Cambridge Journal of Economics 2008, **32,** 273–288
doi:10.1093/cje/bem042
Advance Access publication 22 November, 2007

Real exchange rate levels and economic development: theoretical analysis and econometric evidence

Paulo Gala*

According to the development approach to exchange rates, competitive currencies have been a key factor in most East and Southeast Asian successful growth strategies. There is also today an important empirical literature that relates overvaluations to low per capita growth rates. While the econometric literature on this issue is relatively rich, theoretical analysis of channels through which real exchange rate levels could affect economic development are very scarce. This paper intends to contribute to the debate by bringing more theoretical elements and providing new econometric evidence to the connections between real exchange rate levels and development.

Key words: Overvaluations, Undervaluations, Economic development
JEL classifications: F3, F4, O2

1. Introduction

According to the development approach to currency management, competitive exchange rates have been a key factor in most East and Southeast Asian successful growth strategies in the last 30 years. More recently, several other countries have also followed this path. Chile, Uganda and Mauritius in the 1980s and India and China in the 1990s have all benefited from competitive real exchange rates, which fostered exports and output growth. Most Latin American and African countries, in contrast, have suffered from severe balance of payment crises due to exchange rate overvaluation. Chile and Mexico in the early 1980s, as well as Mexico, Brazil and Argentina in the 1990s are good examples.

Following the traditional Keynesian macroeconomic channel, an expansionary devaluation boosts exports, income and employment. Exchange rate management may also have strong impacts on aggregate savings as it influences paths of consumption and investment via real wage determination (Bresser-Pereira, 2006). An excessively overvalued currency could cause savings displacement. By stimulating the export sector, a relatively undervalued currency may help to avert financial crises and put the economy on a more sustained developmental path. It is an important tool to promote the development of the tradable sector, which is

Manuscript received 26 February 2007; final version received 26 September 2007.
Address for correspondence: Paulo Gala, Sao Paulo School of Economics, Getulio Vargas Foundation, Rua Itapeva 474, 13o andar, Sao Paulo, Brazil, 01332-000; email: pgala@fgvsp.br

* Sao Paulo School of Economics. I am grateful to Luiz Carlos Bresser-Pereira, Yoshiaki Nakano, Eliana Cardoso, Albert Fishlow, Ha-Joon Chang, Gabriel Palma, Claudio Lucinda, Luiz Gonzaga Belluzzo, Roberto Frenkel, Lance Taylor, K. S. Jomo, José Luis Oreiro, Gilberto Tadeu Lima, Luis Fernando de Paula, Fiona Tregenna and Codrina Rada for all the comments and suggestions during the work.

usually very dynamic and contributes to innovations and productivity increases. Exchange rate policy may therefore be important to avoid Dutch disease (Williamson 2003). Numerous studies have argued that most balance of payments crises are related to overvalued or misaligned currencies (Goldfajn and Valdes, 1996; Palma, 2003).

There is also today an important empirical literature that relates per capita growth rates to real exchange rate levels. Many works find negative correlations between exchange rate misalignment and growth for a long list of developing countries since the 1970s; the more overvalued the currency, the lower the per capita growth rate (Cavallo *et al.*, 1990; Dollar, 1992; Razin and Collins, 1997; Benaroya and Janci, 1999; Acemoglu *et al.*, 2002; Fajnzylber *et al.*, 2002). Other studies have found positive correlations between growth and undervalued currencies measured as accumulation of foreign exchange reserves, a result that seems to suggest an important relationship between growth and exchange rate levels (Popov and Polterovich, 2004). A recurrent issue in this empirical literature is the relative undervaluation of the Asian currencies compared with those in Latin America and Africa for the period 1970–1999 (Dollar, 1992; Benaroya and Janci, 1999). In most works, a lower currency level for Asian countries emerges, which appears to be a regional pattern. For the Latin American and African cases, the pattern seems to be the opposite and overvaluation cycles are very common.

While the empirical literature on this issue is relatively rich, theoretical analysis of channels through which real exchange rate levels could affect economic growth and development are very scarce. Most works tend to concentrate on issues of exchange rate measurement, concepts of equilibrium and indications of misalignment, leaving the theoretical issues aside. The literature on exchange rate policy concentrates itself on country experiences, dedicating little attention to how overvaluations or undervaluations may affect growth. The only literature that briefly mentions these theoretical aspects is a recent one that deals with policy advice (Frenkel and Taylor, 2006; Dooley *et al.*, 2005; Bresser-Pereira and Nakano, 2003).

This paper intends to contribute to the debate by bringing more theoretical elements and providing new econometric evidence to the connections between real exchange rate levels and development. One contribution of this work would then be the focus on macro programming aspects of development, instead of the more traditional trade and industrial policy discussions. The work is divided into five sections. Section 1 is the introduction. Section 2 briefly presents possible long-term effects of real exchange rate levels on growth through two main channels: technological upgrading and capital accumulation. Section 3 deals with the relationship between real exchange rate levels and investment in the short run. It is shown that, for given productivity levels, the real exchange rate may play an important role in determining real wages, profitability and capital accumulation. The model assumes non-neutrality of the nominal and real exchange rate as in the tradition of Keynesian economics. Section 4 presents the econometric analysis, and Section 5 reports some conclusions of the paper.

2. Long-term effects of real exchange rate levels

Two important channels through which exchange rate levels affect long-term growth are related to investment and technological change. By affecting real wages, exchange rate levels influence aggregate savings, investment and foreign debt dynamics. As some authors have demonstrated, in capital account liberalisation processes with strong inflows, what usually happens is currency overvaluation, which increases the consumption of tradable goods. The artificially high real wages caused by the appreciation of the currency stimulates consumption in the country that receives the inflows. Debt is used to finance consumption instead of generating resources to repay it, causing what can be characterised as savings displacement (Bresser-Pereira, 2004). The increase in external borrowing eventually generates unsustainable debt dynamics, and the result of those cycles is a balance of payments crisis.

