Growth and the Real Exchange Rate - Evidence from Eleven Countries

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Abstract

There are conflicting theories about the effect of real exchange rate movements on output growth. Expenditure switching models suggest that a real depreciation leads to an increase in net exports due to the increase in competitiveness of the export sector, and hence to an increase in output growth. Contractionary depreciation models, on the other hand, suggest that real depreciations can reduce output growth. In this paper we examine the evidence on the impact of real exchange rate movements on the real economy for a number of countries. We find that different countries have had quite different experiences with respect to the response of output growth to exchange rate changes, and we offer some suggestions as to why this has been the case.

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1. Introduction

The conventional view about exchange rate depreciations is that the resulting rise in import and export prices induces a switch in expenditures towards home-produced goods, and hence a rise in output. There are, however, a number of plausible alternative views on the effects of exchange rate depreciations. "Contractionary depreciation" models argue that there are a number of channels through which an exchange rate depreciation can reduce output. Diaz-Alejandro (1963) argues that a depreciation would lead to a transfer of income from workers, who receive a fixed nominal wage, to capitalists. With capitalists assumed to have a higher propensity to save than workers, this transfer will lead to a decline in demand, and hence to a decline in income. Krugman and Taylor (1978) provide a formal treatment and some extensions to this approach. Bruno (1979) and van Wijnbergen (1986) argue that a depreciation can increase the cost of imported capital goods. If there are no close substitutes for the imported capital goods, firms will face rising input costs and an increased need for credit. If credit is rationed or only available at very high interest rates firms may choose to restrict output. Hence depreciations can reduce the supply of output, as well as reducing output through the demand side channels emphasised by Diaz-Alejandro (1963).

Agénor (1991) develops a rational expectations model of depreciations, and finds that an anticipated depreciation of the real exchange rate leads to a rise in the expected price level and a fall in output (as workers increase their nominal wage demands). An unanticipated depreciation does not affect prices and real wages, but instead leads to an increase in aggregate demand, due to the fall in the relative price of domestic output. The result is a rise in prices and output.

A more recent literature has emphasised the role of unhedged foreign borrowings in leading to contractionary depreciations. These models have been thought to be particularly useful in understanding the Asian financial crisis. Chang and Velasco (1998) and Radelet and Sachs (1998) argue that economies that become open to foreign borrowing may find themselves facing a maturity mismatch between a demand for long-term loans to fund investment projects versus a supply of short-term loans from overseas. In this environment a sudden loss of confidence in the ability of firms to repay loans can lead to a rapid reversal of foreign credit, and a decline in investment and in output. Krugman (1998), Burnside, Eichenbaum and Rebelo (1999) and Corsetti, Pesenti and Roubini (1999) emphasise the role played by moral hazard among financial intermediaries, due to implicit government guarantees, leading to over-investment and vulnerability to a financial crisis. Moral hazard can encourage overseas borrowing that is unhedged, leading to contractionary depreciations and financial crises.

In this paper we provide empirical evidence on the impact of real exchange rate changes on output growth, using a sample of eleven countries. We find that the evidence is quite mixed on any effect of depreciations on output growth, with most countries showing little evidence of any such effect. Prior to the Asian crisis our point estimates suggest that in all but one of our countries depreciations were expansionary. This suggests that the depreciations that occurred in 1997 were unlikely to have been the only cause of subsequent falls in output. The structure of our paper is as follows. In the next section we briefly outline the empirical literature on exchange rate changes and growth, while in section 3 we present our empirical methodology and results. Section 4 of the paper provides some concluding comments.

2. Existing Evidence on Devaluations and Output Growth

Much of the existing literature on the impact of real exchange rate changes on growth has focused on the potentially contractionary effects of devaluations in developing countries, or more recently in Asian crisis countries.[1] Cooper (1971) examines the behaviour of output before and after depreciations in nineteen developing countries that took place between 1959 and 1966. Cooper finds evidence of an improving trade balance and balance of payments after depreciations, but he also finds that depreciations were contractionary. A problem with the Cooper study is that his approach does not properly allow for other potential influences on output growth. Depreciations often occur in developing countries when the general macroeconomic environment is poor, and it is important in such cases to disentangle these other influences on output growth from the influence of the depreciation *per se*.

Kamin (1988) and Edwards (1989) examine a larger set of developing countries, of which some experienced devaluations over the sample considered, and some did not. Kamin finds that falls in output growth occur before, rather than after devaluations. Growth then remains low for the year following depreciation, before improving and surpassing the growth rates of non-devaluing countries. Kamin concludes that overall the evidence is consistent with devaluations not affecting the long-run level of output in developing countries. Edwards (1989) analyses the impacts of devaluations in eighteen Latin American countries, and compares the performance of these economies three years prior and three years after devaluations to macroeconomic performance in twenty-four other developing countries. He finds that declines in output growth around devaluation episodes are due to the imposition of restrictions and other policies that have accompanied devaluations in Latin America, rather than due to the devaluation itself.

