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Abstract

Growth is endogenous in small open economies with substantial hidden or open unemployment, even under constant returns to scale. Growth promoting policies, however, have implications for the balance of trade, and two instruments are needed in order to achieve targets for both the growth rate and the balance of trade. The real exchange rate can serve as one of those instruments. Distributional conflict imposes constraints on real exchange rate policies, but in LDCs the main exchange-rate related distributional conflict may be over the sectoral distribution of profits, rather than the real wage. This paper develops a model along these lines and presents empirical support for the hypothesis that real exchange rate undervaluations are a useful instrument for the pursuit of accumulation and growth in low income countries.

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1 Introduction

Growth is endogenous in a dual economy without full employment, as evidenced for instance by the classic Harrod-Domar and Lewis models. This endogeneity of the growth rate also applies to open economies. In open economies, however, one needs to consider the implications of growth promoting policies for the balance of trade. Our basic argument is simple: two instruments are needed in order to achieve two targets (a growth rate and a balance of trade target). The real exchange rate can serve as one of those instruments.

Most of contemporary economics assumes full employment, and those models that do include unemployment tend to play down the balance of payments constraint and the role of the real exchange rate in this regard. We disagree with both of these positions. Many developing economies have significant amounts of (hidden) unemployment, and a recent empirical literature suggests that the real exchange rate may have an important influence on long term economic performance. The precise mechanisms behind this influence, however, are unclear, and it is one of the aims of this paper to help fill that gap.[1]

We set up a stylized model of a small open economy. The economy has two sectors, both with constant returns to scale. A modern sector produces a tradable good while the output of a traditional sector is non-tradable. Only the former uses capital and all capital goods are imported. Assuming unemployment, we show that changes in the real exchange rate affect the quantity and composition of employment and that the real exchange rate can be used to facilitate sustained capital accumulation. Real exchange rate policies of this kind have distributional effects but in low income countries, we argue, the main exchange-rate related distributional conflict may be over the sectoral distribution of profits.

Our empirical section focuses on the role of real exchange rate undervaluations in promoting investment and output growth. We begin by replicating the results reported by Rodrik (2008). We find that Rodrik's conclusion pertaining to differences between developing and developed countries in the growth effect of real exchange rate misalignments is sensitive to how these groups are defined in terms of income levels. We then create alternative classifications and find that, in general, real exchange rate misalignments do appear to have a more significant effect on growth for developing countries. Our main empirical contribution, however, is to analyze the relationship between real exchange rate changes and *investment* in light of our theoretical framework. We show that real exchange rate undervaluations are (statistically) significant drivers of investment growth, but only in developing countries. This result is robust to different specifications, controls, and econometric methods.

The paper falls in eight sections. Section 2 surveys relevant literature while Section 3 provides some more context with the help of Chinese historical data. The benchmark model is presented in Section 4. We analyze the long-run implications of the model in Section 5 and consider the short run in Section

[1] According to Eichengreen (2007) the literature has invested more in documenting the growth rate-real exchange rate correlation than in identifying channels of influence.

6. Section 7 discusses the econometrics and presents the results. Section 8 concludes.

2 Literature Review

Macroeconomic analysis has traditionally played down the role of the exchange rate in causing or sustaining growth, although this may have recently begun to change. The real exchange rate has been seen as an endogenous variable, its value being determined in a general equilibrium set-up by 'deeper' parameters such as preferences, factor endowments, and productivity, along with the level of income of a country (the Balassa-Samuelson effect). In the canonical (small country) dependent economy framework, for example, the domestic price of tradables in domestic currency terms is determined internationally while the price of non-tradables is determined by the deeper parameters. Development economists, on their part, may reject assumptions of purchasing power parity and full employment but, with important exceptions, have tended in the past to ignore the potential role of the real exchange rate in development policy, perhaps due to the traditional view of developing countries as exporters of primary commodities and the resulting elasticity pessimism.

The perceived irrelevance of policy in influencing exchange rates is now being challenged. A body of literature shows that the real exchange rate tracks the nominal exchange rate quite closely over time which suggests that targeting the latter may effectively target the former as well, at least in the short- and medium-run. Moreover, the ability of policy to influence the exchange rate in the presence of capital mobility may have been underestimated. As illustrated by the Feldstein-Horioka puzzle, even assets from countries with completely open capital accounts appear not to be perfect substitutes (and capital controls seem to influence the nature if not magnitudes of capital flows). The capital-account-openness vertex of the impossible trilemma is, therefore, less binding than would be the case in a world with unrestricted capital mobility and negligible country risk premia. While the effect of sterilized interventions in developed countries is debatable, such interventions in developing countries do seem to have an impact, perhaps because international risk premia are higher for developing country assets, and/or because foreign exchange markets tend to be less deep in such countries.[2] Thus, governments have a variety of policy options including monetary and fiscal policy, saving incentives, capital controls, and reserve management, and the evidence suggests that governments do indeed use several tools at their disposal to target exchange rates.

Such policies can be effective. Recent empirical studies of the role of competitive exchange rates in promoting development have found a robust correlation between competitive exchange rates and economic growth.[3] An interesting ex-

[2] See, for example Frenkel and Rapetti (2008) for a discussion of the Argentinean experience of exchange rate management with sterilized interventions.

[3] See Razin and Collins (1997), Levi-Yeyati and Sturzeneggar (2007), Rodrik (2008), and the literature cited below. A few recent studies have found a similar relationship between

ample is the study by Hausmann et al. (2005) which identified and analyzed determinants of 'growth episodes' in the latter half of the twentieth century. In other studies, Polterovich and Popov (2002) empirically identify exports as one of the channels through which competitive exchange rates correlate with productivity and long term growth while Berg et al. (2008) find that episodes of growth in developing countries tend to be sustained and prolonged by competitive exchange rates and export diversification.

Rodrik (2008) finds that (i) an undervaluation has a positive impact on the size (and share) of output of the tradable sector in general and the industrial sector in particular, and (ii) the effects of exchange rate changes on growth acts through the related change in the size of the tradable sector. Generally one would expect an expansion of the tradable sector to be accompanied by greater employment in that sector and, indeed, Galindo et al. (2001) and Frenkel and Ros (2006) find that real exchange rate depreciations boost industrial employment in samples of Latin American countries. Prasad et al. (2007a) reach the near mirror image conclusion that foreign capital inflows (roughly the flip side of current account surpluses) tend to be associated with exchange rate overvaluation, which in turn has a detrimental effect on sectoral allocation, manufactured exports and growth (a form of the "Dutch disease" phenomenon).

This emerging body of empirical evidence - along with East Asia's rapid accumulation of reserves in the pursuit of what is widely seen as "export-led growth" - has stimulated interest in the theoretical linkages between the real exchange rate and growth. A common justification for undervalued real exchange rates is the need to shift resources toward the tradable sector, but in a traditional framework with full employment this begs the question of what makes the tradable sector special. Rodrik (2008) provides an answer in terms of market failures and endogenous growth. Production in the tradable sector, he argues, is especially afflicted by institutional weaknesses and market failures (information and coordination externalities), and this leads to a bias against this sector in the allocation of resources. Exchange rate undervaluation boosts profits in the tradable sector and the resulting sectoral reallocation raises the growth rate in an AK-type model of endogenous growth.

While Rodrik's model focuses on sectoral differences in the degree of institutional weakness, development economics has traditionally stressed both the level effects of moving labor from low productivity sectors to the modern industrial sector and dynamic effects associated with greater scope for learning by doing (or other growth enhancing externalities) in the tradable sector. Even if the magnitude of the externalities and scale effects in the tradable sector is insufficient to allow for permanent endogenous growth, the scale effects may generate multiple equilibria, and temporary exchange rate shocks can send the economy to a new long run equilibrium (Krugman, 1987; Ros and Skott, 1998).

Some form of increasing returns, broadly interpreted, underpins these explanations. An alternative macroeconomic justification for undervalued exchange

real exchange rates and growth *take-offs* on the one hand and real exchange rates and the *duration* of growth episodes on the other. See, for example, Hausmann et al. (2005) and Berg et al. (2008).

rates is provided by Kaleckian models with underutilized resources. In this setting, a depreciation may boost aggregate demand (via the trade balance) and output in the short-run, and in a profit-led regime a real depreciation also stimulates growth due to the ensuing redistribution of income towards capitalists.[4]

Sectoral dimensions, however, tend to get ignored in the Kaleckian tradition, and developing economies typically have dual labor markets with the tradable goods being produced mainly in modern/urban/formal sectors and the non-tradables in traditional/rural/informal sectors.[5] Policies that benefit the tradable sector have consequences for the distribution between wages, profits, and land rents, as well as for distribution between workers in the two sectors. Most Kaleckian models pay little attention to these aspects, and the Kaleckian tradition, moreover, tends to emphasize quantity adjustments to external disequilibria over external relative price adjustments.

The "balance of payments-constrained" growth model (BPCG), due originally to Thirlwall (1979), shares the latter property. The BPCG model postulates that, given constraints on external balances, the growth of external demand determines the rate at which internal demand can grow, which in turn constrains output growth. To the extent that real exchange rate depreciations relax the external constraint, a depreciation would promote growth in this framework. A lasting effect on growth, however, requires a process of continuously depreciating exchange rates, and this literature typically treats the real exchange rate as an exogenously given constant.

Our long-run model in this paper takes tradable goods' prices to be determined internationally but, unlike the standard "dependent economy model," we assume that there is substantial hidden or open unemployment, that the mobilization of these underemployed resources is at the core of the development problem, and that the real exchange rate affects growth via its impact on investment, saving, distribution, and the trade balance. Unlike most Keynesian inspired models, we use a two sector framework with tradable and non-tradable goods. Unlike Kaleckian open economy models, we assume that trade is balanced and that the rate of capital utilization is unaffected by exchange rate policy in the long run.[6] Unlike the BPCG tradition, our focus is on the real exchange rate and we assume that the demand for exports is perfectly elastic.

An interesting feature of the existing literature is that in studies with both developing and industrialized countries, the undervaluation-growth nexus appears to hold for developing countries but not developed countries.[7] This result

[4] See, for example, Blecker (2002). To the extent that they come at the expense of other countries, these effects in Kaleckian models have a beggar-thy-neighbor flavor. See Blecker and Razmi (2008) for an investigation of the "fallacy of composition" argument.

[5] Agricultural goods produced in rural areas are potentially tradable goods but the non-standardized nature of these products, the fact that a large proportion of food is grown for (extended) household consumption, and the widespread presence of tariffs, taxes, and quantitative, non-tariff barriers in agriculture renders a substantial portion of this sector's output non-tradable.

[6] Accommodating variations in the rate of capital utilization are central to the Kaleckian approach, but this mechanism becomes questionable beyond the short run (Skott, 2008).

[7] Examples are Prasad et al. (2007a), Rodrik (2008), and Polterovich and Popov (2002).

is consistent with the theoretical argument and the empirical results in this paper (but also with Rodrik's 2008 argument, since the market failures and distortions are likely to be more prevalent in developing countries).

3 China: Some illustrative statistics

This section illustrates the motivation underpinning our theoretical model and empirical analysis by briefly focusing on a major developing country, China. As is well-known, the Chinese economy has sustained record growth rates over the last three decades. The process has involved moving millions of workers from the rural hinterland to the industrialized urban areas (mainly to the coastal provinces in the south and south east). Goods produced in the rural areas tend to be relatively non-traded in nature in many low-income countries, partly due to lack of modern infrastructure that makes it harder to satisfy the quality standards demanded by international markets. This is particularly true for the agricultural sector where health and other non-tariff barriers remain high. Figure 1 illustrates this in the Chinese context. The measure of tradability was developed from the input-output tables from National Bureau of Statistics (2008, Table 3-24) by subtracting one from the ratio of the total domestic usage for each sector to the total domestic output of that product.[8] We interpret the absolute magnitude as a proxy for the tradability of a sector's output and the sign as an indication of whether it is import-intensive (positive sign) or export-intensive (negative sign). Mining appears to be the most import-intensive sector while textile, apparel, and footwear appears to be the most export-intensive. "Other manufacturing" also appears to fall in the highly export-intensive category. Notice that the index for agriculture is close to zero. Not surprisingly, construction, the supply of electricity, and real estate also appear to have a very low traded component.