On the one hand, overvalued currencies also have strong profit squeezing effects in the tradable sector, which usually bring investment rates down. Undervalued currencies tend, on the other hand, to be associated with higher investment levels at the macro level. Based on the work of Bhaduri and Marglin (1990), it is possible to show in a Keynesian framework how an undervalued currency contributes to investment and capital accumulation as discussed in the next section. If we define an investment function that depends on capacity utilisation and on profit margins and a consumption function that depends on real wages, the real exchange rate level can be indirectly introduced in the capital accumulation process.

For given productivity levels, the real exchange rate defines the level of real wages by setting the relative prices of tradables to non-tradables; a relatively appreciated currency meaning lower tradable prices, higher real wages, lower profit margins, higher consumption and lower investment, and a relatively undervalued currency meaning higher tradable prices, lower real wage levels, higher profit margins and investment. In the latter case, an undervaluation would also contribute to more employment and investment by increasing capacity utilisation through higher exports. With sufficiently elastic investment and export responses, the economy would get into an investment-led pattern of growth. Overvaluations would reduce employment and investment.

It is also possible to investigate the shortcomings of low investment levels at the macro level due to overvaluations from a technological perspective. Excessively appreciated currencies affect mostly the profitability of investments in the manufacturing (tradable) sector, where increasing returns are ubiquitous. By relocating resources to non-manufacturing sectors, especially non-tradable activities and commodity production, where decreasing returns rule, overvaluations affect negatively the overall productivity dynamics of the economy. Undervaluations, in contrast, tend to boost profitability and investment in increasing returns sectors.

From a Kaldorian perspective, the real exchange rate level is, thus, a key variable affecting development in an open economy environment. By defining the relative prices of tradables to non-tradables and, therefore, the level of profitability in most manufacturing industries, the real exchange rate determines which sectors are viable. In a developing economy, intense overvaluations tend to shut down whole industries, blocking the channel of productivity increases in the overall economy through the relocation of abundant labour from low-earning and low-productivity jobs to high-earning and high-productivity jobs in manufacturing. In Kaldorian terms, overvaluations may impede developing economies reaching a 'mature' state where surplus labour has been exhausted (Kaldor, 1978). Relative undervaluations may, on the other hand, contribute to productivity increases by integrating workers in increasing returns sectors, avoiding the problems raised by the Dutch disease literature.

By stimulating these non-traditional industries, a competitive exchange rate may be able to change non-price characteristics of goods in the sense of changing export and import elasticities as Barbosa-Filho (2006) argues. If the country is able to move from traditional commodity production to manufacturing for world markets by the help of a competitive currency, exchange rate policy may promote better 'non-price characteristics' of the goods and higher productivity levels. The framework is Kaldorian in the sense that increasing returns are assumed in manufacturing production (or non-traditional commodity-related tradables) and, by stimulating those industries, a competitive currency may help increasing productivity.

On technological grounds, an adequate exchange rate policy can, thus, help the non traditional tradable sector of developing economies, particularly the ones related to export manufactures. As Williamson (2003) argues in his 'development approach' to exchange rates, a competitive currency would provide stimulus for the development of a non-commodity-dependent tradable sector, therefore avoiding Dutch disease problems and premature deindustrialisation (Palma, 2004). By stimulating the production of industrial manufactures to the world markets, a competitive exchange rate would help developing countries to climb up the technological ladder. Learning by doing and cumulative technological progress would depend heavily on the development of the manufacturing sector (Williamson, 2003; Palma, 2004). The argument is especially relevant for resource-rich countries. Appreciated currency levels originating from high commodity exports would prevent the development of an industrial sector with its related economies of scale and technological spillovers. In this sense, by avoiding overvaluations, exchange rate policy could work as an effective industrial policy tool.

To sum up, following all those approaches, competitive exchange rates would avoid savings displacement and contribute to capital accumulation by stimulating investment. On technological grounds, it would encourage the development of the non-traditional tradable sector, helping countries go through structural change and climb up the technological ladder. By increasing productivity and employment, the development of a dynamic non-traditional tradable sector could also increase real wages, counteracting the negative effects of a weak currency for workers.

3. Effects of real exchange rate levels on aggregate investment

One of the most important real effects of exchange rate levels for long-term growth is on aggregate investment. Based on the work of Bhaduri and Marglin (1990), we can show in formal terms how a competitive currency may increase investment and savings, and thus stimulate capital accumulation. By defining an aggregate investment function that depends on capacity utilisation and on profit margins, and a consumption function that depends on real wages, it is possible to set up a macro model where savings and investment levels are a function of real wages and, thus, real exchange rate levels.

We start, following Bhaduri and Marglin (1990), with a savings function that depends on a fixed share of capitalists' profits. Workers do not save, in so far as they consume all their income.

$$S = sR = s(R/Y)(Y/Y^{\star})Y^{\star} \tag{1}$$

where R is the capitalists' income, and $Y^{\star}$ the potential output. By defining $h=R/Y$ as the capitalists' share of total income, $z=Y/Y^{\star}$ as capacity utilisation and normalising potential output $Y^{\star}=1$, we have:

$$S = shz \tag{2}$$

$$1 > h > 0 \tag{2.1}$$

$$1 > z > 0 \tag{2.2}$$

By following a Kaleckian mark-up pricing rule, we can define the price level as follows:

$$p = (1 + m)bw \tag{3}$$

where p is the price level, w the nominal wage, $1/b$ the productivity level, and m a mark-up over labour costs. By defining W/Y as the labour share in income, N as the level of employed workers. and $b=N/Y$, we have the labour share in income as a function of the mark-up level,

$$W/Y = wN/pY = bw/p = 1/1 + m \tag{4}$$

and the capitalists' share in income $h=R/Y$ will be

$$h = R/Y = (pY - wN)/pY = 1 - W/Y = m/1 + m \tag{5}$$

Expressions (3)–(5) give us the traditional distributive relations. For given productivity levels, there is an inverse relationship between mark-ups and real wages. The higher the mark-ups, the lower the real wages and the higher the share of profits in income h.