Khan (1990) assesses the impact of IMF supported programs between 1973 and 1988 on the balance of payments, the current account, inflation, and growth in sixty-nine developing countries. It is found that real exchange rates have a small, though insignificant, negative effect on output growth. Agénor (1991) estimates an output growth equation in a pooled sample of twenty-three developing countries over the period 1978-87. He is careful to distinguish between expected and unexpected changes in the explanatory variables, and finds that anticipated depreciations have a negative (though not significant) effect on growth, while unanticipated depreciations increase growth.

Moreno (1999) estimates equations similar to those estimated by Agénor (1991) for a pooled sample of six East Asian economies. Using the Hodrick-Prescott filter to estimate trends in the variables and so to decompose each variable into anticipated and unanticipated components, Moreno finds that real depreciations reduce growth, though the size and significance of this effect is reduced in instrumental variable as opposed to OLS estimation. Kandil (2000) also follows the approach of Agénor, though she decomposes real exchange rate changes into positive and negative shocks in order to see if there is any asymmetry in the relationship between the exchange rate and growth. She examines twenty-two developing countries using annual data spanning periods ranging from 1955 to 1996. She finds that in a number of countries output growth declines in response to unanticipated depreciations, but growth does not rise when the exchange rate appreciates, while in a different set of countries output growth declines in response to unanticipated appreciations.

1 For a more detailed survey of the literature on developing countries see Agénor (1991).

In the next section of the paper we estimate equations similar to those employed by Agénor (1991) and Moreno (1999) for eleven countries over the period 1980 to 2000. We estimate time series equations using quarterly data for each country using a number of different techniques to detect any influence of exchange rate changes on output growth. Our use of time series analysis allows us to pick up any different effect of exchange rate changes on growth in different countries. One could view some of the models above as being more applicable to certain types of countries than to others, so that it might be expected that some countries could have a positive, some a negative, and some no relationship between depreciations and growth. For example, it has often been argued that Korea experienced a deep recession after the exchange rate depreciations during the Asian crisis because of the high levels of unhedged foreign currency denominated debt at this time. This explanation is consistent with the arguments of Chang and Velasco (1998) and Radelet and Sachs (1998), and suggests that we may find evidence of contractionary depreciations more generally in Korea. One could not, however, make the same argument about Taiwan, and so we might expect to find a different relationship between depreciations and growth in that country. An advantage of using quarterly data is that it allows us discriminate between high and medium frequency impacts of real exchange rate changes on growth, as well as allowing us to estimate time series rather than pooled regressions over a short sample period. Again, some of the models above, such as the imported capital goods model, predict different short-run effects of exchange rate changes from the medium- to longer-run effects, and our estimation strategy will allow us to pick up these different effects.

3. Empirical Methods and Results

To examine the impact of real exchange rate changes on output growth we estimate reduced form equations similar to those estimated by Agénor (1991), Moreno (1999) and Kandil (2000), of the following form:

$$y_t = \sum_{i=1}^{4} \varphi_i y_{t-i} + \sum_{i=1}^{4} \alpha_i e_{t-i} + \sum_{i=1}^{4} \beta_i m_{t-i} + \sum_{i=1}^{4} \delta_i g_{t-i} + \sum_{i=1}^{4} \gamma_i y^*_{t-i} + \sum_{i=1}^{4} \tau_i r^*_{t-i} + \varepsilon_{t,} \qquad (1)$$

where y_t is the current level of output, e_t is the level of the real (trade-weighted, CPI based) exchange rate at time t, defined so that a rise in e is a real appreciation, m_t is the level of the M2 money supply or its equivalent, g_t is the level of government consumption expenditure at t, y^* and r^* are foreign (U.S.) income and interest rate variables respectively, and ε is a white noise error term. In the actual estimation, all variables are either differenced, or filtered using the procedure described in Baxter and King (1999).[2] The regressions using the differenced data will allow us to examine the influence of high frequency movements of real exchange rates on output growth. The regressions using the filtered data will allow

2 Baxter and King (1999) compare this filter to the Hodrick-Prescott filter and some other detrending methods in some detail. The band pass filter renders any I(1) or I(2) series stationary. The filter leaves components in a series that are similar to those obtained using the HP filter, though an important advantage over the HP filter is the fact that no phase shifts in the filtered series are induced. The filter used in this paper removes from each series movements in the variable which persist for less than eighteen months or more than eight years. These filtered series are often described as business cycle components of the series in question. Stock and Watson (1999) also discuss the merits of this filter.

us to examine the impact of business cycle frequency movements of the real exchange rate on these same movements in real output.[3] The variables included capture most of the influences on output suggested in the theoretical literature, though some possible weaknesses in this specification are explored at the end of this section.[4]

Our sample of countries includes seven non-OECD Asian economies (Hong Kong SAR, Singapore, Korea, the Philippines, Malaysia, Thailand and Taiwan), and four OECD economies (Australia, Japan, France and the U.K.). This sample of countries has a broad range of exchange rate regimes, from fixed in Hong Kong to relatively flexible over most of the sample in Australia and Japan, and also large differences in characteristics such as openness and trade balance experience. These differences will enable us to speculate on the reasons for any contradictory findings in different countries.

