Contractionary Devaluation in Developing Countries: An Analytical Overview", *IMF Staff Papers,* Vol. 36 No. 1, pp. 182-227.

McGettigan, D., Moriyama, K., Ntsama, J.N.N., Painchaud, F., Qu, H. and Steinberg, C. (2013), "Monetary Policy in Emerging Markets: Taming the Cycle", *IMF Working Paper*, Vol. 96.

Meade, James E (1951), *The Theory of International Economic Policy, I: The Balance of Payment*, Oxford University Press, Oxford.

Mendoza, E. G. (1992), "The Effect of Macroeconomic Shocks in a Basic Equilibrium Framework", *IMF Staff Papers,* Vol. 39 No. 4, 855-89.

Pesaran, S. and Smith (1999), "Pooled Mean Group Estimation of Dynamic Heterogeneous Panels", *Journal of the American Statistical Association,* Vol. 94, No. 446, pp. 621-634.

Rogers, John H., and Wang, P. (1995), "Output, Inflation, and Stabilization in a Small Open

Economy: Evidence from Mexico", *Journal of Development Economics,* Vol. 46.

Shone, R. (1989), *Open Economy Macroeconomics*, Harvester Wheatsheaf.

Solimano, A. (1986), "Contractionary Devaluation in the Southern Cone- The Case of Chile", *Journal of Development Economics,* Vol. 23, pp. 135-51.

Van W., Sweder (1989), "Exchange Rate Management and Stabilization Policies in Developing Countries", *Journal of Development Economics,* Vol. 23, pp. 227-47.

Appendix A

Data Sources

Based on data availability, the sample period for investigation is 1966-2006. Annual data for the above countries are described as follows:

1. Real Output: Real output of GDP or GNP measured in terms of 1982 dollars.
2. The Price Level: The deflator for GDP or GNP.
3. Short-Term Interest Rate: Representatives of short-term market rates for the various countries, i.e., rates at which short-term borrowing is affected between financial institutions or rates at which short-term government paper is issued or traded in the market.
4. Government Spending: Nominal values of all payments by the government.
5. Money Supply: the sum of currency plus demand deposits.
6. Real Effective Exchange Rate: Real value of weighted exchange rate with major trading partners (the domestic price of foreign currency).

Sources: Series 1 through 6 are taken from the *World Economic Outlook*, data bank available from the International Monetary Fund, Washington, D.C.

Series 7 is constructed following the procedure described in Bahmani (1995) and Bahmani and Mirzaie (2000) as well as other details from the authors.

First, bilateral exchange rates (defined as national currency per US $) of 22 top trading partners are identified. These series are used to construct the nominal effective exchange rates and real effective exchange rates following Bahmani-Oskooee and Mirzaie (2000) with some minor adjustments, the trade share captures both imports and exports (trade turnover) and varies over time. Import and export shares are collected over the sample period from various issues of *Direction of Trade Statistics*, from the IMF. Taking all of these factors into account, nominal and real exchange rates are calculated as follows:

$$NEER_{j,t} = \sum_{i=1}^{n} \alpha_{ji,t} [\frac{(R_{ji})_t}{(R_{ji})_{95}}(100)]$$

and

$$REER_{j,t} = \sum_{i=1}^{n} \alpha_{ji,t} [\frac{(P_j R_{ji} / P_i)_t}{(P_j R_{ji} / P_i)_{95}}(100)]$$

where *NEER* is the nominal effective exchange rate index of the subject country *j*, *REER* is the real effective exchange rate, *n* is the number of country *j*'s trading partners, R_{ij} is the bilateral exchange rate defined as the number of country *i*'s currency per unit of country *j*'s currency, 1995 is the base year, $P_j (P_i)$ is the price level of country *j* (country *i*), and $\alpha_{ij,t}$ is the share of country *j*'s trade turnover with trading partner *i* with $\sum \alpha_{ij,t} = 1$.