Figure 2 shows time plots of our (Balassa-Samuelson effect-adjusted) measure of real exchange rate undervaluation, GDP growth, and capital accumulation (see Section 7 for details of how the measure of undervaluation was constructed). Data for accumulation were derived from Wang and Szirmai (2008). The numbers are 5 year averages for the period 1950-2004. The Chinese real exchange rate, according to our measure, was overvalued (less than zero in value) up until the early 1980s and has been undervalued since then. The turning point neatly coincides with the market reforms of the early eighties that transformed China into a much more open economy. The co-movement between the degree of undervaluation on the one hand, and output growth and accumulation on the other is quite clear. In particular, output growth and accumulation pick up noticeably once the measure of undervaluation turns positive in the early 1980s. Figure 3 presents a scatter plot to more directly illustrate the relationship between undervaluation and investment growth. Finally, Figure 4

[8] In other words, for sector i, $TI_i = (C_i + I_i + G_i + M_i - X_i)/(C_i + I_i + G_i + X_i - M_i) - 1$, where TI = tradability index, C = consumption, I = investment (excluding inventories), G = government expenditures, X = exports, and M = imports.

suggests a very strong positive association between the degree of undervaluation and the trade balance (a surplus being positive). While disaggregated data are not available from UN COMTRADE for earlier years, data since 1995 show that China managed to grow at a rapid clip while avoiding large deficits and even while it experienced negative net exports of capital goods through most of this period.[9]

While this section has provided some context for the theoretical exercise in the next section, we formally explore some of these correlations in Section 7.

4 A Long-Run Model

The benchmark model is deliberately kept simple. It captures, we believe, important features of most low income countries, and many of the assumptions can be relaxed without affecting the qualitative conclusions (see appendix A). This section describes a long run equilibrium; short run modifications are introduced in section 6.

We consider a small open economy with a non-tradable and a tradable goods sector. Investment goods are imported while the domestically produced tradable good can be used for domestic consumption or export. The non-tradable good is produced using labor (and a fixed supply of land),

$$Y_N = AL_N^{\beta}; \qquad 0 < \beta \leq 1 \tag{1}$$

where Y_N, L_N denote output and employment in the non-tradable sector. Under profit maximization and perfect competition, the income share of labor would be constant and equal to β. We shall retain the assumption of constant distributive shares in the non-tradable sector but take the share of wages to equal $v\beta$. Deviations from marginal productivity pricing could occur for a number of reasons, including monopsonistic effects (which would imply $\nu < 1$) and the influence of social norms and conventions (with $\nu \gtrless 1$). We do not make any specific assumption about the value of ν but restrict the product $\nu\beta$ (the share of labor) to be strictly less than one.[10]

Empirical measures of the real wage in a traditional, non-tradable sector may be hard to interpret in the presence of hidden unemployment and underemployment. Our distributional assumptions imply that the wage share is uniquely determined, but the effective labor input L_N may be spread across a larger number of workers and/or involve a larger amount of low intensity work. We therefore consider two distinct measures of the real wage in the traditional sector. One of them, the 'effective wage' ω_N, is found by dividing the well-defined

[9] The authors' calculations from UN COMTRADE data show that between 1995 and 2008, China ran a deficit in industrial supplies and capital goods (BEC categories 2 and 4) and a surplus in consumer goods (BEC category 6) throughout almost the entire period. Data are not available for earlier years.

[10] The condition $\nu\beta < 1$ is needed to ensure the existence of an equilibrium solution when workers in the traditional sector spend their entire income on non-traded goods. Once we relax this latter assumption (see the appendix), this condition is no longer needed.

total wage payment by the effective labor input L_N :

$$\omega_N = \frac{w_N}{p_N} = \nu\beta A L_N^{\beta-1}; \qquad 0 < \nu \leq 1, \nu\beta < 1 \tag{2}$$

An alternative measure assumes that the traditional sector is characterized by work sharing. If unemployment takes the form of underemployment, the empirically measured wage in the traditional sector may be the average remuneration, that is, total labor income divided by the number of workers not employed in the formal sector. This 'sharing wage' ($\tilde{\omega}_N$) is given by

$$\tilde{\omega}_N = \frac{\omega_N L_N}{L - L_T} \leq \omega_N \tag{3}$$

where L_T is employment in the tradable sector. Depending on institutional characteristics, the measured wage in the traditional, non-tradable sector may fall anywhere between the sharing wage $\tilde{\omega}_N$ and the effective wage ω_N.

Tradable goods are produced in the formal (advanced, capitalist) sector. This sector uses both labor and capital, and for simplicity a fixed coefficient production function is assumed, i.e.

$$Y_T = \min\{aL_T, \bar{b}K\} \tag{4}$$

where Y_T, L_T and K denote output, employment and capital in the tradable goods sector. The parameters a and $\bar{b}$ are taken to be fixed, and we assume that there is no labor hoarding and that capital utilization is at the desired rate $\bar{u}$. Hence,

$$Y_T = aL_T = \bar{u}\bar{b}K = bK \tag{5}$$

where $\bar{u}$ is desired utilization and $b = \bar{u}\bar{b}$. The utilization assumption will be modified in section 6 when we address short-run issues.

Labor is mobile across sectors. However, workers in the tradable sector may receive a wage premium, and we take the tradable-sector real wage to be determined by the tradable-sector employment rate L_T/L, the relative price of tradables q, and the saving rate s,

$$\omega_T = \frac{w_T}{p_N} = \phi\left(\frac{L_T}{L}, q, s\right); \quad \phi_1 \geq 0, \phi_2 \geq 0, \phi_3 \leq 0 \tag{6}$$

A wage premium may exist for a variety of reasons, including principal-agent problems (efficiency wages) and bargaining in the presence of costly search and relationship-specific investment. The value of sharing wage $\tilde{\omega}_N$ along with the tradable-sector employment rate L_T/L are key determinants of workers' fall-back position in both efficiency wage and bargaining models, and the general specification in equation (6) is consistent with tradable-sector wages being determined as a markup on the sharing wage, with the markup as a function of employment and the exchange rate: $\omega_T = \lambda(\frac{L_T}{L}, q)\tilde{\omega}_N$ (see note 12 below). The real exchange rate enters the $\phi-$function both because it determines the total revenue (the size of the 'pie') in the tradable sector and may affect the size of the wage premium λ and because of its influence on the demand for non-tradables, non-tradable employment and the sharing wage; the saving rate enters the $\phi-$function because it affects the demand for non-tradables and the sharing wage.

By definition, the equilibrium condition for non-tradables is given by

$$Y_N = E_N \tag{7}$$

where E_N is the domestic demand for the non-tradables. We assume that the non-tradables are used only for consumption. Workers do not save and consume only non-tradables.[11] Non-workers (capitalists and landlords), on the other hand, save a fraction s of their income and consume both non-tradables and tradables. Thus, the demand for non-tradables can be written

$$E_N = \omega_N L_N + \omega_T L_T + \alpha(1-s)[qbK - \omega_T L_T + (1-\nu\beta)AL_N^{\beta}] \tag{8}$$

where α is the proportion of capitalist and landlord consumption that is spent on the non-tradable. These assumptions about the demand for non-tradables fit, we believe, the stylized facts for LDCs; the appendix examines the implications of allowing worker saving and worker consumption of tradables.

The proportion α depends on q, and if tradable and non-tradables are gross substitutes (the likely case), the dependence is positive

$$\alpha = \alpha(q), \quad \alpha' > 0 \tag{9}$$

The tradable good can be exported or consumed domestically. We take world demand to be perfectly elastic at a given price in foreign currency, p_T, and with a given supply of tradables, the equilibrium condition for the tradable goods sector serves to determine the trade balance net of investment (or, equivalently, the net exports of the tradable good),

$$X_T = Y_T - E_T \tag{10}$$

Clearly, it can be difficult to break into new export markets, and the infinite-elasticity assumption will be modified in the short run analysis (see section 6).

[11] Data for a number of developing countries from LABORSTA (2009) suggest that the proportion of household expenditures devoted to food and housing decreases, while that devoted to clothing and "other manufactures" increases as we move up the income distribution. For Macau, China in 2002-03, for example, expenditures on food and housing decline from 69.6% to 27.4% while expenditure on clothing, footwear, and other manufactures rises from 8.4%to 17.8% as we move from the lowest to the highest decile of expenditure distribution.

The saving propensity out of wages is small in most developing economies. Even for high saving countries like China, the bulk of the saving comes from profit and rent income. One indirect piece of evidence in this regard comes from the oft-cited empirical regularity that the wage share of national income in developing countries tends to be positively correlated with the consumption share. World Bank (2007, p. 6) illustrates the co-movement of these variables in China in recent years, and Kuijs (2006) finds that while Chinese household saving out of disposable income (which includes some interest, rent and profit income) is high, what makes the saving to GDP ratio exceptional is the presence of high enterprise and government savings.

We relax these assumptions in the appendix.

The domestic consumption demand for the tradable good is given by

$$E_T = (1-\alpha)(1-s)[qbK - \omega_T L_T + (1-\nu\beta)AL_N^{\beta}]/q \tag{11}$$

and the relative price of tradables, which is our long-run measure of the real exchange rate, can be written

$$q = \frac{ep_T}{p_N} \tag{12}$$

where e is the nominal exchange rate (i.e., the domestic currency price of foreign currency). All capital goods are imported at a world market price p_K in foreign currency. Thus, the trade balance (in terms of non-tradables) can be written

$$TB = q\left(X_T - \frac{p_K}{p_T}I\right) = q\left(Y_T - E_T - \frac{p_K}{p_T}I\right) \tag{13}$$

Trade need not be balanced in the short run but sustainability requirements constrain the value of the trade balance (relative to the size of the economy) in the long run. For simplicity, we assume that in the long run

$$TB = 0 \tag{14}$$

The accumulation rate in the tradable goods sector depends on its profitability relative to the international profit rate and the cost of investment. Formally,

$$\frac{I}{K} = f(r - r^*, \gamma) = f\left(b\frac{p_T}{p_K}\left(1 - \frac{\phi\left(\frac{L_T}{L}, q, s\right)}{aq}\right) - r^*, \gamma\right); \qquad f_r > 0, f_\gamma > 0 \tag{15}$$

where r^* is the international profit rate and γ can be interpreted as a policy variable that affects the incentive to invest. We take this policy variable to be an inverse measure of the cost of finance/the interest rate, rather than, say, a government subsidy to investment which would need to be financed, adding variables to the model. Finally, real aggregate income and aggregate domestic demand, both in terms of non-tradables, are given by

$$Y = Y_N + qY_T \tag{16}$$

$$E = E_N + qE_T + q\frac{p_K}{p_T}I \tag{17}$$

5 The real exchange rate and economic growth

5.1 Analysis

Tradable-sector employment is determined by the capital stock,

$$L_T = \frac{b}{a}K \tag{18}$$

and, substituting (18) into (6), the tradable-sector wage can be written

$$\omega_T = \phi\left(\frac{b}{a}\frac{K}{L}, q, s\right) \tag{19}$$

The solutions for non-tradable output, employment and wages are more involved. Using equations (2) and (5)-(8), the equilibrium value of non-tradable output is

$$Y_N = \left[\frac{\alpha(1-s)q}{(1-\alpha(1-s))} + \frac{\phi(\frac{b}{a}\frac{K}{L}, q, s)}{a}\right]\frac{bK}{(1-\nu\beta)} \tag{20}$$

and the solutions for effective non-tradable employment and wages are given by[12]

$$L_N = \left\{\left[\frac{\alpha(1-s)q}{(1-\alpha(1-s))} + \frac{\phi(\frac{b}{a}\frac{K}{L}, q, s)}{a}\right]\frac{bK}{A(1-\nu\beta)}\right\}^{1/\beta} \tag{21}$$

$$\omega_N = \nu\beta A\left\{\left[\frac{\alpha(1-s)q}{(1-\alpha(1-s))} + \frac{\phi(\frac{b}{a}\frac{K}{L}, q, s)}{a}\right]\frac{bK}{A(1-\nu\beta)}\right\}^{(\beta-1)/\beta} \tag{22}$$

$$\tilde{\omega}_N = \frac{1}{L-L_T}\nu\beta\left[\frac{\alpha(1-s)q}{(1-\alpha(1-s))} + \frac{\phi(\frac{b}{a}\frac{K}{L}, q, s)}{a}\right]\frac{bK}{(1-\nu\beta)} \tag{23}$$

Both tradable and non-tradable employment are increasing in K (equations (18) and (21)) as are wages in the tradable sector (equation (19)). The average non-tradable remuneration also depends positively on K (equation (23)) but the effective real wage in the non-tradable sector is unaffected if $\beta = 1$ or declines if $\beta < 1$ (equation (22)). Non-tradable output, employment, average wage remuneration, and tradable-sector wages are increasing in q and decreasing in s; effective wages in the non-tradable sector are decreasing in q and increasing in s (if $\beta < 1$). The positive effect of q on non-tradable output and employment – which is due both to income and substitution effects – flows from the existence of unemployment. In a standard full employment model, a rise in the relative price of a good would shift resources away from the sector whose relative price has declined; with unemployment and a perfectly elastic export demand, however, the change in relative prices generates an increase in non-tradable demand, and a rise in employment makes it possible to meet this extra demand.