In Table 1 we report the coefficient on the first lag of the real exchange rate, as well as the impact of a one-unit shock to the exchange rate on output growth four quarters later.[5] We also report the p-values associated with the null hypothesis that $\alpha_1 = 0$, along with the p-value for $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = 0$. Each variable is differenced, and four lags of each variable are included in the regressions. p-values less than .05 are highlighted in bold. Regressions are run for each country up until 1997:2 and over the full sample available. It is of considerable interest to test for the stability of our models over the sample period considered. One reason to do so is to see if one could have predicted the output falls observed in Asian economies after the Asian crisis, given the size of real exchange rate depreciations that occurred. A second reason is to see whether changes in the structure of an economy over the last two decades have led to any changes in the relationship between real exchange rates and output growth, particularly around the time of the Asian crisis. Rather than using conventional stability tests, such as Chow tests, for structural breaks, we simply report the truncated sample and the full sample results. While this approach is informal, it is noted that Chow tests will have degrees of freedom problems with detecting structural breaks at the beginning or at the end of a sample.

The results in the left three columns of Table 1, referring to equations estimated up until 1997:2, show some important differences across countries. α_1 is negative for six countries and positive for five, and never significantly different from zero. The impact of a change in the real exchange rate on output growth four quarters later is negative for seven of the eleven countries, being positive only in Hong Kong, Singapore, France and Australia. Lags of the real exchange rate are significantly different from zero for Hong Kong, Korea and Taiwan. In other words, the point estimates are consistent with

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3 These regressions are similar to the band-spectral regressions described in Engle (1976). Thoma (1994) employs a similar regression approach using filtered variables to examine the evidence for a liquidity effect in the US. Both differencing and the filtering approach used here will remove the trends in the series, and can be thought of as retaining the unanticipated movements in the series in a similar manner to Agénor (1991) or Moreno (1999).

4 A potential problem with the estimates in Table 1 is endogeneity of the real exchange rate. One solution to this problem is to use instrumental variables estimation, but in practice good instruments for the real exchange rate are difficult to find. Using lags of the real exchange rate will be appropriate when the real exchange rate does not respond to contemporaneous growth, because, for example, output growth data is unavailable until after the current quarter.

5 This depends on the coefficients on the lagged output growth variables, as well as on the coefficients on lagged exchange rate changes. Specifically, the multiplier is equal to $(\phi_1^3 + 2\phi_1\phi_2)\alpha_1 + (\phi_1^2 + \phi_2)\alpha_2 + \phi_1\alpha_3 + \phi_3\alpha_1 + \alpha_4$.

depreciations of the real exchange rate over the previous year leading to rises in output growth in seven of the eleven countries - consistent with expenditure switching models. In particular, in all of the Asian crisis countries one would predict that real depreciations would lead to *increases* in growth within four quarters of the exchange rate change. In general, the other variables in the model are not helpful in explaining output growth, once lags of output growth and real exchange rate changes are included in the model. The government expenditure variable is only significant for the Philippines, while U.S. growth is only significant in Australia, and the Federal Funds rate has only a short-run influence on Hong Kong growth.

Results for the full sample show some interesting differences to the pre- 1997:2 sample. Variables other than the real exchange rate have similar coefficients and significance to the sub-sample results. Korea, Malaysia and Thailand now have α_1 positive and significant - in these countries the Asian crisis shows up in the regressions as output growth falling significantly within one quarter of the real depreciation. The four-quarter impact of exchange rate changes has switched sign in Hong Kong, and the lag coefficients on the exchange rate lags have become significant in Korea, Malaysia and Thailand. Notably, the coefficients have not changed significantly in sign or size (in other words one cannot reject the restriction that the αs are the same over both sub-samples), but have simply been estimated more precisely.

These results have several interesting implications. Firstly, the results suggest that the impact of exchange rates on output growth was quite different after the Asian crisis than before in Hong Kong. Prior to the Asian crisis, depreciations were contractionary, but since the Asian crisis the appreciation in the Hong Kong currency has been contractionary. In Korea, Malaysia and Thailand the impact of the exchange rate changes one quarter after the Asian crisis, depreciations were sharply contractionary, but the longer-run multipliers suggest a normal response to these depreciations within four quarters of the crisis. Within four quarters expenditure switching has occurred and output growth is above that predicted in the absence of the depreciations. Another implication of these results is that one would not have predicted that a large depreciation of the exchange rate would have caused output growth to fall on the basis of data up until 1997:2. In non-Asian crisis countries the data does not suggest any relationship between exchange rate movements and changes in output growth.