It is important to introduce at this point a crucial (but fairly ignored) role of real exchange rate levels on the determination of real wages and profitability in the short run. As discussed in the previous section, the more overvalued the domestic currency is, the higher real wages will be, in so far as the prices of tradable consumption goods, especially commodities, will fall together with the appreciation. If we assume that workers receive a nominal wage w and consume tradable and non-tradable goods, their cost of living will depend on the nominal exchange rate level and on the share of tradable goods in their consumption basket. According to this kind of reasoning, real wages and profits will, thus, depend on the level of the real exchange rate, in addition to the patterns of income distribution and productivity levels.

A devaluation of the nominal exchange rate, causing increases in tradable prices compared with the nominal wage, means a reduction in real wages and an increase in profits as long as eventual increases in w due to the devaluation are lower than the increases in the nominal exchange rate, for given international price levels. This usually happens if nominal wages remain constant or move more slowly than the prices of goods. We are, thus, assuming here the hypothesis of nominal wage rigidity and real wage flexibility, as opposed to nominal flexibility and real rigidity.

By assuming, as Bhaduri and Marglin (1990) do, that workers do not save, we can then conclude that higher real wages and appreciated currencies are associated with lower saving rates and higher consumption levels. As a consequence, aggregate demand can increase or decrease because of higher real wages, depending on the effects of lower profit margins on aggregate investment. Following Bhaduri and Marglin (1990), we define an investment function that depends only on profit margins:

$$I = I(h) \tag{6}$$

$$\partial I/\partial h > 0 \tag{6.1}$$

Equilibrium in the goods market is achieved by the traditional savings = investment restriction; in other words an IS curve:

$$shz = I(h) \tag{7}$$

Capacity utilisation levels will vary as a function of profit margins according to the following derivative:

$$\partial z/\partial h = (I_h - sz)/sh \tag{8}$$

$$I_h = \partial I/\partial h > 0 \tag{8.1}$$

As sh is always positive, capacity utilisation will increase or decrease depending on (I_h–sz). If investment is inelastic to changes in profit margins, real wage falls will be recessionary because decreases in consumption will not be compensated for by increases in investment (I_h<sz). This is the classical under-consumptionist thesis, where low real wages lead to low consumption and aggregate demand. In contrast, real wage increases will be expansionary compensating for low investment levels. This kind of 'consumption-led' growth can, nevertheless, be problematic in the long run because of installed capacity constraints. If investment is elastic to profit margins, we have the opposite effect. Lower real wages will increase profit margins and investment, stimulating aggregate demand, capacity utilisation and savings. Growth will then be 'investment led'.

Building on this simple model, Bhaduri and Marglin (1990) introduce capacity utilisation as a direct determinant of investment levels. Responses of aggregate investment depend now on capacity utilisation z and on profit margins and profit shares in income h, which leads to a new goods market equilibrium:

$$I = I(h, z), I_h > 0, I_z > 0 \tag{9}$$

$$shz = I(h, z) \tag{10}$$

$$\partial z/\partial h = (I_h - sz)/(sh - I_z) \tag{11}$$

By imposing the Keynesian condition that equilibrium in goods market is achieved through changes in savings rather than investment (sh–I_z)>0, they arrive at the same conclusions of the simple case where investment depends only on profit margins and profit shares in income h. In a final step, Bhaduri and Marglin (1990) extend the model to the open economy case, with exports X_e and imports X_m that depend, respectively, on the real exchange rate θ and on capacity utilisation z, with the following elasticities:

$$(dX_e/d\theta)(\theta/X_e) = \eta_e \tag{12}$$

$$(dX_m/d\theta)(\theta/X_m) = -\eta_m \tag{13}$$

$$(\partial X_m/\partial z)(z/X_m) = u \tag{14}$$

In the new goods market equilibrium, total savings plus imports M equals total investment plus exports E:

$$shz + M = I(h, z) + E \tag{15}$$

The partial derivative of capacity utilisation z with respect to profit margins and profit share h is very similar to the closed economy case (8):

$$\partial z/\partial h = (I_h - sz)(gu + sh - I_z) \tag{16}$$

where g represents the initial share of imports and exports in GDP, and u is the elasticity of imports with respect to capacity utilisation. By assuming that (gu+sh–I_z) > 0, we arrive again at the same conclusions of the simple case.

In the open economy case, a real devaluation decreases the real wage and increases profit margins for given productivity levels. Income, exports and investment will increase as long as those two macro functions are sufficiently elastic. In the case of exports and imports, the overall effect on external accounts will be positive if the Marshall–Lerner condition holds ($\eta_e+\eta_m>1$).

4. Overvaluations, undervaluations and growth

Currency misalignment measures are far from consensual. Two methods of dealing with the problem are the most popular: purchasing power estimates and 'fundamental' exchange rate equilibrium. The first is based on Purchase Power Parity (PPP) comparisons, usually adjusted for the Balassa–Samuelson effect, and considers high international price levels as a proxy for overvaluations for a given real GDP per capita level. According to Balassa (1964), developed countries are more productive than developing countries in tradables and have the same productivity in non-tradables. Assuming that prices of tradables equalise between countries (law of one price) and that the domestic labour markets are not segmented, lower labour productivity in tradables will mean lower wages in developing countries in both sectors, tradables and non-tradables, resulting in lower relative prices of non-tradables in these economies. The second method takes into account internal and external conditions (capacity utilisation and balance of payment financing conditions for a given state of variables) when measuring 'fundamental' exchange rate equilibrium and considers low growth levels or unsustainable current account trajectories as possible signs of misalignment; see Montiel and Hinkle (1999) for a detailed discussion.