[12] In the special case where $\omega_T = \lambda(\frac{L_T}{L}, q)\tilde{\omega}_N$, the expression for $\tilde{\omega}_N$ can be written

$$\tilde{\omega}_N = \frac{a\nu\beta\alpha(1-s)q}{[1-\alpha(1-s)][(1-\frac{L_T}{L})(1-\nu\beta) - \frac{L_T}{L}\lambda\nu\beta]}\frac{L_T}{L}$$

The right hand side of this equation is increasing in the formal-sector employment rate L_T/L and the real exchange rate q and decreasing in the saving rate s. It follows that $\omega_T = \lambda\left(\frac{L_T}{L}, q\right)\tilde{\omega}_N$ is a special case of the general specification in equation (6), $\omega_T = \phi\left(\frac{L_T}{L}, q, s\right)$.

Turning now to the trade balance, eqs. (5)-(6), (11), (13)-(15) and (21) imply that

$$\begin{aligned} 0 &= \frac{TB}{q\frac{p_K}{p_T}K} = \frac{b}{\frac{p_K}{p_T}}\frac{s}{1-\alpha(1-s)} - \frac{I}{K} \qquad (24) \\ &= \frac{b}{\frac{p_K}{p_T}}\frac{s}{1-\alpha(1-s)} - f\left(b\frac{p_T}{p_K}\left(1-\frac{\phi(\frac{b}{a}\frac{K}{L},q,s)}{aq}\right) - r^*, \gamma\right) \\ &= F\left(q;\gamma,\frac{K}{L}\right); \qquad F_q \gtrless 0, F_\gamma < 0, F_K \geq 0 \qquad (25) \end{aligned}$$

The partials F_γ and F_K are straightforward. By assumption an increase in γ (a decrease in the cost of finance) stimulates investment, thus reducing the trade balance; an increase in the capital stock relative to the total labor force, on the other hand, raises the tradable sector real wage which reduces profitability and accumulation. The effects of an increase in the real exchange rate, by contrast, are ambiguous: a real depreciation shifts domestic consumption toward non-tradables, thus releasing a larger proportion of tradable sector output for exports, but it may also raise profitability and investment (and thus imports). The evidence suggests that the first of these effects generally dominates in the long run: the Marshall-Lerner-Robinson-Bickerdike condition (MLRB condition) is usually satisfied, also for LDCs.[13] Assuming that this is the case, we have $F_q > 0$ and the equilibrium condition (25) defines the real exchange rate as a function of γ and K :

$$q = \eta\left(\gamma, \frac{K}{L}\right); \quad \eta_\gamma > 0, \eta_K \leq 0 \qquad (26)$$

The negative sign of η_K fits the standard Balassa-Samuelson and Bhagwati-Kravis-Lipsey results: higher levels of income (higher capital stocks) are associated with an appreciated real exchange rate.

Viewed from another angle, the above analysis shows that two targets ($\frac{I}{K}$ and TB) can be achieved using the two instruments γ and q. The structure of the model is such that, given I/K, equation (24) determines q,

$$q = \psi\left(\frac{I}{K}\right); \quad \psi' > 0 \qquad (27)$$

where the sign of the derivative ψ' follows from the assumption that $\alpha' > 0$. The accumulation function (15) can now be used to determine γ,

$$\gamma = \xi\left(\frac{I}{K}, q, \frac{K}{L}\right); \quad \xi_{\frac{I}{K}} > 0, \xi_q \gtrless 0, \xi_K \geq 0 \qquad (28)$$

[13] See, for example, Bahmani-Oskoee and Niroomand (1998) for a test of the Marshall-Lerner condition for a large sample of countries. The standard Marshall-Lerner condition focuses on demand elasticities, assuming a perfectly elastic supply. In our case this supply elasticity assumption is far from being met: the supply of traded output is constrained by the capital stock while the world demand elasticity for traded goods is taken to be infinite. Note that the MLRB condition is less stringent than the Marshall-Lerner condition.

In other words, given the target rate of accumulation, the trade balance condition determines the real exchange rate while the accumulation target determines the investment incentive. Equation (27) captures the key result: an increase in accumulation requires a real depreciation in order to switch domestic expenditure away from tradables and make room for increased capital good imports.

The effects of a depreciation on accumulation are ambiguous. This ambiguity may seem surprising, but the intuition is simple: a depreciation raises the demand for non-tradables and thereby stimulates both employment and the "shared wage" $\tilde{\omega}_N$. The result is upward pressure on real wages in the tradable sector, and depending on the strength of this effect, tradable sector profitability can go either way. Thus, depending on the precise functional form of the wage equation (6), a real depreciation may raise or lower the rate of accumulation. If the MLRB condition is satisfied, however, a rise in q improves the trade-balance and even if it raises accumulation, an additional growth stimulus from reductions in the cost of finance (that is, a rise in γ) is necessary to avoid an improvement in the trade balance: a rise in both q and γ is needed to bring about an increase in I/K while keeping $TB = 0$.

The comparative statics depend on both the MLRB condition and the assumption of substitutability in consumption ($\alpha' > 0$). If the former is violated, increased accumulation is associated with a decline in γ but the real exchange rate still depreciates; complementarity in consumption implies that $\alpha' < 0$, and an appreciation is required in order to reduce domestic consumption of tradables and accommodate a rise in the target accumulation rate.

5.2 Compositional and distributional effects

Changes in real exchange rates influence the sectoral composition of output. The share of the non-traded sector in total output can be written

$$\frac{Y_N}{Y_N + qY_T} = \frac{1}{1 + \frac{q}{Y_N} Y_T}$$

The value of Y_T is determined by the capital stock, $Y_T = bK$, and from equation (20) it follows that

$$\frac{Y_N}{q} = \left[\frac{\alpha(1-s)}{(1-\alpha(1-s))} + \frac{\phi(\frac{b}{a}K, q)}{aq} \right] \frac{bK}{(1-\nu\beta)}$$

The sign of the derivative $\partial(\frac{Y_N}{q})/\partial q$ depends on the sensitivity of α to variations in q and the relative magnitude of the two terms $\frac{\alpha(1-s)}{(1-\alpha(1-s))}$ and $\frac{\phi(\frac{b}{a}K, q, s)}{aq}$. Thus, the long-run impact of a real depreciation on the share of the non-traded sector can be positive. The intuition behind this ambiguity is simple: a real depreciation stimulates employment in the traditional sector, and this expansionary effect may dominate the negative valuation effect.

The ambiguity of the long-run sectoral effect carries over to the average wage share (and thus, given the saving assumptions, the average saving rate in the economy, too). We have

$$\frac{\omega_N L_N + \omega_T L_T}{Y_N + qY_T} = \frac{\omega_N L_N}{Y_N} \frac{Y_N}{Y_N + qY_T} + \frac{\omega_T L_T}{qY_T} \left(1 - \frac{Y_N}{Y_N + qY_T}\right) \tag{29}$$

Hence, the change in the wage share becomes

$$\begin{aligned} d\left(\frac{\omega_N L_N + \omega_T L_T}{Y_N + qY_T}\right) \quad &= \quad \frac{Y_N}{Y_N + qY_T} d\left(\frac{\omega_N L_N}{Y_N}\right) + \left(1 - \frac{Y_N}{Y_N + qY_T}\right) d\left(\frac{\omega_T L_T}{qY_T}\right) \\ &\quad + \left(\frac{\omega_N L_N}{Y_N} - \frac{\omega_T L_T}{qY_T}\right) d\left(\frac{Y_N}{Y_N + qY_T}\right) \end{aligned} \tag{30}$$

By assumption the wage share in the non-tradable sector is constant ($\omega_N L_N / Y_N = \nu\beta$) so the first term on the right hand side of equation (30) is zero. The signs of the second and third terms, however, are both ambiguous.

Turning to the wage *rate*, our (strong) assumption about the composition of workers' consumption implies that a growth policy and the associated real depreciation raise the consumption real wage in the formal sector as well as the effective employment and the average remuneration in the traditional sector. These results, which hold for a given capital stock, are reinforced by the positive effects of higher accumulation on wages and employment in both sectors. Fast growth, by construction, is generated by raising the rate of return relative to the cost of finance in the tradable sector, and it follows that workers and tradable-sector capitalists have a shared interest in growth. Distributional conflicts between workers and capitalists may emerge if workers consume tradables and the wage function ϕ is insensitive to changes in q, but as long as the share of tradables in workers' consumption remains small, the consumption real wage would decline much less, proportionately, than the product real wage.

Opposition to a growth policy that involves a real depreciation could come from landlords. By lowering the real wage in the traditional sector, a depreciation increases rents, but the change in the relative price may reduce the real value of rents. Depending on the composition of landlord consumption (and thus the relevant price index), the net effect could go either way.

5.3 The full employment ceiling

The growth policies in this paper are predicated on the existence of unemployment. Using (18) and (21), the full employment constraint can be written

$$L_N(q, K, s) + L_T(K) \leq L \tag{31}$$

For a given value of L, this equation defines a maximum, full-employment value of the real exchange rate

$$q \leq q^{\max} = h(K, s); \quad h_K < 0, h_s > 0 \tag{32}$$

The presence of large amounts of (hidden) un- and underemployment means that this condition fails to be binding in most LDCs. Using (26), however, it is readily seen that the maximum value of the real exchange rate translates into a maximum growth rate of the capital stock. As the capital stock increases (relative to the population) the maximum values of the real exchange rate and the associated growth rate both decline. Putting it differently, an undervalued exchange rate and fast capital accumulation ceases to be desirable when the capital stock is large relative to the size of the total labor force and the pool of unemployment (and underemployment) dries up. This property of the model has empirical support: the relation between undervaluation and growth holds only for developing countries (see Sections 2 and 7).[14]

5.4 Steady states

Steady growth paths with a positive growth rate do not exist if there are diminishing returns to labor in the non-tradable sector and no technical change. With these assumptions, however, the model has a stationary state if the total labor supply L is given. In this stationary state we have

$$\frac{I}{K} = \delta \tag{33}$$

where δ is the rate of depreciation and, using equations (27) and (33), the steady-state value of the real exchange rate is given by

$$q = \psi(\delta) \tag{34}$$

Using (28), the investment incentives (γ) now determine the ratio $\frac{K}{L}$ and hence the capital stock, if L is taken as exogenously given. With the capital stock and the exchange rate fixed, equations (20)-(23) can be used to find non-tradable employment, output and wages, while outcomes in the tradable sector are given by (18)-(19). An increase in γ pushes up both total output and employment, but full employment (or inflation barriers) clearly sets an upper limit. This upper limit can be found as in section 5.3, but in the absence of a well-defined, structural NAIRU, a range of employment outcomes may be feasible.

Analogously, a steady growth path exists if there are constant returns to labor in the non-tradable sector ($\beta = 1$) and the labor force grows at the rate n. In this case,

$$\frac{I}{K} = n + \delta \tag{35}$$

[14] The presence of unemployment may, it could be argued, lead to downward pressure on money wages, and with a given world market price of traded goods and a given nominal exchange rate, the result would be a real depreciation. Thus, a fully flexible money wage might take the economy to a full employment position with $q = q^{\max}$. This mechanism may not work for a variety of reasons, and stickiness of money wages may be desirable: if the real exchange rate is determined by the trade balance condition (equation (25)), a decline in money wages would be associated with changes in the nominal exchange rate, the real exchange rate would be left unchanged, and standard Keynes/Mundell/Fisher arguments suggest that falling wages and prices are more likely to be deflationary than expansionary if the real exchange rate is fixed. The model leaves out Keynes/Mundell/Fisher effects on accumulation and the equilibrium solution is homogeneous of degree zero in the nominal wage.

$$q = \psi(n + \delta) \tag{36}$$

and equations (28), (18)-(22) and (5) can be used to solve for capital intensity, employment rates and real wages.

Steady growth with $g \neq n$ may be of greater interest from the perspective of LDCs. Growth paths of this kind become possible if $\beta = 1$ and changes in L_T/L do not affect the tradable-sector real wage ($\phi_1 = 0$ in equation (6)). The latter condition may be reasonable when there is a large pool of hidden unemployment. If $g > n$, the condition will eventually be violated, but the economy may show endogenous steady growth for a prolonged period, and the steady growth rate will be related to the real exchange rate, $q = \psi(g + \delta)$.

5.5 Zero sum game?

In this model the pursuit of faster growth through an appropriate combination of real exchange rates and investment incentives does not imply a zero sum game: the gains of a fast-growing country are not necessarily offset by losses in other countries. A stylized two country model can be used to demonstrate this.