Table 2 reports the results from similar regressions, but instead of differencing the variables each variable is filtered so that both the noise and the trends are removed from the series. We can think of the filtered data as representing “business cycle components” of the variables, or fluctuations in the variables that persist for more than eighteen months, but less than eight years. It may be that some of the movement in the real exchange rate reflects noise that reverses itself in subsequent quarters. We can think of the estimates in Table 1 as picking up the influence of such noisy movements in the real exchange rate on output growth. Removing this noise leaves us with fluctuations in the real exchange rate around a long-run trend, which is itself driven by productivity and other fundamental factors. Such fluctuations could be due to non-permanent shocks to the real exchange rate, or to exchange rate misalignments in a fixed exchange rate regime. Figures 1 to 11 plot the filtered real exchange rate series and filtered output for each country. The figures show that for most countries the real exchange rate is more variable than output, though there is no obvious correlation pattern across the different countries.

The results from Table 2 in general are quite different than those in Table 1. For Hong Kong the results are now consistent with contractionary depreciations, while for Singapore there is again no evidence that real exchange rate movements affect output. In Korea, the Philippines and Malaysia the evidence is now broadly consistent with contractionary depreciations in both the subsample and the full sample of the data, while the same is now true in Thailand in the pre-Asian crisis period. Finally, in Japan the pre-Asian crisis coefficients on the exchange rate become significant, while the same coefficients for the U.K. are now significant in the full sample.

How can the results for Korea, Malaysia and the Philippines from the two tables be reconciled? Recall that in Table 1 the tests are picking up any influence that high frequency (noisy) movements of the real exchange rate have on output growth. In Korea depreciations in the real exchange rate caused output to increase within four quarters, according to Table 1. The results from Table 2 suggest that in these countries depreciations of the real exchange rate that persisted for longer than eighteen months reduced output below its predicted cyclical position, both before and after the crisis.[6]

In Table 3 we check to see whether any insignificant coefficients on the exchange rate variables are due to the inclusion of other insignificant variables in the model. We delete all variables for which all coefficients are insignificantly different from zero, but retain the exchange rate variables and the lagged dependent variables (which are usually significant in any case). These results are very similar to those for Table 1, and so it does not seem that this form of mis-specification is affecting our conclusions in Table 1.

In Table 4 we replace the monetary variable with a short-term interest rate (and again include all of the other variables in the model). Financial market deregulation and changes to central banks' monetary policy procedures in the recent past suggest that such an interest rate, rather than a monetary aggregate, may be the most appropriate monetary policy variable in output equations. The results are again similar to Table 1 with the only notable differences being a positive long-run impact of real exchange rate changes for Hong Kong, and an insignificant positive estimate of the same coefficient for Korea.

We have also experimented with specifications that include the real exchange rate variable multiplied by the size of a country's trade balance. Krugman and Taylor (1978) find that depreciations will only be contractionary if the trade balance is in deficit, when the income effect of a depreciation will be negative. We have tried several specifications that try to capture this idea, but in general our results are similar to those already reported. We have also estimated some equations that attempt to pick up any non-linearities or asymmetry in the relationship between exchange rate changes and growth, along the lines of the models estimated by Kandil (2000). Evidence on both non-linearities and asymmetries very much depends on whether the Asian crisis period is included in the estimation. If one thought that only large changes in the exchange rate affect growth, then for most countries by far the largest change in the real exchange rate is in 1997. The end result is that the conclusions that we draw are similar to those that we

6 Another way of examining the different influences of short-run versus longer-run influences of the real exchange rate on output would be to look for cointegrating relationships between the variables in the model. We have explored a number of possible cointegration equations involving output and exchange rates, but we have not found any evidence of cointegration.

made in summarising Table 1 - the Asian crisis period was unusual in Asian crisis countries, but whether the contractionary depreciations were due to non-linearities, asymmetries or other factors is difficult to know.

Overall, we are led to the conclusion that the evidence on whether depreciations are contractionary or expansionary is quite mixed. For the OECD countries in our sample there appears to be little evidence that exchange rate changes affect output in any significant way. In Hong Kong the evidence is consistent with expenditure switching models, though there is some evidence that the real appreciations that occurred after 1997 were contractionary. In Singapore there is little support for the idea that the exchange rate affects output. This may be due to the fact that monetary policy has used management of the real exchange rate to control inflation. When the economy is growing strongly and demand pressures are strong, the Monetary Authority of Singapore allows the real exchange rate to appreciate. When such pressures are expected to be weaker real exchange rate appreciation is allowed to moderate, or the exchange rate is allowed to depreciate as has been the case since the Asian crisis. It is interesting that this policy does not lead us to find a positive relationship between the real exchange rate and growth. It is possible that in fact real exchange rate depreciations increase growth in Singapore, but our equation is combining this effect with the policy reaction function so that overall we are not finding any relationship between the two variables.

In Malaysia, Thailand and Korea the Asian crisis saw large real depreciations, and large falls in output. Our full-sample results suggest that at least some of the falls in output were caused by the depreciations, though the long-run effect of the depreciations was not to reduce output. However, in none of the Asian crisis countries was there any evidence prior to the Asian crisis of contractionary depreciations. What factors led to the depreciations being contractionary during the Asian crisis? One factor emphasised by Radelet and Sachs (1998) and others is the large build up in foreign currency denominated short-term debt in these countries. Figure 12 shows that loans from foreign banks grew rapidly through the 1990s in these three countries, before turning around sharply at the end of 1997. This high level of short-term unhedged debt dramatically worsened the balance sheets of firms in these countries, leading to falls in output growth as insolvent firms went out of business from the end of 1997.