In misalignments measured as PPP deviations with Balassa–Samuelson adjustments, a currency is regarded to be in a 'wrong' position if prices in international comparisons are too high compared with what they should be if per capita income levels are taken into account (Dollar, 1992; Benaroya and Janci, 1999). Per capita income levels can be taken as proxies for productivity levels and, thus, as good measures for non-tradables remuneration, especially labour, compared with tradables. A 'correct' exchange rate in terms of PPP deviations would align real wages with productivity levels. Overvalued currencies would be associated with excessively high real wages and foreign indebtedness or high trade protectionism. An equilibrium real exchange rate would, thus, be associated with adequate real wage levels according to per capita income.

For the second method, an equilibrium exchange rate would be associated with reasonable growth and sustainable external debt, in other words, to full employment (internal balance) and proper current account financing (external balance). This 'equilibrium' usually depends on several other macro variables, such as: i) terms of trade, ii) domestic and international interest rates, iii) tariffs, iv) international transfers and aid, v) capital controls, vi) government spending and vii) productivity shifts. An increase in international interest rates, worsening terms of trade and lower tariffs or transfers and aid tend to depreciate the currency. An opening of capital accounts, an increase in government spending in non-tradables and productivity increases tend to appreciate the currency (see Cavallo *et al.*, 1990).

In this paper, we present new econometric evidence for the exchange rate levels and growth relation based on PPP deviations. In line with other works in the literature, the results here show a negative relationship between growth and overvaluations for a panel of 58 developing countries from 1960 to 1999 using PPP measures. The estimations also adopt a new overvaluation index that takes into account variations in real per capita incomes, thus adjusting traditional exchange rate estimates for the so-called Balassa–Samuelson effect (Balassa, 1964). By correcting traditional real exchange rate annual estimates for gross domestic product (GDP) per capita increases, the index controls the data for appreciation due to productivity increases (as Dollar (1992) and Benaroya and Janci (1999) do for some specific years). The real exchange rate is introduced in the panel analysis in the spirit that its level has important real consequences, in terms of both capital accumulation and technological development, following the tradition of Keynesian economics, as discussed above.

The prime source for the panel data analysis that follows is the database compiled by Easterly (2005). Real exchange rate levels are measured by the computations of Easterly (2001), following Dollar's (1992) work as explained below. GDP levels and growth rates are computed from the World Bank database. The sample contains 58 developing countries with average per capita income between approximately US$500 and US$7.000 PPP in the period from 1960 to 1999. If the lower bound for inclusion in the sample was above US$500, many African countries which experienced significant exchange rate appreciation would be left outside the sample. If the bound was set above US$7.000 PPP, many countries that are now considered developed would be included. From a grand total of 58 countries, 23 are from Africa, 19 from Latin America and Caribbean, 13 from Asia and Middle East and 3 from Europe. In addition to the selection based on per capita income levels, data availability were also taken into account.

Figure 1 shows—on a logarithmic scale—a scatter plot of per capita GDP growth rates and real exchange rate levels for the mentioned countries from 1960 to 1999. The averages

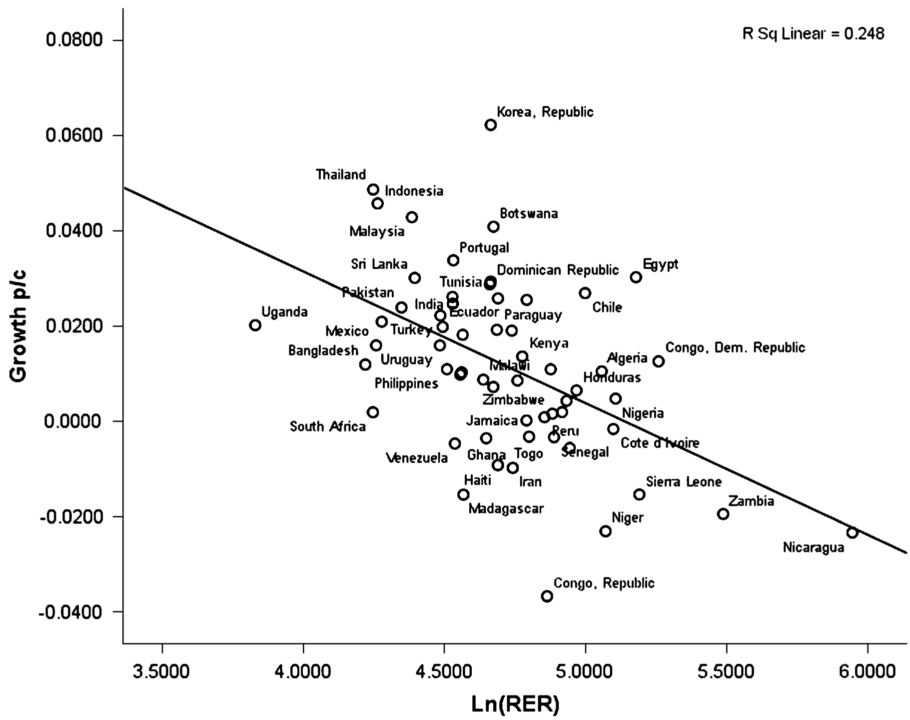

Fig. 1. *Growth and overvaluations. Elaborated by the author based on Easterly (2001).*

were computed according to data availability. The data show that, for the period average, countries with relatively overvalued real exchange rates experienced lower per capita income growth rates. The African countries tend to cluster on the right-hand side of the figure, showing relative overvaluation and the Asian countries on the left-hand side, showing relative undervaluation.

Control variables chosen for the econometric analysis can be classified into two groups: structural and macroeconomic. The first group represents the well-known variables of the economic growth literature and includes proxies for human capital, physical and institutional infrastructures. The second group uses variables from a more recent literature that tries to correlate short-run variables with long-run economic results. In that group, we have selected inflation rates, capacity utilisation—or product gap—and terms of trade shocks.