The home country is described by the model in section 4. We now supplement this with a simple specification of the "rest of the world" (ROW). We assume that ROW can produce either investment goods or the tradable consumption good, using the same production process. Thus,

$$Y_K^* + Y_T^* = F(L^*, K^*) \tag{37}$$

This specification of production possibilities implies that $p_K = p_T$, assuming that both types of goods are produced in ROW. Subject to this constraint, the home country can exchange its tradable good one-for-one for investment goods. ROW neither gains nor loses from this trade, and the accumulation rate in the home economy (and the associated real exchange rate) has no impact on ROW.

This result should not be surprising. Growth in our open economy is not export-led. Our open economy with $TB = 0$ is isomorphic to a closed economy in which the modern sector (corresponding to the tradable sector) produces an output that can be used either for investment or for consumption. With given investment demand and a given supply of modern sector output, the equilibrium condition for the modern sector determines the relative price (corresponding to the real exchange rate), and aggregate employment and output can now be determined in this closed economy.

Needless to say, it is not our claim that domestic policies never have welfare effects in other countries. Growth policies, however, *need* not have negative externalities for the rest of the world.

6 Short-run dynamics

At least three assumptions need to be relaxed if the model is to be applied to the short run: export demand is not perfectly elastic, capital in the modern sector is not always fully utilized, and net exports are not always zero. With respect to exports, we assume that the level is predetermined at any moment but that the growth of exports depends on the international competitiveness of the domestically produced export good

$$\hat{X} = F\left(\frac{p_T}{p_T^*}\right); \qquad F' < 0 \tag{38}$$

where p_T^* is the (foreign currency) price of the foreign goods and a 'hat' over a variable is used to denote a growth rate ($\hat{X} = (dX/dt)/X$). The relation between the terms of trade and the relative price q is given by

$$\frac{p_T}{p_T^*} = \frac{ep_T}{p_N}\frac{p_N}{ep_T^*} = q/z \tag{39}$$

where $z = ep_T^*/p_N$. We take z to be a policy variable. The domestic currency price of the domestically produced tradable good (ep_T), on the other hand, depends on demand conditions. A simple specification along the lines suggested by Flaschel and Skott (2006) relates changes in the price markup to the rate of utilization:

$$\hat{e} + \hat{p}_T = \hat{w}_T + \lambda(u - \bar{u}) \tag{40}$$

where u and $\bar{u}$ are the actual and desired capital utilization rates in the tradable sector. We simplify the wage specification for the tradable sector by assuming that the real wage is constant in terms of non-tradables

$$\omega_T = \frac{w_T}{p_N} = \bar{\omega} \tag{41}$$

This assumption implies that $\hat{w}_T = \hat{p}_N$, and we get the following expression for the growth rate of q,

$$\hat{q} = \hat{e} + \hat{p}_T - \hat{p}_N = \lambda(u - \bar{u}) \tag{42}$$

The utilization rate in the tradable sector is determined by

$$\begin{aligned} u &= \frac{Y_T}{\bar{b}K} = \frac{X + E_T}{\bar{b}K} = \frac{X}{\bar{b}K} + (1-\alpha)(1-s)\left[u - \frac{\bar{\omega}L_T}{q\bar{b}K} + (1-\nu\beta)\frac{Y_N}{q\bar{b}K}\right] \\ &= \frac{X}{\bar{b}K} + (1-\alpha)(1-s)u\left\{1 - (1-\pi) + \left[\frac{\alpha(1-s)}{(1-\alpha(1-s))} + (1-\pi)\right]\right\} \end{aligned}$$

or

$$u = \frac{1-\alpha(1-s)}{s}\frac{X}{\bar{b}K} = h(q)\frac{X}{K};\ h' < 0 \tag{43}$$

where $\pi\left(= \frac{ep_T Y_T - w_T L_T}{ep_T Y_T} = 1 - \frac{1}{a}\frac{\bar{\omega}}{q}\right)$ is the profit share and the sign of h' follows from the assumption of gross substitutability. The profit rate, a key determinant of accumulation, is given by

$$r = \pi\frac{p_T Y_T}{p_K K} = \pi u\frac{p_T}{p_K}\bar{b} = \pi u\frac{p_T^*}{p_K}\frac{q\bar{b}}{z} \tag{44}$$

Using (43) and (44) the accumulation function (15) can now be written

$$\begin{aligned}\hat{K} &= \frac{I}{K} - \delta \\ &= g(u, q; \gamma, z) - \delta; \qquad g_u > 0, g_q > 0, g_\gamma > 0, g_z < 0 \end{aligned} \tag{45}$$

and, combining (38) and (45), we have

$$\hat{X} - \hat{K} = F\left(\frac{q}{z}\right) - g(u, q; \gamma, z) + \delta \tag{46}$$

Given γ and z, equations (42) and (46) form a two dimensional system of differential equations in $(\frac{X}{K}, q)$. There is a unique (non-trivial) stationary point and the Jacobian is given by

$$J\left(\frac{X}{K}, q\right) = \begin{bmatrix} -g_u h & \frac{1}{z}F' - g_u h' \frac{X}{K} - g_q \\ \lambda h & \lambda h' \frac{X}{K} \end{bmatrix}$$

The determinant and trace are positive and negative, respectively, and the stationary point is (locally asymptotically) stable. The utilization rate is equal to the desired rate at the stationary point, but the stationary solution depends on the policy variables γ and z, and the trade balance need not be zero if γ and z are set independently.

Figure 5 illustrates the dynamics. The $\hat{q} = 0$ locus is upward sloping while the $(\widehat{X/K}) = 0$ locus can be either negatively or positively sloped; in the latter case it is steeper than the $\hat{q} = 0$ locus. An increase in z (a real depreciation) leaves the $\hat{q} = 0$ locus unchanged but shifts the $(\widehat{X/K}) = 0$ locus upwards. Thus, starting from an arbitrary point in the phase diagram (i.e. allowing $u \neq \bar{u}$) a real depreciation raises the growth rate of exports and this generates (possibly with a delay) an increase in the accumulation rate: the new stationary point has a higher value of q and an unchanged value of u, and from the accumulation function it therefore follows that the system converges to a stationary point with a higher accumulation rate. The utilization rate initially falls but then increases again as it moves toward the (unchanged) desired rate.

An increase in γ also raises the accumulation rate. The $(\widehat{X/K}) = 0$ locus shifts down and the new solution involves a lower export-capital ratio. Thus, a depreciation and an increase in the investment incentive have similar effects on the accumulation rate, but the implications for the trade balance are quite different. We have

$$\frac{TB}{K} = p_T \frac{X}{K} - p_K(\hat{K} + \delta) \tag{47}$$

At a stationary point $\hat{X} = \hat{K} = g$ and $p_T = p_T(g)$. Hence,

$$\frac{TB}{K} = p_T(g) \frac{X}{K} - p_K(g + \delta) \tag{48}$$

An increase in g reduces the trade balance, and if the stimulus comes from an increase in γ, this effect is reinforced by a decline in the export-capital ratio. If the stimulus comes from a real depreciation, however, the deterioration may be offset by an increase in the export-capital ratio.

7 Empirics

7.1 Deriving the index of real exchange rate misalignment

We follow the three-step methodology pursued by Rodrik (2008) to obtain an index of real exchange rate undervaluation. Using data from Penn World Tables 6.2 (Heston, Summers, and Aten, 2006), we first calculate the real exchange rate (RER) as the ratio between the nominal exchange rate ($XRAT$) and the purchasing power parity conversion factor (PPP). We use a 5-year frequency, in which each observation corresponds to the period average. Both variables are expressed as national currency units per U.S. dollar. However, since PPP is calculated over the entire GDP, the basket includes non-tradables for which we do not expect the law of one price to hold. Thus, in order to calculate equilibrium real exchange rates, in a second step we adjust for the Balassa-Samuelson (BS) effect, regressing RER on real GDP per capita ($RGDPCH$):

$$\ln RER_{it} = \alpha + \beta \ln RGDPCH_{it} + f_t + \varepsilon_{it} \tag{49}$$

where i and t are country and time indexes, respectively, f_t accounts for time fixed effects, and ε_{it} is the error term. Similarly to Rodrik, we obtain an estimate of $\widehat{\beta} = -0.24$, with a t-statistic of 21.29. The sign of the coefficient is in line with the Balassa-Samuelson prediction; in this case, a 10% increase in $RGDPCH$ is associated with a 2.4% real appreciation. Finally, we define the undervaluation index ($UNDERVAL$) as the ratio of actual to BS-adjusted real exchange rates: $UNDERVAL_{it} = RER_{it}/\widehat{RER_{it}}$. Defined this way, $UNDERVAL$ is comparable across countries and over time; when it exceeds unity, the domestic currency is undervalued in real terms (i.e. domestic goods are cheap in *international* dollar terms). We use $\ln UNDERVAL$ as the main variable of interest; it has a zero mean and a standard deviation of 0.47.[15]

7.2 Growth Regressions

This section replicates and evaluates key results of Rodrik (2008). Following Rodrik, we conducted a series of panel data regressions for a data set of a maximum of 184 countries and up to eleven 5-year time periods spanning 1950-2004.[16] The fixed effects model can be written as follows:

$$GROWTH_{it} = \alpha + \beta \ln RGDPCH_{it-1} + \delta \ln UNDERVAL_{it} + f_t + f_i + \gamma X_{it} + \varepsilon_{it} \tag{50}$$

The dependent variable is the average annual growth rate of real GDP per capita, $RGDPCH_{it-1}$captures the convergence term, f_t time specific effects, f_i country specific effects, ε_{it} is the error term, and X is a vector of standard control variables, which includes government consumption, the inflation rate,

[15] Rodrik reports that $\ln UNDERVAL$ has a zero mean and standard deviation of 0.48.

[16] Following Rodrik, for the growth regressions we exclude from the sample three countries with extreme values of $\ln UNDERVAL$: Iraq, the Democratic Republic of Korea and Laos.

gross domestic savings,[17] degree of openness, human capital (years of education), terms of trade, foreign debt, real exchange rate volatility, and an index of rule of law.[18] Table 1 lists the variable definitions and data sources. The specification in (50) estimates the effect of changes in undervaluation on changes in the rate of growth "within" countries.

In the baseline regression (Table 2, column 1), the estimated coefficient of $\ln UNDERVAL$ is $\widehat{\delta} = 0.015$ which is significant at 1%. This implies that a one standard deviation (0.47) in $\ln UNDERVAL$ boosts the rate of growth by almost 0.75 percent points per annum. The coefficient, however, turns smaller and less significant as the number of control variables is increased, and when the terms of trade is added to the control group, $\ln UNDERVAL$ becomes insignificant. The regression in column 6 controls for the rule of law index, for which data are available for only two periods, 1995-99 and 2000-04. The estimated coefficient is larger ($\widehat{\delta} = 0.024$) and significant at 5%.

Classifying developing (developed) countries as those with a real GDP per capita of less (more) than \$6,000, Rodrik (2008) argues that the effect of $UNDERVAL$ on economic growth is larger and significant for developing countries. He finds that the estimated coefficient of $\ln UNDERVAL$ in the baseline regression is low and not significant for developed countries, whereas it is large and significant for developing countries. Columns 3 and 4 in Table 3 reproduce those results. Table 3 also shows that the asymmetric effect of undervaluation between countries is very sensitive to the choice of the GDP per capita that divides the sample between developed and developing countries. For instance, if the cut-off is selected from anywhere in the \$9,000-\$15,000 range, the estimated coefficient is large (between 0.016 and 0.031) and significant for developed countries too.[19] Thus, Rodrik's claim regarding the asymmetric effect of undervaluation between developed and developing countries critically depends on the choice of the GDP per capita cut-off. Columns (1) to (3) also show that for the group of low-income countries (less than \$6,000) the effect of undervaluation tends to increase as income per capita decreases. Overall, the evidence in Table 3 suggests not only that the effect of undervaluation on growth depends on income level but also that the relationship is non-monotonic: it appears to operate for very low and middle-income countries.

Given how sensitive the result is to the choice of the GDP per capita cut-off, we next explored whether the asymmetric effect of undervaluation between

[17] Since both our model and casual empiricism suggest that the saving rate is affected by the real exchange rate, $UNDERVAL$ and the saving rate ($GDSGDP$) are likely to be highly collinear. To correct for multicollinearity, we estimated the effect of undevaluation on the saving rate ($GDSGDP = \alpha + \beta \ln UNDERVAL_{it} + f_t + f_i + \varepsilon_{it}$) and then used the residuals of this regression as a control variable. With this methodology the coefficient on $\ln UNDERVAL$ captures its direct effect on the dependent variable ($GROWTH$) and its indirect effect through the saving rate. The coefficient on the residuals captures the effect of the saving rate on the dependent variable, net of the effect of $\ln UNDERVAL$.

[18] We also explored lagged effects of *lnunderval* but found these to be insignificant in the baseline regression.