4. Conclusions

In this paper we have examined the relationship between real exchange rate changes and output in a sample of eleven countries. We have found that there is no relationship between these two variables which is common across countries. We have also found that until the Asian crisis one would have been led to the conclusion that real depreciations tend to be expansionary in Asian crisis countries, as predicted by expenditure switching models. One problem with empirical work on this topic is that data on some of the variables relevant to testing some of the models does not exist. Early theoretical work emphasised the role of imported capital goods in generating contractionary depreciations. Inclusion of variables such as the share of capital goods that are imported in each country would enable testing of this proposition, but at this point time series on such data is not available.

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Table 1: Results where all variables are differenced

Equation $$\Delta y_t = \sum_{i=1}^{4} \varphi_i \Delta y_{t-i} + \sum_{i=1}^{4} \alpha_i \Delta e_{t-i} + \sum_{i=1}^{4} \beta_i \Delta m_{t-i} + \sum_{i=1}^{4} \delta_i \Delta g_{t-i} + \sum_{i=1}^{4} \gamma_i \Delta y^*_{t-i} + \sum_{i=1}^{4} \tau_i \Delta r^*_{t-i} + \varepsilon_{t,}$$

	1980:1 to 1997:2			***1980:1 to 2000:1***		
Country	α_1 (p-value)	"LR"	$\alpha_i = 0 \; \forall \; i$ p-value	α_1 (p-value)	"LR"	$\alpha_i = 0 \; \forall \; i$ p-value
Hong Kong	-0.30	0.06	**.02**	-0.30	-0.06	**.00**
	(.14)			(.06)		
Singapore	0.11	0.02	.57	0.03	0.03	.85
	(.56)			(.84)		
Korea	-0.00	-0.19	.14	**0.19**	-0.16	**.02**
	(.30)			**(.01)**		
Philippines	0.00	-0.19	**.02**	0.01	-0.17	**.00**
	(.98)			(.92)		
Malaysia	0.17	-0.18	.26	**0.20**	-0.10	**.00**
	(.14)			**(.04)**		
Thailand	0.06	-0.11	.55	**0.18**	-0.10	**.00**
	(.55)			**(.01)**		
Taiwan	-0.03	-0.14	**.01**	-0.02	-0.13	.08
	(.74)			(.82)		
Japan	-0.01	-0.07	.21	0.05	-0.06	.42
	(.69)			(.16)		
U.K.	0.00	-0.02	.55	0.01	-0.02	.43
	(.94)			(.65)		
France	-0.08	0.08	.27	-0.05	0.07	.37
	(.21)			(.46)		
Australia	-0.04	0.01	.52	-0.04	0.01	.38
	(.15)			(.12)		

Notes: "LR" is the impact of a unit change of the exchange rate on output growth after 4 quarters (see footnote 5 of the text).

Table 2: Results where all variables are filtered

Equation $$y_t^f = \sum_{i=1}^{4} \varphi_i y_{t-i}^f + \sum_{i=1}^{4} \alpha_i e_{t-i}^f + \sum_{i=1}^{4} \beta_i m_{t-i}^f + \sum_{i=1}^{4} \delta_i g_{t-i}^f + \sum_{i=1}^{4} \gamma_i y_{t-i}^{*f} + \sum_{i=1}^{4} \tau_i r_{t-i}^{*f} + \varepsilon_t,$$

	1980:1 to 1997:2			***1980:1 to 2000:1***		
Country	α_1 (p-value)	"LR"	$\alpha_i = 0 \; \forall \; i$ p-value	α_1 (p-value)	"LR"	$\alpha_i = 0 \; \forall \; i$ p-value
Hong Kong	0.32	2.29	**.02**	0.40	2.68	**.02**
	(.27)			(.15)		
Singapore	0.00	0.11	.85	-0.09	-0.61	.28
	(.99)			(.71)		
Korea	0.17	4.50	.28	0.17	0.58	.15
	(.65)			(.51)		
Philippines	**0.34**	0.92	.16	0.07	1.72	.41
	(.03)			(.47)		
Malaysia	-0.02	1.94	**.00**	**0.27**	1.03	**.00**
	(.89)			**(.04)**		
Thailand	0.09	1.02	**.01**	-0.01	-0.39	**.00**
	(.10)			(.73)		
Taiwan	**-0.24**	-1.33	.11	-0.08	0.22	.71
	(.02)			(.28)		
Japan	-0.08	-2.28	**.05**	-0.11	-2.00	.08
	(.28)			(.10)		
U.K.	-0.00	0.25	.51	-0.00	0.26	**.01**
	(.84)			(.75)		
France	0.08	-0.89	.29	0.18	-0.81	.26
	(.81)			(.47)		
Australia	-0.06	0.17	.74	-0.01	0.60	.84
	(.27)			(.83)		

Notes: p-values are in parentheses.