The first variable in the structural group is related to current investment in human capital, which is considered to be a production factor, as well as having effects on total factor productivity. This is measured from data on the gross rate of secondary school enrolment, according to the tradition in the literature (see Easterly, 2001; Fajnzylber *et al.*, 2002). The second structural variable to be used tries to measure public infrastructure availability. The results relating higher growth rates to better infrastructure are also well known in the empirical literature. Given the difficulties on data collection in this area, we decided to use data on telecommunications infrastructure, measured as the number of phone lines per capita, as computed in Fajnzylber *et al.* (2002). It seems reasonable to use this variable as a proxy for physical infrastructure because the literature documents a high correlation between per capita phone lines and other infrastructure measures such as transport and energy. The third structural variable refers to the quality of the institutional environment, which should be directly connected to production and investment conditions. We used the index computed by the *Political Risk Services* (International Country Risk Guide—ICRG) which includes the following variables: rule of law, quality of bureaucracy, absence of corruption and the level of accountability of public servants. Population growth was also used as a control variable in the regressions because it affects per capita growth rates independently of the growth of output.

Regarding macro-environment variables, the first one is related to price level stability. Following various studies, we take the yearly average inflation level as an indication of macroeconomic stability. The second one, which we denote 'Initial GDP gap' gives a measure of idle installed capacity or output gap. The lower the activity level, the greater are the opportunities for increases in income and production due to a greater use of already existing capital and labour stocks. The variable terms of trade shocks captures the positive—or negative—effects of international trade, which can be translated into changes in GDP growth rates. Data on both the product gap and terms of trade are from Fajnzylber *et al.* (2002). Finally, the most important variable for this paper measures the degree of overvaluation of the national currency using an adjusted series based on Easterly (2001).

Easterly (2001) builds a series of real exchange rates from 1960 until 1999 for developed and developing countries. The author applies, initially, the traditional methodology for calculations of the real exchange rate: (Domestic CPI)/(Exchange Rate Domestic Currency to per Dollar $\times$ US CPI). To make the series of different countries fairly comparable, he centres his results in index numbers using the values found by Dollar (1992). For each country, the author benchmarks the series of index numbers in order to make the averages for the period 1976–1985 equal to Dollar's work (Easterly, 2001, p. 9). A real exchange rate of 100 in Easterly's (2001) series means a position exactly equivalent to a PPP exchange rate adjusted for the per capita income of the country between the years 1976 and 1985 using Dollar's methodology; in other words, a 'neutral' exchange rate. An index higher than 100 means a relative overvaluation and lower than 100 a relative undervaluation.

Dollar (1992) uses Heston and Summers' PPP estimations to calculate relative international price levels for 95 developing countries from 1976 to 1985. The author compares local prices measured in dollars using current nominal exchange rates with prices in dollars in the US. If prices are the same, the exchange rate is said to be in a neutral position. If prices are higher (lower) there might be some overvaluation (undervaluation). As Dollar (1992) argues, those estimates have to take into account the fact that prices of non-tradables in poorer countries tend to be lower because of lower wages. Thus, overvaluation or undervaluation has to be analysed in terms of relative per capita income levels. Following Dollar (1992), we adjust Easterly's (2001) index for the estimations to consider changes in productivity levels (proxied by per capita incomes) for all years since 1960. According to the arguments presented on the previous sections, we expect overvalued real exchange rates to be related to lower GDP growth rates due to their short-run problems (balance of payments crises), as well as their long-run negative effects (low investment, lack of technological innovations and productivity growth, as in Dutch disease cases).

Finally, the initial per capita income level was used as an additional regressor following the conditional convergence hypothesis of the economic growth literature. Given the same macroeconomic and structural characteristics (such as human capital, inflation levels, etc.), countries with higher per capita PPP incomes are expected to grow less owing to decreasing marginal returns on the capital stock. All variables on the estimations, except product gap, population growth, terms of trade shocks and per capita income growth rates, were transformed into logarithms. Despite the care in selecting countries regarding data availability, the final panel database was unbalanced, as data could not be found for all countries in all years. The main estimation procedure was done using five-year averages.

The econometric framework used follows the traditional literature of growth regressions (for some examples, see Acemoglu, 2002; Fajnzylber *et al.*, 2002). GDP per capita growth rate is the dependent variable, which is expected to depend on a vector of variables representing growth determinants $X_{i,t}$, together with the initial GDP per capita levels $Y_{i,t}$ for each country i in a given time period t. The estimated model follows the traditional specification in which n is the number of periods included:

$$(\ln(Y_{i,t+1}) - \ln(Y_{i,t}))/n = \beta_0 + \beta_1 \ln(Y_{i,t}) + \beta_2 X_{i,t} + \epsilon_{i,t} \qquad (17)$$

The main advantage of panel data estimation is that it allows both the cross-sectional and time series characteristics of the sample to be exploited. However, some adjustments must be made regarding estimation problems. Among the possible pitfalls, we can single out the endogeneity problem posed by Bond *et al.* (2001). By using the initial level of per capita income on the right-hand side of equation (17) for convergence analyses, the model ends up using the dependent variable as one of the regressors, causing possible biases on the estimators. An additional problem lies in the use of the per capita income level as a proxy for productivity differentials in order to adjust the level of real overvaluation. Thus, panel estimates, with either fixed or random effects for modelling the unobserved heterogeneity, are expected to be biased.

To avoid these problems, the following specification with generalised method of moments (GMM) estimation was used. The left-hand side of the equation represents per capita income growth rates for each period analysed, μ captures time specific effects, η country specific effects, and $\varepsilon_{i,t}$ represents the idiosyncratic errors.

$$\ln(Y_{i,t+1}) - \ln(Y_{i,t}) = \beta_1 \ln(Y_{i,t}) + \beta_2 X_{i,t} + \mu_t + \eta_i + \epsilon_{i,t} \tag{18}$$

The results are shown in Tables 1 and 2. The estimation technique used was GMM, because it is flexible enough to deal with the measurement errors and endogeneity problems, as in Bond *et al.* (2001). Following Arellano and Bover (1995) and Blundell and Bond (1998), GMM system estimators were also used. They are expected to outperform the GMM difference estimator when the instruments present a high degree of persistence. In those cases, lagged differences tend to be poor instruments, leading to unreliable estimates for the GMM difference estimators. All standard errors presented in the results (Table 1)—for both the system and difference GMM estimates—are robust to heteroscedasticity and autocorrelation of arbitrary form. As for the choice of variables, the initial output gap for each five-year period and terms of trade growth were included as exogenous, and the others were assumed to be endogenous, for which their own lags were used as instruments.