[19] For countries with GDP per capita less than a cutoff in the range of \$6,000-\$16,000, the estimated coefficient is between 0.024 and 0. 017 and always significant at 1%. An appendix with details is available on request.

developing and developed countries persists when we use alternative classifications. First, we used a relatively standard classification in defining developed countries as a group of 23 countries typically considered industrialized.[20] We refer to this as "classification I." One potential objection to this classification is its static nature: countries are classified as either developed or developing based on their current status. In our sample period that covers 55 years, it is not evident that a country that is now seen as developed would have been considered the same at the beginning of the sample. Some European countries in the immediate post-war period come to mind in this regard. Similarly, there might be developing countries today which could have been considered developed at the beginning of the sample. An example is Argentina. In order to provide a more dynamic classification of countries, our second classification, termed "classification II," defines developed countries as those which in a given 5-year period were at a per capita GDP level at least half that of the US, excluding those that had a population of less than a million in 2004. Under this classification, some countries are defined as developed (developing) at the beginning but not at the end of the sample.[21]

Tables 4 and 5 present estimates of equation (50) for developing and developed countries, respectively, according to Classification I. The effect of undervaluation on growth in developing countries appears to be large and highly significant. The estimates are robust to the use of different control variables. The estimated coefficient reported in columns 1 to 5 remains stable in the range between 0.017 and 0.026 and is always significant at 1%, except for the regression that includes the rule of law index, where it is significant at 5%.[22] The effect of undervaluation is also robust to changes in the sample period. The coefficient is significant for both periods (1950-79 and 1980-2004, respectively), although it varies from 0.031 to 0.013.

The results for developed countries are not as conclusive as those for developing countries. This may partly result from the smaller sample size. In the baseline regression in Table 5, $\ln UNDERVAL$ is significant at 1% and the coefficient is very similar to that estimated for developing countries. Given the relatively smaller sample size, we introduced control variables one at a time. In the regressions reported in columns 2 to 6, $\ln UNDERVAL$ appears to be significant mostly at 5% and its estimated coefficient remains stable in the 0.014-0.017 range. These results would suggest that for developed countries the effect of undervaluation on growth is large (although smaller on average than in developing countries) and statistically significant. The regressions reported in the

[20] The countries are Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxemburg, Netherlands, New Zeland, Norway, Portugal, Spain, Sweden, Switerland, United Kindom and United States. Other studies have followed a similar classification. See, for example, (Prasad et al., 2007a).

[21] According to classification I, there are ($11 \times 23 =$) 253 observations for developed countries. The number changes to 226 under classification II. Of these, 196 are common. The lists of developed countries according to these criteria are presented in the available-on-request appendix.

[22] Recall that rule of law index data is available for only two time periods, 1995-99 and 2000-04 and therefore there is little time variation.

columns 7 to 10 are however not supportive of such a judgement. When using terms of trade (column 7) and the rule of law index (column 8) as controls, $\ln UNDERVAL$ is not significant. When we control for changes in the terms of trade, the estimated coefficient actually turns negative. Finally, once we divide the sample into two periods, $\ln UNDERVAL$ is significant (at 5%) only for the period 1980-2004.

Using classification II generates qualitatively similar results to those for classification I for both developed and developing countries. The noteworthy differences are that for developed countries under classification II $\ln UNDERVAL$ appears not to be significant in the regressions in which the sample is divided into two sub-periods and its coefficient turns negative when the regression includes rule of law as a control. These results are provided in the unpublished appendix.

The results based on our two classification criteria do not provide particularly strong support for Rodrik's claim that the effect of undervaluation on growth is especially important for developing countries. Although the results are more robust for these countries, there is still evidence that undervaluation affects growth positively in developed countries. An alternative strategy to evaluate his claim is to investigate whether the effect of undervaluation on growth varies with countries' income levels. Table 2 suggested that this could be the case. Rodrik (2008) makes $\ln UNDERVAL$ interact with real GDP per capita ($RGDPCH$) and finds that the effect of undervaluation decreases monotonically with income level. Column 7 in Table 2 replicates Rodrik's finding.[23] Our estimated coefficients are almost identical to those obtained by Rodrik. According to these, the effect of $\ln UNDERVAL$ turns negative at levels of GDP per capita above \$17,549. Columns 8 and 9 in Table 2 report results from regressions in which we add quadratic and cubic interaction terms. Figure 6 illustrates the effect of undervaluation on growth at different levels of GDP per capita for the linear, quadratic, and cubic forms (columns 7-9).

In both the linear and the cubic forms, the effect of undervaluation on growth tends to decrease with the income level. The cubic form performs best statistically among the three (both in terms of adjusted R^2 and t-statistics). This form was anticipated by the results in Table 2, where we found that the effect of undervaluation was the largest for the poorest countries, but also appeared to be significant for middle income countries. It is not easy, however, to find a convincing explanation for why the effect of undervaluation decreases non-monotonically with income level. Figure 6 initially led us to think that the estimated decreasing part of the cubic form in the low-income range was due either to outliers or to data of dubious quality "infecting" the results. We actually found that once the sample is truncated at a level of GDP per capita greater than \$3,000, the best fit is a quadratic form describing an inverted U curve. Such a shape would be easier to interpret. Undervaluation may not favor growth in very poor countries because relatively small increases in profitability

[23] Instead of using the lag of the undervaluation index ($\ln RGDPCH_{t-1}$) as Rodrik does, we use the current level ($\ln RGDPCH_t$).

in the tradable sector may not adequately compensate for entrenched structural factors characterizing underdevelopment (e.g. lack of infrastructure and rule of law, supply constraints, low stock of human and physical capital, etc.), and in richer countries because the tradable sector is already mature. However, the observations below \$3,000 account for almost 40% of the sample, and data quality may not justify the exclusion of all low income countries: when we controlled for data quality by excluding countries with grade "D" (i.e. the lowest quality according to the grading scheme in the Penn World Tables), the cubic form remained the best fit.

In conclusion, the effect of currency undervaluation on growth appears to be larger and more robust for developing countries. This results derives mainly from interacting $\ln UNDERVAL$ with real GDP per capita. The latter indicates that the effect of currency undervaluation tends to decrease with the level of GDP per capita. However, the decrease is not monotonic as Rodrik suggests. Consistent with his results, the effect of undervaluation on growth seems to be the largest for very poor countries, but it is also sizable for middle-income countries. More research is needed to identify the factors driving this result.

7.3 Investment growth regressions

7.3.1 Empirical model

Our theoretical model predicts a positive relationship between the degree of exchange rate undervaluation and the rate of capital accumulation. Lacking reliable and consistent panel data for the capital stock, however, we rewrite the accumulation equation to get an expression for the average rate of growth of investment ($GROWTHGFCF$). Using equation (45), we have

$$\frac{I}{K} = g(u, q; \gamma, z)$$

or

$$\ln I = \ln K + \ln g(u, q; \gamma, z) \tag{51}$$

The values of u and q converge to stationary points determined by (γ, z). With very fast convergence, the average values of u and q over a discrete period will be determined largely by the contemporary values of (γ, z); more generally, both contemporary and lagged values of (γ, z) will affect u and q. Thus, equation (51) suggests the following discrete-time version of the investment equation

$$\ln I = \ln K + \ln H(\gamma, \gamma_{-1}, ...\gamma_{-n}, z, z_{-1}, ..., z_{-n}) \tag{52}$$

Taking first differences, this investment equation implies that

$$\begin{aligned}
\Delta \ln I &= \Delta \ln K + \Delta \ln H(\gamma, \gamma_{-1}, ...\gamma_{-n}, z, z_{-1}, ..., z_{-n}) \\
&= \frac{I_{-1}}{K_{-1}} + \Delta \ln H(\gamma, \gamma_{-1}, ...\gamma_{-n}, z, z_{-1}, ..., z_{-n}) \\
&= G(\gamma, \gamma_{-1}, ...\gamma_{-n}, \gamma_{-(n+1)}, z, z_{-1}, ..., z_{-n}, z_{-(n+1)}) \qquad (53)
\end{aligned}$$

We use the degree of undervaluation as an indicator of the z variable and include a range of variables to control for the general investment/growth environment (corresponding here to the current and lagged values of γ). Thus, using a linear approximation and setting $n = 1$, we estimate equations of the form

$$\begin{aligned} GROWTHGFCF_{it} &= \alpha + \beta_0 \ln RGDPCH_{it-1} + \delta_0 \ln UNDERVAL_{it} \\ &\quad + \delta_1 \ln UNDERVAL_{it-1} + \delta_2 \ln UNDERVAL_{it-2} \\ &\quad + \rho X_t + f_t + f_i + \varepsilon_{it} \qquad (54) \end{aligned}$$

The long-run effect of a persistent increase in undervaluation (the sum of the $\delta-$coefficients) is expected to be positive, but the existence of lags implies that the individual $\delta-$coefficients cannot be signed unambiguously by the model.[24]

7.3.2 Econometric estimates

The average annual rate of investment growth ($GROWTHGFCF$) is calculated from the gross fixed capital formation (GFCF) series obtained from the World Bank's *World Development Indicators*. The available sample period is 1960-2004 and we continue to use 5-year observations for the 184 countries. In all the regressions we exclude extreme values of the undervaluation index from the sample ($-1.5 > \ln UNDERVAL > 1.5$).[25] Ideally, one would want to include lags of the controls. Since many of the controls are only available for shorter periods, however, there would be a high cost in terms of degrees of freedom.

Table 6 reports results from the estimation of equation (54) for the whole sample with different combinations of control variables. The table reports the individual estimates of coefficients on $\ln UNDERVAL$ (δ_i) and also its long-run effect, along with the associated Wald statistic for the test of joint significance $\sum_{i=0}^{2} \hat{\delta}_i = 0$. In columns 1 to 5, the coefficient on $\ln UNDERVAL_{t-1}$ is significant at 1% and stable in the range 0.042-0.051. This would suggest that

[24] The first-order approximation of (53) at a stationary point $(\underline{\gamma}^*, \underline{z}^*, \dot{\underline{\gamma}}^*, \dot{\underline{z}}^*) = (\underline{\gamma}^*, \underline{z}^*, \underline{0}, \underline{0})$ can be written

$$\begin{aligned} \Delta \ln I &= \alpha + \sum_{i=0}^{n} H_{\gamma_{-i}}(\underline{\gamma}^*, \underline{z}^*)\gamma_{-(i+1)} + \sum_{i=0}^{n} H_{z_i}(\underline{\gamma}^*, \underline{z}^*) z_{-(i+1)} \\ &\quad + \sum_{i=0}^{n} \frac{H_{\gamma_{-i}}}{H}(\gamma_{-i} - \gamma_{-(i+1)}) + \sum_{i=0}^{n} \frac{H_{z_{-i}}}{H}(z_{-i} - z_{-(i+1)} \\ &= \alpha + \frac{H_\gamma}{H}\gamma + \frac{H_z}{H} z + \sum_{i=0}^{n-1}\left(H_{\gamma_{-(i+1)}} + \frac{H_{\gamma_{-(i+1)}} - H_{\gamma_{-i}}}{H}\right)\gamma_{-(i+1)} \\ &\quad + \sum_{i=0}^{n-1}\left(H_{z_{-(i+1)}} + \frac{H_{z_{-(i+1)}} - H_{z_{-i}}}{H}\right) z_{-(i+1)} + \left(H_{\gamma_{-n}} - \frac{H_{\gamma_{-n}}}{H}\right)\gamma_{-(n+1)} \\ &\quad + \left(H_{z_{-n}} - \frac{H_{z_{-n}}}{H}\right) z_{-(n+1)} \end{aligned}$$

With 5-year periods, each estimated coefficient may be a weighted average of some of the coefficients in the above equation and cannot be unambiguously signed. The long-run effect of a persistent change in undervaluation, however, is given by $\sum H_{z_{-i}} > 0$.

[25] This involves excluding a maximum of 15 data points.

some time is needed for a competitive currency to stimulate investment decisions. The current effect of $\ln UNDERVAL$ is slightly negative (between -0.002 and -0.017) and insignificant, whereas the twice lagged coefficient is negative, varies between -0.015 and -0.027 and is significant at either 5% or 10%, except for the baseline equation where it is not significant. When we consider the overall long-run effect of undervaluation on investment growth, we observe that it tends to be small and statistically insignificant, except for the baseline equation in which it is moderately large (0.023) and the Wald test indicates significance at 10%. In the regressions that include the terms of trade and the rule of law index (columns 6 and 7, respectively) $\ln UNDERVAL$ and its lags are not significant either individually or jointly. Column 8 reports the regression in which $\ln UNDERVAL$ interacts with the level of GDP per capita. The negative sign on the interaction term indicates that as income per capita increases the effect of $\ln UNDERVAL$ decreases. According to the estimated coefficients, the long-run effect of undervaluation becomes nil at a level of GDP per capita around $8,800. Thus, the positive effect of currency undervaluation on investment growth appears to operate particularly for developing countries.[26]

Tables 7 and 8 provide further evidence that the effect of undervaluation on investment growth is particularly important for developing countries (as defined under Classification I). Table 7 reports the fixed effect regressions for developing countries. The long-run effect of undervaluation is large, significant and robust to various controls. In columns 1 to 6, the estimated long-run coefficient is in the range of 0.056-0.066. The only case where the coefficient is smaller and not significant is the regression that includes the rule of law index (column 7). Note, however, that undervaluation is not the only variable that loses explanatory power. Most of the control variables that in the previous specifications are highly significant turn insignificant here. This result seems attributable to the small number of observations available for the rule of law index.