Table 3: All variables are differenced, insignificant variables deleted

Equation $$\Delta y_t = \sum_{i=1}^{4} \varphi_i \Delta y_{t-i} + \sum_{i=1}^{4} \alpha_i \Delta e_{t-i} + \sum_{i=1}^{4} \beta_i \Delta m_{t-i} + \sum_{i=1}^{4} \delta_i \Delta g_{t-i} + \sum_{i=1}^{4} \gamma_i \Delta y^*_{t-i} + \sum_{i=1}^{4} \tau_i \Delta r^*_{t-i} + \varepsilon_t,$$

	1980:1 to 1997:2			***1980:1 to 2000:1***		
Country	α_1 (p-value)	"LR"	$\alpha_i = 0 \; \forall \; i$ p-value	α_1 (p-value)	"LR"	$\alpha_i = 0 \; \forall \; i$ p-value
Hong Kong	-0.09	0.07	**.02**	-0.13	-0.02	**.00**
	(.49)			(.29)		
Singapore	0.10	-0.04	.56	-0.01	-0.01	.71
	(.52)			(.94)		
Korea	-0.04	-0.20	.10	**0.19**	-0.16	**.01**
	(.64)			**(.00)**		
Philippines	-0.03	-0.20	**.00**	-0.01	-0.19	**.00**
	(.60)			(.83)		
Malaysia	0.09	-0.11	.74	**0.29**	-0.15	**.00**
	(.40)			**(.00)**		
Thailand	0.04	-0.11	.65	**0.10**	-0.08	**.00**
	(.60)			**(.04)**		
Taiwan	-0.03	-0.17	**.00**	0.00	-0.18	**.01**
	(.60)			(.94)		
Japan	-0.03	-0.03	.52	0.02	-0.03	.99
	(.30)			(.43)		
U.K.	0.01	-0.03	.14	-0.00	-0.04	**.05**
	(.75)			(.99)		
France	-0.04	0.06	.15	-0.04	0.05	.07
	(.41)			(.31)		
Australia	-0.02	0.01	.66	-0.02	0.01	.65
	(.55)			(.45)		

Notes: "LR" is the impact of a unit change of the exchange rate on output growth after 4 quarters (see footnote 5 of the text).

Table 4: Short-term interest rates replacing M2

Equation $$\Delta y_t = \sum_{i=1}^{4} \varphi_i \Delta y_{t-i} + \sum_{i=1}^{4} \alpha_i \Delta e_{t-i} + \sum_{i=1}^{4} \beta_i \Delta r_{t-i} + \sum_{i=1}^{4} \delta_i \Delta g_{t-i} + \sum_{i=1}^{4} \gamma_i \Delta y^*_{t-i} + \sum_{i=1}^{4} \tau_i \Delta r^*_{t-i} + \varepsilon_t,$$

	1980:1 to 1997:2			***1980:1 to 2000:1***		
Country	α_1 (*p*-value)	"LR"	$\alpha_i = 0 \; \forall \; i$ *p*-value	α_1 (*p*-value)	"LR"	$\alpha_i = 0 \; \forall \; i$ *p*-value
Hong Kong	-0.09	0.18	**.03**	-0.08	0.01	**.00**
	(.61)			(.57)		
Singapore	0.08	0.02	.74	-0.08	0.03	.91
	(.67)			(.60)		
Korea	-0.15	-0.14	.15	0.16	0.17	.15
	(.19)			(.07)		
Philippines	0.04	-0.21	**.01**	0.04	-0.18	**.00**
	(.64)			(.52)		
Malaysia	0.22	-0.12	.57	**0.25**	-0.10	**.02**
	(.11)			**(.01)**		
Thailand	0.02	-0.06	.90	0.10	-0.11	**.00**
	(.87)			(.08)		
Taiwan	-0.09	-0.07	**.02**	-0.05	-0.07	.08
	(.29)			(.49)		
Japan	0.00	-0.08	.16	0.05	-0.07	.42
	(.96)			(.18)		
U.K.	0.02	-0.00	.35	0.02	-0.02	.24
	(.45)			(.32)		
France	-0.03	0.07	.41	-0.00	0.06	.58
	(.68)			(.99)		
Australia	-0.03	0.01	.76	-0.03	0.00	.71
	(.30)			(.26)		

Notes: "LR" is the impact of a unit change of the exchange rate on output growth after 4 quarters (see footnote 5 of the text).