The estimates using the real exchange rate with productivity adjustments *à la* Balassa–Samuelson are in accordance with expectations; the initial per capita income gives a significant negative sign in all estimated models. As for the structural variables, the coefficient associated with the schooling variable presents a positive sign, significant in the GMM system estimates. In the case of the macroeconomic variables, both inflation and the output gap present coefficients with the expected signs in GMM system estimation. Terms of trade are positively related to per capita income growth rates, and exchange rate overvaluation is negatively related to per capita income growth. The coefficients for the time dummies point to a decrease in growth rates in recent years.

As a check on the model's adequacy, the Sargan test for orthogonality of the instruments and error terms was used. The *p*-values of the tests indicate both models—system and difference GMM estimators—as adequate; however, the difference in the Sargan statistics points to the superiority of the GMM system estimator compared with the GMM difference estimator. The models were also estimated without the heteroscedasticity and autocorrelation corrections, reaching closer results to the ones presented by Fajnzylber *et al.* (2002) (Table 2). Several other specifications with the control variables were also tried, and no relevant differences in the results in terms of sign and significance of the variables were found.

The estimates using real exchange rates with and without adjustments for productivity differentials (proxied by per capita income differentials) show that both the absolute value and the significance of the coefficient associated with overvaluations are relevant. This indicates that real exchange rate levels have an important impact on real per capita income growth rates. The estimated coefficients for this variable are negative, ranging between 0.0111 and 0.0153 and highly significant. This implies that an exchange rate 'undervalued' by 10 percentage points is associated with a growth of real per capita income up to $0.0153 \times 10/100 = 0.00153$ or 0.153% higher.

5. Latin America versus East Asia

According to the arguments presented above, a central issue in understanding the East and Southeast Asian successes, compared with the Latin American and African failures in the last 30 years, might be in the way in which they have conducted their exchange rate policies

Table 1. *Overvaluations and growth (robust)*

Dependent variable: p/capita growth rates	MQO pool	Fixed effects	GMM-DIFF	GMM-SYS
Initial GDP per capita	–0.0208*** (–4.4760)	–0.0753*** (–8.4897)	–0.0698*** (–3.6041)	–0.0456** (–2.7261)
Initial output gap	–0.1028* (–2.1985)	–0.1098* (–2.4021)	–0.1830*** (–3.4430)	–0.1772** (–2.7505)
Education	0.0117*** (3.8613)	0.0028 (0.4804)	0.0011 (0.0768)	0.0209* (2.1486)
Public infrastructure	0.0077** (3.1896)	0.0209*** (3.6915)	0.0310 (1.6492)	0.0266* (2.1848)
Governance	0.0044*** (3.3654)	0.0040 (1.9253)	–0.0027 (–0.6868)	0.0050 (1.3169)
Lack of price stability	–0.0149*** (–4.8950)	–0.0120*** (–3.6655)	–0.0102 (–1.8065)	–0.0154 (–1.6718)
Exchange rate overvaluation (adjusted)	–0.0121*** (–4.3960)	–0.0174*** (–4.2385)	–0.0089 (–1.0164)	–0.0153** (–2.6281)
Terms of trade shocks	0.0447 (1.5800)	0.0449 (1.7495)	0.0439 (1.3194)	0.0411 (1.2928)
Population growth	–0.2309 (–1.2505)	–0.1664 (–0.5222)	0.6523 (0.6448)	1.1928 (1.5563)
Years 66–70	–0.0018 (–0.2572)	0.0062 (0.9582)	0.0076 (1.0577)	–0.0037 (–0.8411)
Years 71–75	–0.0038 (–0.5503)	0.0059 (0.8407)	0.0051 (0.4127)	–0.0117 (–1.6269)
Years 76–80	–0.0102 (–1.4617)	0.0075 (0.8818)	0.0061 (0.3261)	–0.0154 (–1.4271)
Years 81–85	–0.0296*** (–4.3898)	–0.0092 (–0.9870)	–0.0105 (–0.4799)	–0.0376*** (–4.7894)
Years 86–90	–0.0193** (–2.8844)	–0.0039 (–0.3836)	–0.0058 (–0.2288)	–0.0324*** (–4.2497)
Years 91–95	–0.0254*** (–3.6885)	–0.0115 (–0.9830)	–0.0111 (–0.3612)	–0.0452*** (–5.0167)
Years 96–99	–0.0283*** (–3.9879)	–0.0148 (–1.1153)	–0.0175 (–0.4894)	–0.0508*** (–4.4281)
Constant	0.2613*** (7.1769)	0.6620*** (9.2520)		0.3627** (2.9970)
N-obs	341	341	281	341
R^2	0.370	0.387		
Sargan			42.087	35.180
Sargan-*p*-val			0.191	0.998
Sargan DF			35.000	62.000

Note: *p<0.05, **p<0.01, ***p<0.001.