Table 7 shows that the positive effect of undervaluation on investment growth in developing countries also appears to operate mainly through the first lag. The estimated coefficient for δ_1 is always large and significant (except for that in column 7). On the other hand, the current effect of $\ln UNDERVAL$ is larger and in some instances significant (columns 3 and 5). The effect of the second lag is insignificant. Finally, the positive long-run effect of currency undervaluation on investment growth for developing countries is robust to changes in the sample period (columns 8 and 9). When we split the sample into two sub-periods (1960-1984 and 1985-2004), the long-run coefficient of $\ln UNDERVAL$ is significant at 5% in both periods. Figure 7, which plots the partial residual plot associated with column 1 of Table 7 suggests a positive relationship between lagged $LNUNDERVAL$ and investment growth.

Table 8 shows the results for developed countries. Because of the small number of observations, we introduce control variables individually. The long-run effect of undervaluation is statistically indistinguishable from zero in all

[26] We also tried non-linear specifications but found the quadratic interaction term to be insignificant.

the regressions. The estimated coefficient on $\ln UNDERVAL_{t-1}$ is large and positive (although not very significant) but is "neutralized" by the negative effects of the current level and second lag. The results using Classification II, reported in the available-on-request appendix, are qualitatively similar to those in Tables 7 and 8.

Tables 9 and 10 report robustness checks of the positive relationship between currency undervaluation and investment growth found for developing countries. Since the real exchange rate is arguably determined jointly with other variables, a potential concern is that the results provided in Table 7 are contaminated by endogeneity/simultaneity problems. To address potential simultaneity/endogeneity problems, we carry out dynamic panel estimations using the Arellano-Bond two-step General Method of Moments (GMM) method. We treat $\ln UNDERVAL$ as endogenous and use its lagged values as instruments.[27] Table 9 reports the main results. The long-run coefficient on $\ln UNDERVAL$ (row (e)) is significant at 1% for developing countries using both Classifications I and II. It is reassuring to see that the values of the estimates with GMM are relatively similar to those of the baseline fixed effect OLS estimation.[28] As in the OLS estimations, the individual coefficient on the first lag is large and significant, and the coefficient on the current value is positive but generally insignificant. The estimated values for the individual coefficients are also similar.[29] For developed countries, the long-run coefficient is not significant under either classification. For the whole sample, the estimated long-run coefficient on $\ln UNDERVAL$ is significant at 1%, but lower than that for developing countries. Overall, the results of the GMM estimations support the earlier findings.

Table 10 reports robustness checks for outliers and asymmetries. Columns 2 and 3 present the results of the baseline regression applied to successively narrower ranges of $\ln UNDERVAL$ for developing countries. The long-run coefficient is always positive and significant. The estimated effect ranges from 0.061 and 0.066. As in the previous analyses, the effect of undervaluation on investment growth operates mainly through the first lag. Columns 4 and 5, reports the estimated coefficients for the baseline equation applied separately to developing countries with undervalued ($\ln UNDERVAL > 0$) and overvalued ($\ln UNDERVAL < 0$) exchange rates, respectively. The long-run effect of undervaluation is marginally insignificant for countries with undervalued exchange rates and only significant at 10% for countries with overvalued exchange rates.

The evidence reported in this subsection suggests that real undervaluations have a positive effect on investment growth mainly for developing countries. This conclusion results from two sources. First, we found that $\ln UNDERVAL$

[27] Given that in the regressions reported in Table 7, the second lag of $\ln UNDERVAL$ was systematically insignificant and very close to zero, we omit it from the GMM analysis. Also, since from a general equilibrium perspective $\ln RGDPCH_{t-1}$ and $\ln UNDERVAL_{t-1}$ are endogenous variables, we treated both as endogenous regressors in the GMM regressions.

[28] The GMM and OLS estimates (Table 6) for the baseline specification are $\widehat{\delta_0} + \widehat{\delta_1} = 0.079$ and 0.060,respectively.

[29] We get $\widehat{\delta_0} = 0.012$ and $\widehat{\delta_1} = 0.048$ in the OLS estimation, and $\widehat{\delta_0} = 0.021$ and $\widehat{\delta_1} = 0.042$ in the GMM estimation.

interacts negatively with the level of real GDP per capita, indicating that its effect on investment growth decreases with countries' income level. Second, using our two classifications of developed and developing countries, we found that the effect of undervaluation on investment growth is large and significant only for developing countries. The small sample size for developed countries somewhat limits the confidence with which we can assess the results, but additional support comes from the fact that the long-run effect of $\ln UNDERVAL$ is insignificant for the whole sample (Table 6), but significant for developing countries (Table 7). Overall, the evidence of a distinction between effects on developing versus developed countries seems more conclusive for investment growth than for GDP growth. These findings appear to be robust to econometric methodology and different degrees of exchange rate misalignment.

8 Conclusions

The theoretical part of this paper analyzed an economy with significant amounts of open and/or hidden unemployment. In this economy, non-tradable output and employment are demand-led; output is not constrained by the supply of labor, and an investment stimulus can affect both the level of output and the growth rate. Put differently, growth in our model is not export-led in the sense of net exports acting as a necessary driver of demand. Instead, there is a close affinity with the argument presented by Rodrik (1997) who saw investment promotion rather than exports as key to growth in Taiwan and Korea. Investment promotion, however, has implications for the balance of payments and requires a suitable real exchange rate policy in order to be sustainable. Thus, the real exchange rate becomes a critical element of successful development, and in this sense there is a link between our argument and the BPCG literature.

The empirical part tested one of the main implications of our model: the existence of a positive relationship between real exchange rate undervaluation on the one hand, and output and investment growth on the other. If, as suggested by the model, the presence of under-employment constitutes an important channel through which the real exchange rate affects the economy, the real exchange rate may be more effective in promoting accumulation and employment in low income developing countries compared to developed countries. Our econometric results, which are robust to a variety of classifications, controls, sample periods, and estimation techniques provide support to this prediction, especially in the case of investment growth. Following Rodrik (2008), undervaluations are also found to boost output growth, although the difference between developing and developed countries appears to be less robust in this case.

Capital market liberalization may affect a country's capacity to implement its growth and trade targets by compromising its ability to set both the interest rate and the exchange rate independently of foreign interest rates. The problem may not be severe: in a flexible exchange rate regime, a decrease in the interest rate will both stimulate investment and alleviate the associated pressure on the trade balance by causing a depreciation. There is likely to be some net effect on the trade balance but, in principle, an interest rate policy that aims to achieve a desired real exchange rate can be supplemented by a combination of taxes and subsidies to provide the required investment incentives. In practice, however, this type of policy may fall foul of WTO regulations and/or involve significant subsidy costs. Partly because of these problems, the implementation of growth policies with balanced trade will typically demand a more sophisticated administrative capability under conditions of free capital mobility. Thus, it may be no accident that the prominent examples of fast growth with an undervalued exchange rate come from countries (and periods) with significant restrictions on capital mobility.[30] We leave these questions for future research.

Even taking for granted the ability of policy makers to influence the real exchange rate, our analysis clearly is highly stylized and has many limitations. As suggested in section 5 and the appendix, however, some of the simplifying assumptions of the benchmark model can be relaxed without affecting the qualitative results.

It has been argued, finally, that exchange rate overvaluations are associated with output volatility.[31] Output volatility, which may be the result of balance-of-payments induced stop-go policies, may in turn lead to social conflict, and some have attributed the negative correlation between overvaluation and growth to the effects of macroeconomic instability and social conflict.[32] [33] This potentially important channel plays no role in the model. However, to the extent that workers mainly consume non-tradables, our model suggests that a real depreciation may avoid the instability and distributional conflicts that could arise if policy makers attempt to raise profits instead through direct wage suppression in the tradable sector.

A Extension: respecifying workers' consumption

As a more general specification, one could allow for saving out of wage income, with saving propensities that depend on both sector and income category, and let the composition of consumption depend on the source of income. Thus, let s_w and s_r represent the saving rates out of wages and rents in the non-tradable sector and σ_w and σ_p the corresponding rates for the tradable sector, and let α_p and α_w be the shares of non-tradables in the consumption out of profits/rents and wages. The equilibrium condition for the non-tradable can now be written

$$Y_N = \alpha_w(1-s_w)\nu\beta Y_N + \alpha_w(1-\sigma_w)W_T + \alpha_p(1-s_r)(1-\nu\beta)Y_N + \alpha_p(1-\sigma_p)(qY_T - W_T)$$

[30] See, for example, Ma and McCauley (2008) and Prasad, Rajan, and Subramanian (2007a,b).

[31] See, for example, Johnson et al. (2007).

[32] See, for example, Fischer (1993).

[33] See, for empirical evidence, Alesina and Perotti (1996) and Berg et al. (2008)

where $W_T = \phi(\frac{bK}{a}, q, s_w, s_r, \sigma_w, \sigma_p)\frac{bK}{a}$ is the wage bill in the tradable sector. Solving for Y_N and substituting into the expression for E_T , we get

$$E_T = AY_T + \frac{B}{q}W_T$$

where

$$\begin{aligned} A &= (1-\sigma_p) - \alpha_p(1-\sigma_p)\frac{s_w\nu\beta + s_r(1-\nu\beta)}{1-\alpha_w(1-s_w)\nu\beta - \alpha_p(1-s_r)(1-\nu\beta)} \\ B &= (\sigma_p - \sigma_w) - [(1-\sigma_w)\alpha_w - (1-\sigma_p)\alpha_p]\frac{s_w\nu\beta + s_r(1-\nu\beta)}{1-\alpha_w(1-s_w)\nu\beta - \alpha_p(1-s_r)(1-\nu\beta)} \end{aligned}$$

The value of A is decreasing in q as long as the substitutability condition is satisfied for both α_p and α_w ($\alpha_p'(q) > 0, \alpha_w(q) > 0$). Hence, the condition $\partial\left(\frac{B}{q}W_T\right)/\partial q \leq 0$ is sufficient to ensure that the domestic demand for tradables will be inversely related to the real exchange rate. Our specification in section 4 emerges as a special case with $\alpha_w = 1, s_w = \sigma_w = 0, s_r = \sigma_p = s > 0$. Another simple case arises with uniform saving rates and consumption compositions ($\alpha_w = \alpha_p$ and $s_w = \sigma_w = s_r = \sigma_p = s > 0$). Both of these cases satisfy the above stated condition since, in both cases, $B \equiv 0$.

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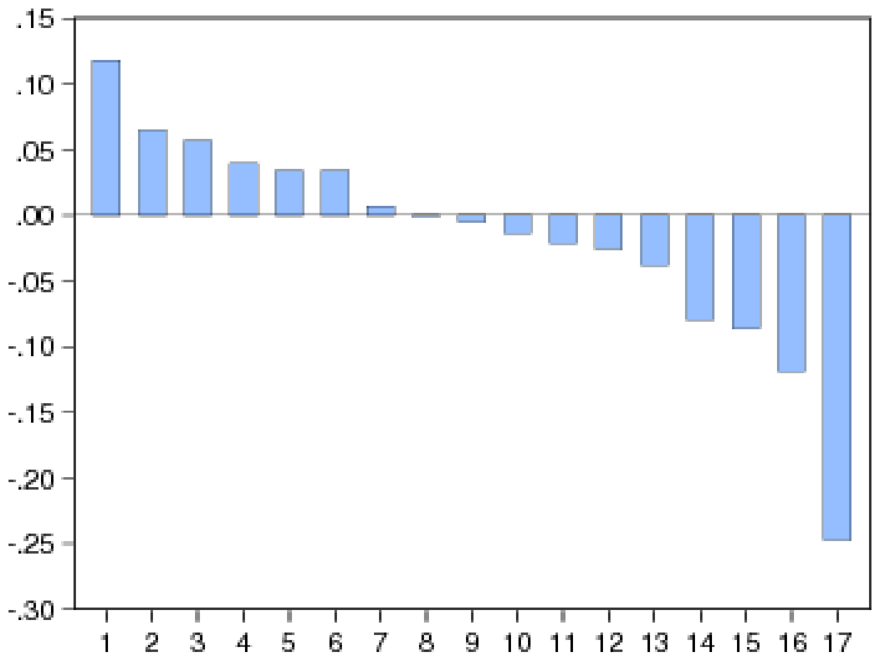

Figure 1: Measure of tradability of sectoral output in China. 1= mining, 2 = chemicals, 3 = machinery & equipment, 4 = petroleum products, 5 = financial services, 6 = Metal products, 7 = agriculture, 8 = construction, 9 = production & supply of electricity, 10 = real estate, 11 = other services, 12 = food, 13 = building materials, 14 = transportation & telecom., 15 = other manufacturing, 16 = wholesale and retail trades, and 17 = textile, apparel, & footwear. Source: National Bureau of Statistics (2008, Table 3-24) and authors' calculations.