Figure 1: Hong Kong - Filtered real output and real exchange rate

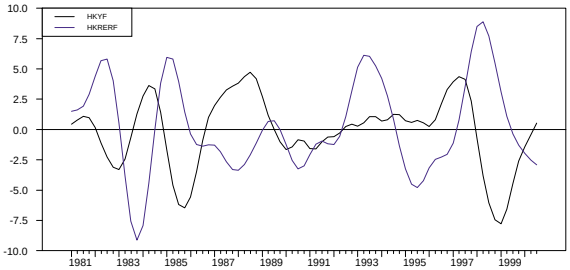


Figure 2: Singapore - Filtered real output and real exchange rate

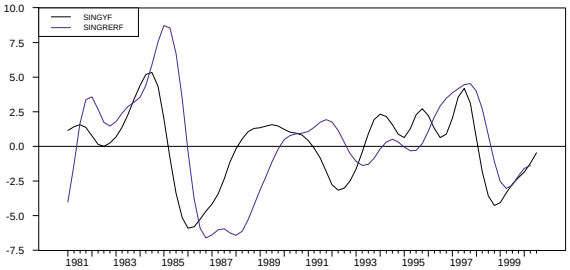


Figure 3: Korea - Filtered real output and real exchange rate

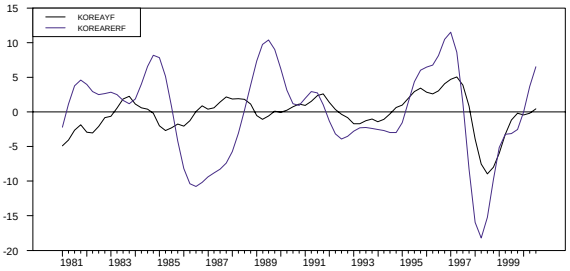


Figure 4: Philippines - Filtered real output and real exchange rate

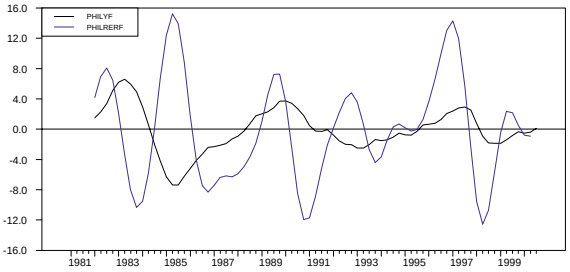


Figure 5: Malaysia - Filtered real output and real exchange rate

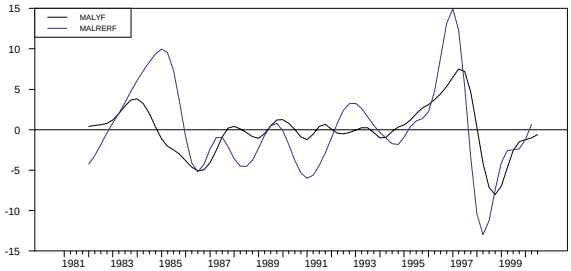


Figure 6: Thailand - Filtered real output and real exchange rate

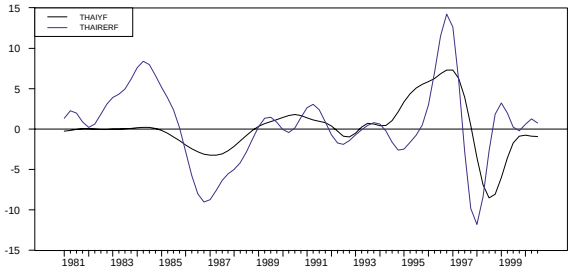


Figure 7: Taiwan - Filtered real output and real exchange rate

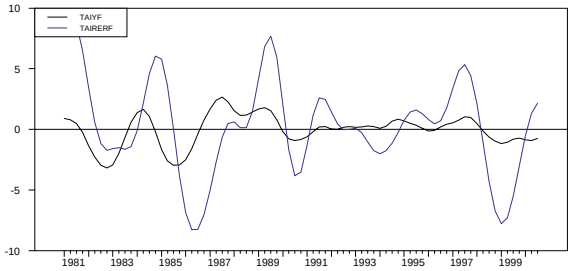


Figure 8: Japan - Filtered real output and real exchange rate

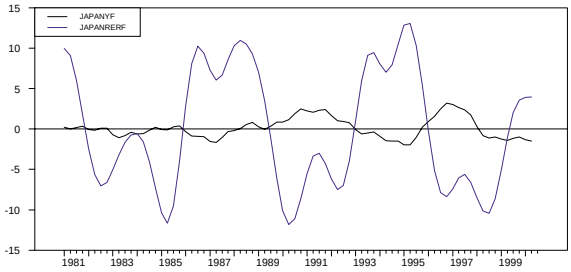


Figure 9: U.K. - Filtered real output and real exchange rate

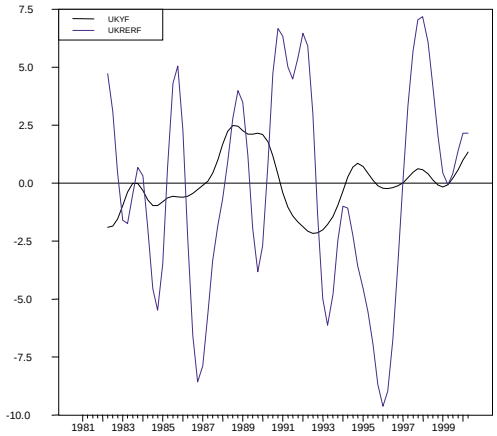


Figure 10: France - Filtered real output and real exchange rate

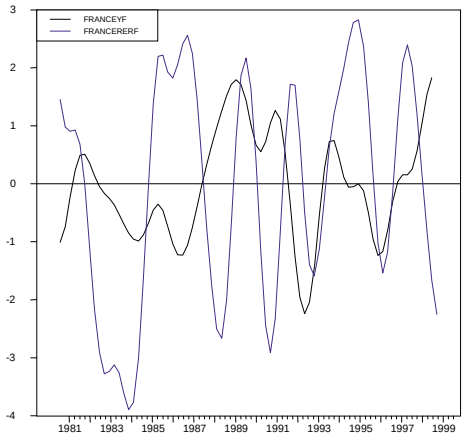


Figure 11: Australia - Filtered real output and real exchange rate