Table 2. *Overvaluations and growth*

Dependent variable: p/capita growth rates	MQO pool	Fixed effects	GMM-DIFF	GMM-SYS
Initial GDP per capita	–0.0177*** (–3.8761)	–0.0588*** (–7.2482)	–0.0633** (–3.1364)	–0.0318*** (–3.9114)
Initial output gap	–0.1002* (–2.1239)	–0.1471** (–3.1667)	–0.2001*** (–3.9553)	–0.1462*** (–3.4627)
Education	0.0110*** (3.5901)	0.0016 (0.2660)	–0.0063 (–0.5051)	0.0209*** (4.5294)
Public infrastructure	0.0068** (2.8214)	0.0204*** (3.4696)	0.0262 (1.5144)	0.0215*** (3.3398)
Governance	0.0044** (3.2963)	0.0038 (1.7692)	–0.0036 (–1.0855)	0.0041* (1.9724)
Lack of price stability	–0.0160*** (–5.2639)	–0.0145*** (–4.3535)	–0.0128* (–2.0163)	–0.0197*** (–5.0448)
Exchange rate overvaluation	–0.0117*** (–3.6625)	–0.0052 (–1.2400)	0.0058 (0.7326)	–0.0111** (–3.1362)
Terms of trade shocks	0.0462 (1.6176)	0.0553* (2.0995)	0.0605* (2.0324)	0.0391** (2.9029)
Population growth	–0.3188 (–1.7376)	–0.2002 (–0.6101)	0.8255 (0.9648)	1.0384** (2.6184)
Years 66–70	–0.0015 (–0.2179)	0.0056 (0.8414)	0.0113 (1.3872)	–0.0041 (–1.6785)
Years 71–75	–0.0032 (–0.4653)	0.0046 (0.6379)	0.0121 (0.9847)	–0.0113*** (–3.5994)
Years 76–80	–0.0093 (–1.3189)	0.0046 (0.5195)	0.0141 (0.8237)	–0.0153*** (–3.5441)
Years 81–85	–0.0287*** (–4.2236)	–0.0112 (–1.1499)	0.0022 (0.1055)	–0.0383*** (–10.9477)
Years 86–90	–0.0195** (–2.8804)	–0.0061 (–0.5699)	0.0098 (0.3902)	–0.0316*** (–8.3012)
Years 91–95	–0.0256*** (–3.6790)	–0.0130 (–1.0444)	0.0084 (0.2772)	–0.0432*** (–8.6943)
Years 96–99	–0.0285*** (–3.9793)	–0.0176 (–1.2536)	0.0044 (0.1221)	–0.0477*** (–7.7964)
Constant	0.2475*** (6.7925)	0.5000*** (8.0758)		0.2740*** (4.5833)
N-obs	341	341	281	341
R^2	0.359	0.350		
Sargan			54.650	32.142
Sargan-*p*-val			0.018	0.999
Sargan DF			35.000	62.000
P-val Autocorr.1			0.000	0.000
P-val Autocorr.2			0.544	0.510

Note: *$p<0.05$, **$p<0.01$, ***$p<0.001$.

and, thus, in their real exchange rate levels. When discussing the impacts of the debt crisis in Latin America and East Asia at the beginning of the 1980s, Sachs (1985), for example, concludes that the superior adjustment of the Asian countries took place mainly because of their superior exchange rate and trade regimes. Except for the case of the Philippines, none of the high performing Asian economies has defaulted on external debt, a very different situation compared with Latin America. According to the author, these two regions had three common and one distinct characteristic that was responsible for their relatively smooth transition in the debt crisis. In terms of external debt, the Asian countries had practically the Latin American levels. South Korea, for example, had a total external debt over GDP of 27.6% in 1981, higher than the Brazilian level of 26.1% for the same year. When it comes to terms of trade, the author argues that some of the Asian countries have had even worse shocks than the Latin American countries. Regarding state intervention, Sachs argues that both regions went through a process of some form of state-led development.

The great difference between these two macro regions is then to be found in 'trade regime and exchange rate management'. While Latin America focused on an inward-looking industrialisation strategy with a strong bias for currency appreciations, East and Southeast Asian countries pursued an export-led growth strategy, with heavy stimulus for the export sector through subsidies and competitive exchange rates. The reason for the better adjustment of East Asia to the debt crisis would then be in the existence of an ample and dynamic tradable sector, capable of producing the hard currency when the day of reckoning came. This difference can be easily seen when we compare the export to external debt ratio for both regions at the beginning of the 1980s. Indonesia, South Korea, Malaysia and Thailand had on average an index of 0.821 in 1981 compared with an average index of 2.715 for Argentina, Brazil, Chile, Mexico, Peru and Venezuela in the same year (Sachs, 1985).

While Latin American countries went through their well-known populist and stabilisation episodes during the 1980s and 1990s, East Asian countries focused on their export-led growth strategy, especially after the Plaza accords, with a permanent stimulus for their export sector avoiding episodes of strong appreciation since the debt crisis. While the former have used exchange rates prominently as a populist or stabilisation tool, the latter have targeted their exchange rate policies in search of external demand, following their development strategy. Regarding the 1997 Asian crisis, it is worth mentioning that the appreciation of some of the currencies in the region in 1996 and 1997 strongly contributed to the collapse. As Lim (2004) puts it, those countries, 'in varying degrees, had a tendency to incur high deficits in their current account and overvalue their currency. This last was what made the East Asian countries eventually "un-East Asian" since the earlier East Asian stereotype was a high saver and a high earner of foreign exchange'(Lim, 2004, p. 67).

Another main difference between these two regions is to be found in their savings and investment levels. East Asia is well known for its very high levels of investment and savings, whereas Latin American countries are famous for their excessive consumption and lack of savings. As we have shown above, it is possible to argue from a broad Keynesian perspective that competitive currencies can also be associated with high levels of savings and investment. The stylised facts found in East Asia regarding savings and investment patterns can, thus, be interpreted from this point of view. Undervalued currencies helped to produce investment-led growth patterns in Asia, whereas overvalued currencies contributed to instability and consumption-led growth cycles in Latin America.

The general empirical findings of this paper also point out the relevance of real exchange rate levels and policy to GDP per capita growth rates. The results are in line with the old econometric evidence that reports the shortcomings of overvaluations for long-term growth. These findings, therefore, support several case studies that show the connections between competitive currencies and high growth in East Asia as opposed to the Latin American and African problematic experiences with overvaluations in the last 30 years.