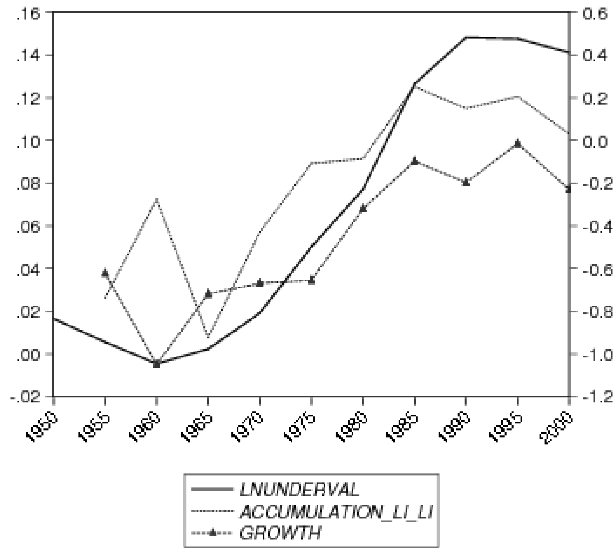

Figure 2: Time plots of undervaluation (right hand scale), output growth, and accumulation rate for China (1952-2004). Source: PWT 6.2, Wang and Szirmai (2008), and authors' calculations.

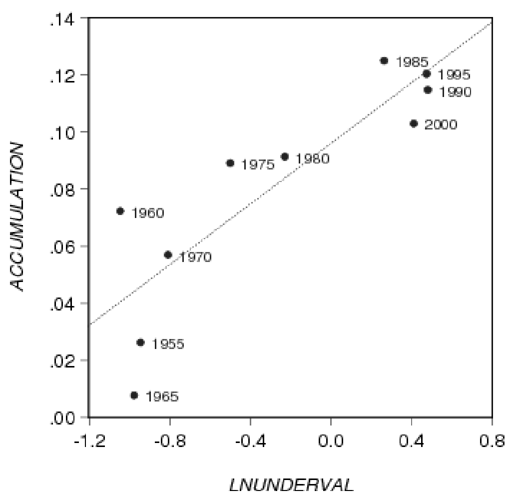

Figure 3: Scatter plot of undervaluation versus accumulation for China (1952-2004). Sources: PWT 6.2, Wang and Szirmai (2008), and authors' calculations..

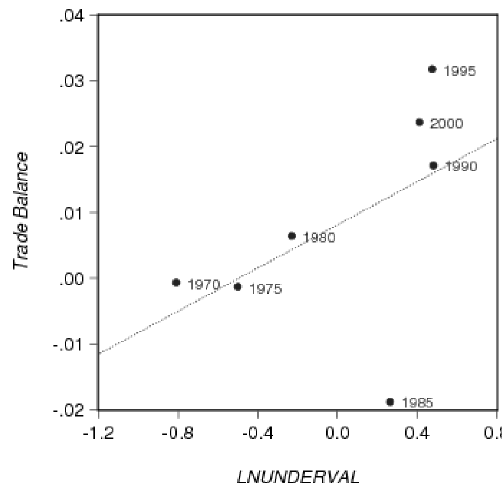

Figure 4: Scatter plot of undervaluation versus the trade balance (as a proportion of GDP) for China (1970-2004). Source: WDI

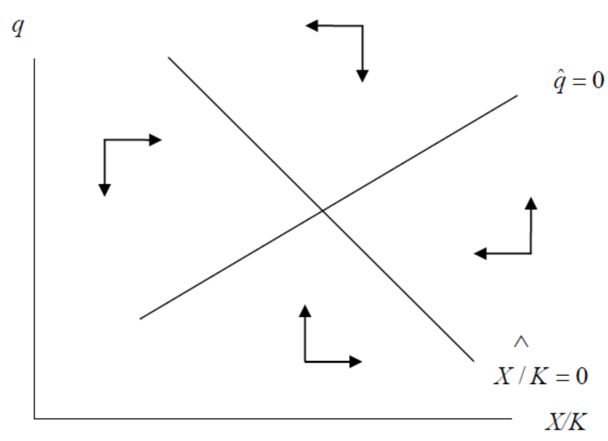

Figure 5: Phase diagram for the short-run set-up

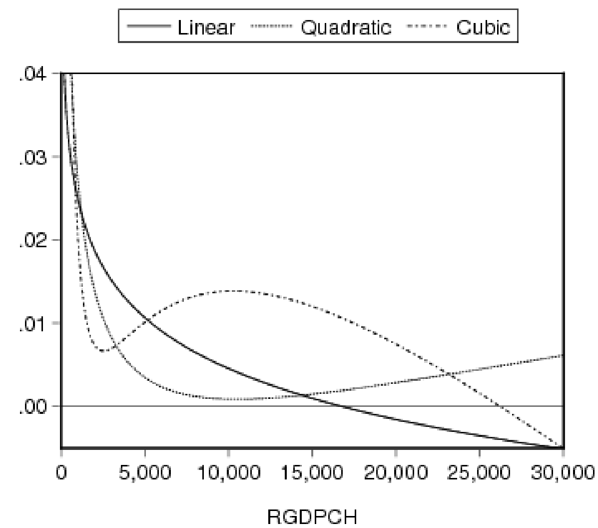

Figure 6: Linear, quadratic, and cubic interactions of GDP per capita growth with $\ln underval$

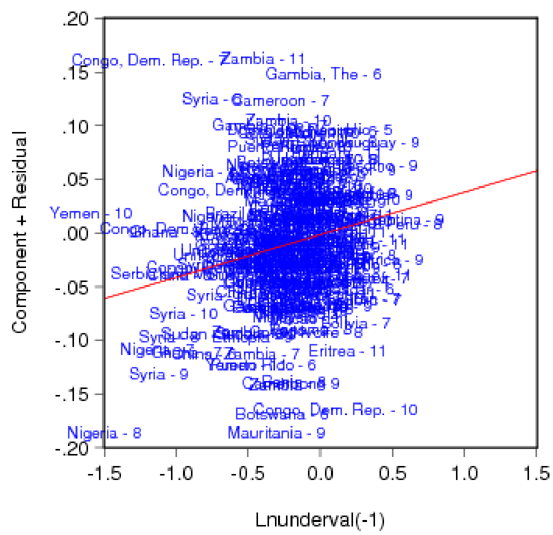

Figure 7: Partial residual plot of investment growth versus lagged undervaluation for developing countries

Table 1: Data definitions, sources, and coverage

Name	Code	Definition	Source	Coverage
Real GDP per cap. growth	$GROWTH$	$GROWTH = [ln(RGDPCH_t) - ln(RGDPCH_{t-1})]/5$	Authors' calculations	1955-2004
Investment growth	$GROWTHGFCF$	$GROWTHGFCF = [(GFCF_t/GFCF_{t-1})^{0.2}] - 1$	Authors' calculations	1965-2004
Real Exchange Rate	RER	$RER = XRAT/PPP$	Authors' calculations	1950-2004
Real Exchange Rate Volatility	$RERVOL$	Calculated as the coefficient of variation of RER within each 5-year period	Authors' calculations	1950-2004
Average years of Education	TYR	Average years of education for the population aged 25 and over.	Barro and Lee (2000)	1960-1999
Rule of Law Index	ROL	Index elaborated based on responses on the quality of governance given by a large number of enterprise, citizen and expert survey. It is measured in units ranging from about -2.5 to 2.5, with higher values corresponding to better governance outcomes.	Kaufmann et al. (2008)	1996-2004
Real GDP per capita	$RGDPCH$	Real GDP per capita in constant U.S. dollar in 2000. It is obtained using a chain index.	PWT	1950-2004
Nominal Exchange Rate	$XRAT$	National currency units per U.S. dollar.	PWT	1950-2004
Degree of Openness	$OPENC$	Exports plus Imports divided by GDP. All variables are expressed in current prices.	PWT	1950-2004
Purchasing Power Parity	PPP	Number of national currency units required to buy goods equivalent to what can be bought with one unit of U.S. It is calculated over GDP	PWT	1950-2004
Gross Domestic Savings	$GDSGDP$	Gross domestic savings is calculated as GDP less final consumption expenditure (total consumption). Data are as share of GDP and divided by 100.	WDI	1960-2004
Government Consumption	$GOVGDP$	It includes all government current expenditures for purchases of goods and services. Data are as share of GDP and divided by 100.	WDI	1960-2004
Consumer Price Index	CPI	Consumer price index.	WDI	1960-2004
Investment (Gross Fixed Capital Formation)	$GFCF$	It includes land improvements; plant, machinery, and equipment purchases; and the construction (including schools, roads, railways, offices, hospitals, private residential dwellings). Data are in constant local currency.	WDI	1960-2004
External debt	$DEBTGNI$	Total external debt stocks to gross national income.	WDI	1960-2004
Terms of Trade	TT	The terms of trade effect equals capacity to import less exports of goods and services in constant prices. Data are in constant local currency.	WDI	1960-2004

Table 2: Panel evidence on GDP per capita growth (all countries: 1950-2004)

Dependent variable: *GROWTH* (GDP per capita growth)[a]	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Baseline								
Ln $RGDPCH_{t-1}$	-0.030***	-0.047***	-0.051***	-0.059***	-0.038***	-0.100***	-0.032***	-0.032***	-0.032***
	(-9.51)	(-11.51)	(-12.27)	(-11.35)	(-5.54)	(-6.57)	(-10.06)	(-10.06)	(-10.38)
Ln UNDERVAL	0.015***	0.010***	0.007**	0.008*	0.003	0.025**	0.086***	0.409***	3.179***
	(5.17)	(2.89)	(2.16)	(1.93)	(0.54)	(2.20)	(4.19)	(3.32)	(4.51)
Government Consumption		0.011	0.010	0.091***	-0.119***	-0.155*			
(share of GDP)		(0.39)	(0.36)	(2.83)	(-2.94)	(-1.94)			
Ln (CPI_t/CPI_{t-1})		-0.005***	-0.004***	-0.005***	-0.003***	-0.013***			
		(-5.58)	(-5.00)	(-5.06)	(-2.76)	(-3.62)			
Gross Domestic Saving (Residuals)		0.126***	0.117***	0.111***	0.103***	0.103***			
		(9.36)	(8.64)	(6.69)	(4.91)	(3.09)			
Openness			0.025***	0.022***	0.020**	-0.009			
(Exports+Imports as share of GDP)			(4.35)	(2.95)	(2.48)	(-0.63)			
Ln (RER volatility)			-0.003**	-0.003**	-0.002	0.001			
			(-2.22)	(-2.55)	(-1.36)	(0.32)			
Average years of Education				0.004**					
				(2.16)					
Ln Terms of Trade					0.002				
					(0.34)				
Rule of Law						-0.001			
						(-0.13)			
Ln (RGDPCH)xLn(UNDERVAL)							-0.0088***	-0.088***	-1.129***
							(-3.51)	(-2.95)	(-4.30)
(Ln(RGDPCH)^2) xLn(UNDERVAL)								0.0048***	0.133***
								(2.67)	(4.13)
(Ln(RGDPCH)^3) xLn(UNDERVAL)									-0.005****
									(-3.99)
Time Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Adjusted R-squared	0.34	0.52	0.53	0.58	0.55	0.69	0.348	0.351	0.360
Number of countries	181	155	155	98	117	151	181	181	181
Observations	1303	856	853	548	451	293	1303	1303	1303

[a] All regressions exclude observations for Iraq, Democratic Rep. of Korea and Laos

Table 3: Panel evidence on GDP per capita growth (countries at different levels of GDP per capital: 1950-2004)

Dependent variable: *GROWTH* (GDP per capita growth)[a]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	RGDPCH <$2,500	RGDPCH <$4,000	RGDPCH <$6,000	RGDPCH >$6,000	RGDPCH >$8,000	RGDPCH >$9,000	RGDPCH >$10,000	RGDPCH >$12,000	RGDPCH >$15,000	RGDPCH >$16,000
Ln $RGDPCH_{t-1}$	-0.052	-0.044	-0.039	-0.054	-0.059	-0.057	-0.059	-0.067	-0.073	-0.077
(p-value)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln UNDERVAL	0.035	0.030	0.024	0.002	0.012	0.016	0.021	0.031	0.027	0.025
(p-value)	(0.000)	(0.000)	(0.000)	(0.789)	(0.127)	(0.052)	(0.014)	(0.003)	(0.068)	(0.127)
Time Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of countries	80	108	131	90	72	67	62	52	46	43
Observations	451	624	790	513	404	373	344	289	216	196