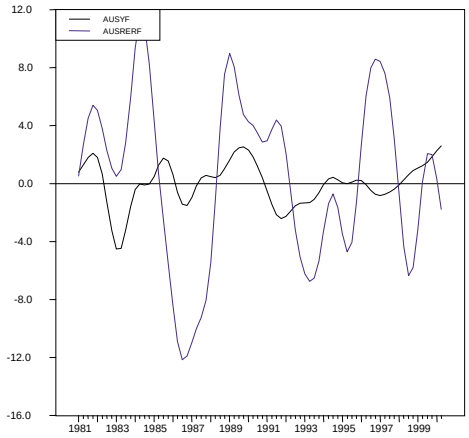
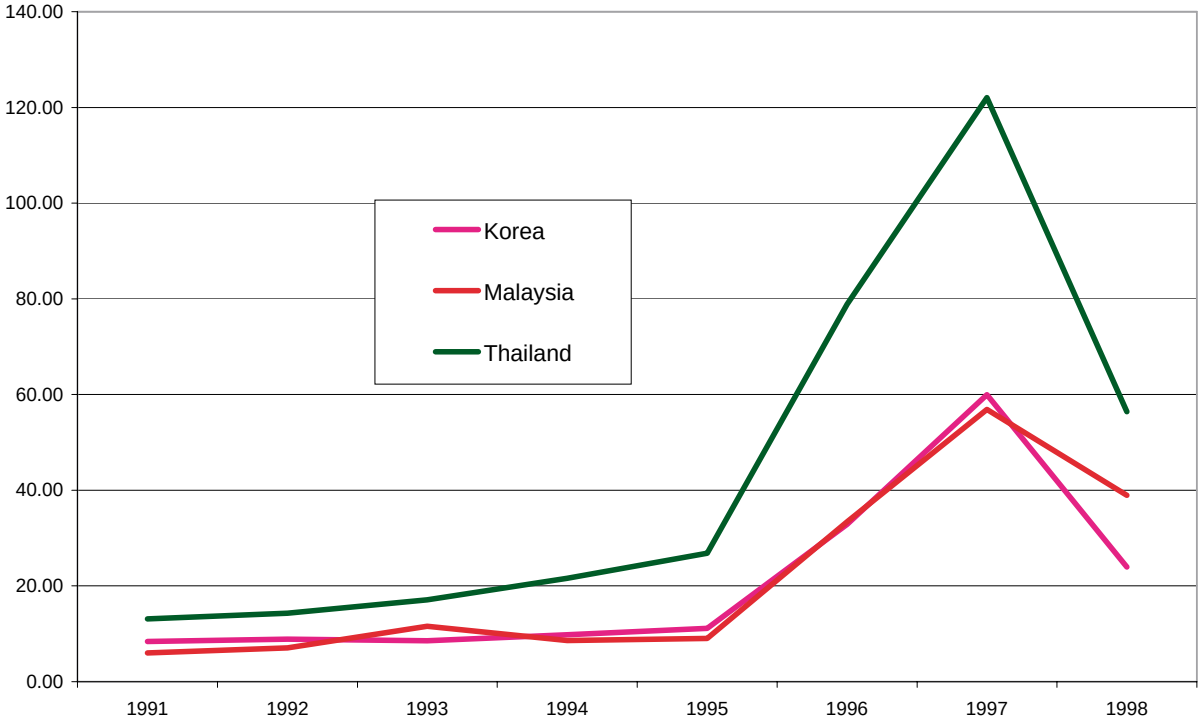


Figure 12: Short-term debt to non-national banks (% of GDP)



Source: BIS-IMF-OECD-World Bank statistics on external debt. Available at www.bis.org

A. Data Appendix

1. Real Exchange Rates
   Real exchange rate series are taken from the IFS for all countries except Indonesia and Thailand, which were taken from the JPMorgan database, and for Hong Kong which is taken from the HKMA internal database.

2. Real Output
   Real output is measured as GDP in constant prices and in domestic currency. The series come from the IFS database line 99, or from the CEIC database. Quarterly data for Malaysia and Thailand is unavailable prior to 1991, and so we have linearly interpolated the annual data.

3. Domestic Interest Rate and Money Supply
   The domestic nominal interest rates used are short-term interest rates and M2 for each country taken from IFS and the CEIC databases.

4. Foreign Interest Rate
   United States Federal Funds rate.

5. Government Consumption Expenditure
   Real government consumption expenditure is taken from the IFS or CEIC databases.