Regarding East Asian countries, we do not claim here that exchange rate policy alone tells the whole story, but we think that the articulation of industrial and trade policies together with what some authors call a pro-investment economic policy (low interest rates and competitive currencies) are a big part of the story. Regarding inflationary processes in Latin America, it is true that the recent story of the continent has been one of overvaluations, devaluations and crises due to economic populism and stabilisation plans based on exchange rate anchors. In that regard, what we argue for here is the avoidance of overvaluations, which are very costly to correct, especially in terms of the inflationary consequences of devaluations.

This is not to say that programming the real exchange rate is an easy task. In cases of full employment or excessive aggregate demand, there is a high probability that nominal devaluations will lead to higher prices, neutralising real devaluations. For a nominal devaluation to work, unemployment (or surplus labour) and relative price stickiness have to be assumed, so that exports and investment can react to the new set of relative prices without triggering an inflationary process. Even if that is the case, in an open capital account environment there might be other difficulties, as Frenkel and Taylor (2006) show. In the face of free capital flows, it might be even harder for the central bank to manage the nominal exchange rate because of interest rates arbitrage. The discussion of all those issues would require another paper. Our main point here was related to the effects of real exchange rate levels on growth as a step towards better explaining the development approach to exchange rates.

Bibliography

Acemoglu, D., Johnson, S., Thaicharoen, Y. and Robinson, J. 2002. 'Institutional Causes, Macroeconomic Symptoms: Volatility, Crisis and Growth', NBER Working Paper 9124

Arellano, M. and Bover, O. 1995. Another look at the instrumental-variable estimation of error-components models, *Journal of Econometrics*, vol. 68, no. 1, 29–52

Balassa, B. 1964. The purchasing power parity doctrine: a reappraisal, *Journal of Political Economy*, December, 584–96

Barbosa-Filho, N. H. 2006. Exchange rates, growth and inflation, paper presented at the Annual Conference on Development and Change ACDC, Campos Do Jordão, Brazil, 18–20 November

Benaroya, F. and Janci, D. 1999. Measuring exchange rates misalignments with purchasing power parity estimates, in Collignon, S., Pisani-Ferry, J. and Park, Y. C. (eds), *Exchange Rate Policies in Emerging Asian Countries*, New York, Routledge

Bhaduri, A. and Marglin, S. A. 1990. Unemployment and the real wages: the economic basis for contesting political ideologies, *Cambridge Journal of Economics*, vol.14, December

Blundell, R. W. and Bond, S. R. 1998. Initial conditions and moment restrictions in dynamic panel data models, *Journal of Econometrics*, vol. 87, 115–43

Bond, S., Hoeffler, A. and Temple, J. 2001. GMM estimation of empirical growth models, *CEPR Discussion Paper* 3048, London

Bresser-Pereira, L. C. 2004. Brazil's quasi-stagnation and the growth cum foreign savings strategy, *International Journal of Political* Economy, vol. 32, no. 4, 76–102

Bresser-Pereira, L. C. 2006. Exchange rate, fix, float or manage it? Preface to Vernengo, M. (ed.), *Financial Integration or Dollarization: No Panacea*, Cheltenham, Edward Elgar

Bresser-Pereira, L. C. and Nakano, Y. 2003. Crescimento com poupança externa? *Revista De Economia Política*, vol. 22, no. 2

Cavallo, D. F., Cottani, J. A. and Kahn, M. S. 1990. Real exchange rate behavior and economic performance in LDCS, *Economic Development and Cultural Change*, vol. 39, October, 61–76

Dollar, D. 1992. Outward-oriented developing economies really do grow more rapidly: evidence from 95 LDCS, 1976–1985, *Economic Development and Cultural Change*, vol. 40, 523–44

Dooley, M. P., Landau, D. F. and Garber, P. 2005. 'Interest Rates, Exchange Rates and International Adjustments', NBER Working Paper 11771, November

Easterly, W. 2001. The lost decades: developing countries' stagnation in spite of policy reform 1980–1998, *Journal of Economic Growth*, vol. 6, no. 2, 135–57

Easterly, W. 2005. Macro time series, http://www.nyu.edu/fas/institute/dri/Easterly

Fajnzylber, P., Loayza, N. and Calderón, C. 2002. *Economic Growth in Latin America and the Caribbean*, Washington, DC, The World Bank

Frenkel, R. and Taylor, L. 2006. Real exchange rate, monetary policy and employment, *DESA Working Paper* 19, New York, United Nations

Goldfajn, I. and Valdes, R. 1996. 'The Aftermath of Appreciations', NBER Working Paper 5650, July

Kaldor, N. 1978. Causes of the slow rate of growth of the United Kingdom, pp.100–38 in *Further Essays on Economic Theory*, London, Duckworth

Lim, J. 2004. Macroeconomic implications of the Southeast Asian crises, in Jomo K. S. (ed.), *After The Storm: Crisis, Recovery and Sustaining Development in Four Asian Economies*, Singapore, Singapore University Press

Montiel, P. and Hinkle, L. 1999. *Exchange Rate Misalignment, Concepts and Measurement For Developing Countries*, World Bank Research Publication, Oxford, Oxford University Press

Palma, G. 2003. The three routes to financial crises: Chile, Mexico and Argentina [1]; Brazil [2], and Korea, Malaysia and Thailand [3], in Ha-Joon Chang (ed.), *Rethinking Development Economics*, Anthem Press

Palma, G. 2004. Four sources of de-industrialization and a new concept of the Dutch Disease, in Ocampo, J. A. (ed.), *Beyond Reforms: structural dynamics and macroeconomic vulnerability.* Stanford University Press and World Bank

Popov, V. and Polterovich, V. 2002. 'Accumulation of Foreign Exchange Reserves and Long Term Growth', mimeo, New Economic School, Moscow

Razin, O. and Collins, S. 1997. 'Real Exchange Rate Misalignments and Growth', NBER Working Paper 6147

Sachs, J. 1985. External debt and macroeconomic performance in Latin America and East Asia, *Brookings Papers on Economic Activity*, vol. 2, 523–73

Williamson, J. 2003. Exchange rate policy and development, presented at Initiative for Policy Dialogue Task Force on Macroeconomics, Columbia, NY