[a] All regressions exclude observations for Iraq, Democratic Rep. of Korea and Laos

Table 4: Panel evidence on GDP per capita growth (developing countries, classification I: 1950-2004)

Dependent variable: *GROWTH* (GDP per capita growth)[a]	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Baseline					1950-1979	1980-2004
Ln RGDPCH (t-1)	-0.031***	-0.054***	-0.047***	-0.068***	-0.101***	-0.067***	-0.060***
	(-8.74)	(-9.43)	(-5.68)	(-8.18)	(-6.10)	(-6.93)	(-11.11)
Ln UNDERVAL	0.018***	0.023***	0.018***	0.017***	0.026**	0.030***	0.013**
	(5.34)	(4.87)	(3.04)	(2.83)	(2.12)	(5.40)	(2.50)
Government Consumption (share of GDP)		-0.064*	-0.088**	0.006	-0.176**		
		(-1.81)	(-2.01)	(0.12)	(-2.00)		
Ln (CPI_t/CPI_{t-1})		-0.004***	-0.002**	-0.004***	-0.014***		
		(-4.08)	(-2.25)	(-3.40)	(-3.65)		
Gross Domestic Saving (Residuals)		0.118***	0.082***	0.144***	0.099***		
		(6.64)	(3.58)	(5.94)	(2.76)		
Openness (Exports+Imports as share of GDP)		0.017**	0.022**	0.017	-0.016		
		(2.31)	(2.43)	(1.64)	(-0.99)		
Ln (RER volatility)		-0.003**	-0.001	-0.003	-0.001		
		(-2.13)	(-0.53)	(-1.64)	(-0.27)		
External Debt (share of GNI)		-0.018***	-0.022***	-0.020***			
		(-4.64)	(4.48)	(-4.00)			
Ln Terms of Trade			-0.001				
			(-0.15)				
Average years of Education				-0.001			
				(-0.22)			
Rule of Law					-0.001		
					(-0.16)		
Time Dummies	yes	yes	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes	yes	yes
Adjusted R-squared	0.32	0.55	058	0.56	0.69	0.58	0.40
Number of countries	158	112	85	66	128	128	158
Observations	1077	540	332	315	248	371	706

[a] All regressions exclude observations for Iraq, Democratic Rep. of Korea and Laos

Table 5: Panel evidence on GDP per capita growth (developed countries, classification I: 1950-2004)

Dependent variable: GROWTH (GDP per capita growth)a	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Baseline								1950-1979	1980-2004
Ln RGDPCH (t-1)	-0.037***	-0.037***	-0.048***	-0.041***	-0.051***	-0.045***	-0.026	-0.048	-0.034***	-0.025
	(-6.55)	(-6.44)	(-6.80)	(-7.00)	(-7.82)	(-4.97)	(-1.26)	(-1.67)	(-4.13)	(-1.50)
Ln UNDERVAL	0.017***	0.016**	0.017**	0.014**	0.014**	0.017**	-0.012	0.032	0.018**	0.017
	(2.78)	(2.55)	(2.41)	(2.31)	(2.00)	(1.99)	(-0.67)	(1.18)	(2.14)	(1.14)
Openness					0.029**					
(X+M)/GDP					(2.27)					
Ln (RER volatility)		-0.001			-0.001					
		(-0.48)			(-0.80)					
Govt. Consumption			-0.178***		-0.039					
(share of GDP)			(-3.43)		(-0.79)					
Ave. years of Education				-0.001						
				(-0.55)						
Gross dom. savings (Resids.)					0.124***					
					(7.58)					
Ln (CPI_t/CPI_{t-1})						-0.003				
						(-0.53)				
Ln Terms of Trade							-0.032**			
							(-2.07)			
Rule of Law								0.033*		
								(1.98)		
Time Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Adjusted R-squared	0.55	0.55	0.60	0.64	0.73	0.52	0.27	0.80	0.71	0.25
Number of countries	23	23	23	22	23	23	18	23	23	23
Observations	226	223	202	194	179	178	86	46	111	115

[a] All regressions exclude observations for Iraq, Democratic Rep. of Korea and Laos

Table 6: Panel evidence on investment growth (all countries: 1960-2004)

Dependent variable: GROWTHGFCF (Investment growth)[a]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Baseline							
Ln $RGDPCH_{t-1}$	-0.071***	-0.070***	-0.087***	-0.097***	-0.110***	-0.110***	-0.162**	-0.080***
	(-5.65)	(-4.90)	(-5.96)	(-6.49)	(-5.81)	(-5.09)	(-2.29)	(-6.36)
Ln $UNDERVAL_t$	-0.006	-0.002	-0.013	-0.014	-0.017	-0.009	0.040	0.107***
	(-0.51)	(-0.12)	(-0.99)	(-1.08)	(-1.19)	(-0.49)	(0.78)	(3.30)
Ln $UNDERVAL_{t-1}$	0.044***	0.042***	0.042***	0.042***	0.051***	0.029	0.003	0.153***
	(3.24)	(2.94)	(3.00)	(3.00)	(3.42)	(1.64)	(0.08)	(4.80)
Ln $UNDERVAL_{t-2}$	-0.015	-0.025**	-0.021*	-0.023*	-0.027*	-0.022	0.034	0.101***
	(-1.27)	(-2.12)	(-1.81)	(-1.94)	(-1.93)	(-1.38)	(1.18)	(3.09)
Government Consumption		0.141	0.148	0.224**	0.295**	0.181	0.299	
(share of GDP)		(1.41)	(1.51)	(2.21)	(2.55)	(1.32)	(0.94)	
Ln (CPI_t/CPI_{t-1})		-0.010***	-0.009***	-0.009***	-0.008***	-0.007**	0.016	
		(-3.88)	(-3.61)	(-3.58)	(-2.70)	(-2.50)	(0.79)	
Ln (RER volatility)		-0.009**	-0.009**	-0.009**	-0.011***	-0.015***	0.003	
		(-2.53)	(-2.57)	(-2.55)	(-2.90)	(-3.10)	(0.34)	
Openness			0.084***	0.077***	0.101***	0.048*	0.019	
(Exports+Imports as share of GDP)			(4.31)	(3.91)	(3.79)	(1.82)	(0.32)	
Gross Domestic Saving (Residuals)				0.137***	0.202***	0.166**	-0.010	
				(2.81)	(3.57)	(2.31)	(-0.06)	
Average years of Education					-0.005			
					(-0.75)			
Ln Terms of Trade						-0.019		
						(-0.98)		
Rule of Law							0.070**	
							(2.58)	
Ln(RGDPCH)x($LnUND_t+LnUND_{t-1}+LnUND_{t-2}$)								-0.013***
								(-3.82)
Time Dummies	yes	yes	yes	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes	yes	yes	yes
$LnUND_t + LnUND_{t-1} + LnUND_{t-2}$	0.023	0.015	0.008	0.005	0.007	-0.002	0.077	-
Wald statistic	3.196	1.238	0.335	0.141	0.187	0.005	1.045	-
p-value	(0.074)	(0.266)	(0.563)	(0.708)	(0.666)	(0.942)	(0.307)	-
Adjusted R-squared	0.18	0.22	0.25	0.26	0.33	0.19	0.22	0.20
Number of countries	153	138	138	138	90	102	131	153
Observations	712	639	639	639	432	395	234	712

[a] All regressions exclude observations for which Ln(UNDERVAL)<-1.5 and Ln(UNDERVAL)>1.5

Table 7: Panel evidence on investment growth (developing countries, classification I: 1960-2004)

Dependent variable: GROWTHGFCF (Investment growth)[a]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Baseline							1960-1984	1985-2004
Ln $RGDPCH_{t-1}$	-0.083***	-0.081***	-0.113***	-0.124***	-0.134***	-0.156***	-0.181**	-0.168***	-0.127***
	(-5.88)	(-5.01)	(-5.88)	(-6.27)	(-5.17)	(-5.37)	(-2.09)	(-3.01)	(-5.55)
Ln $UNDERVAL_t$	0.012	0.017	0.027*	0.026	0.036*	0.015	0.040	0.019	-0.001
	(0.86)	(1.14)	(1.70)	(1.63)	(1.69)	(0.81)	(0.68)	(0.53)	(-0.06)
Ln $UNDERVAL_{t-1}$	0.048***	0.040**	0.032*	0.032**	0.023	0.048**	-0.022	0.092**	0.049***
	(3.18)	(2.47)	(1.96)	(1.97)	(1.17)	(2.50)	(-0.49)	(2.13)	(2.93)
Ln $UNDERVAL_{t-2}$	0.006	0.003	0.001	-0.000	-0.003	-0.004	0.028	0.008	0.008
	(0.47)	(0.20)	(0.04)	(-0.02)	(-0.15)	(-0.22)	(0.76)	(0.17)	(0.052)
Government Consumption		0.024	0.092	0.149	0.149	0.319**	0.211		
(share of GDP)		(0.21)	(0.76)	(1.20)	(0.98)	(2.09)	(0.57)		
Ln (CPI_t/CPI_{t-1})		-0.010***	-0.007***	-0.007***	-0.007**	-0.006	0.023		
		(-3.59)	(-2.61)	(-2.63)	(-2.08)	(-1.61)	(0.96)		
Ln (RER volatility)		-0.015***	-0.011**	-0.011**	-0.015**	-0.012**	-0.005		
		(-3.30)	(-2.39)	(-2.38)	(-2.52)	(-2.04)	(-0.52)		
Openness			0.065***	0.060**	0.049	0.101***	0.030		
(Exports+Imports as share of GDP)			(2.63)	(2.42)	(1.60)	(2.84)	(0.39)		
External Debt			-0.051***	-0.050***	-0.054***	-0.043**	-0.007		
(share of GNI)			(-3.87)	(-3.83)	(-3.43)	(-2.53)	(-0.17)		
Gross Domestic Saving (Residuals)				0.136**	0.126	0.227***	0.084		
				(2.16)	(1.55)	(2.78)	(0.43)		
Ln Terms of Trade					-0.015				
					(-0.71)				
Average years of Education						0.002			
						(0.17)			
Rule of Law							0.087**		
							(2.61)		
Time Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes
$LnUND_t + LnUND_{t-1} + LnUND_{t-2}$	0.066	0.060	0.060	0.058	0.056	0.059	0.046	0.118	0.056
Wald statistic	15.79	10.94	8.85	8.37	3.86	4.80	0.27	4.90	4.43
p-value	(0.000)	(0.001)	(0.003)	(0.004)	(0.049)	(0.029)	(0.600)	(0.027)	(0.035)
Adjusted R-squared	0.23	0.28	0.32	0.33	0.24	0.37	0.23	0.45	0.22
Number of countries	130	115	100	100	76	61	98	65	130
Observations	552	484	420	420	294	261	173	166	386

[a] All regressions exclude observations for which Ln(UNDERVAL)<-1.5 and Ln(UNDERVAL)>1.5

Table 8: Panel evidence on investment growth (developed countries, classification I: 1960-2004)

Dependent variable: GROWTHGFCF (Investment growth)[a]

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Baseline									
Ln $RGDPCH_{t-1}$	-0.109***	-0.107***	-0.119***	-0.125***	-0.107***	-0.104***	-0.116***	-0.121***	-0.147***	-0.098*
	(-4.48)	(-4.44)	(-5.38)	(-5.32)	(-4.34)	(-4.29)	(-5.00)	(-5.49)	(-5.02)	(-1.79)
Ln $UNDERVAL_t$	-0.019	-0.024	-0.033	-0.049*	-0.017	-0.011	-0.042	-0.043	-0.033	-0.092
	(-0.63)	(-0.81)	(-1.22)	(-1.68)	(-0.55)	(-0.37)	(-1.46)	(-1.57)	(-1.09)	(-1.77)
Ln $UNDERVAL_{t-1}$	0.056*	0.043	0.050*	0.064**	0.057*	0.058*	0.055*	0.054*	0.053	0.071
	(1.72)	(1.30)	(1.69)	(2.06)	(1.70)	(1.78)	(1.77)	(1.82)	(1.58)	(1.50)
Ln $UNDERVAL_{t-2}$	-0.020	-0.012	0.006	-0.010	-0.025	-0.023	-0.007	0.007	-0.018	-0.039
	(-0.81)	(-0.48)	(0.28)	(-0.42)	(-0.93)	(-0.91)	(-0.28)	(0.30)	(-0.72)	(0.90)
Government Consumption		-0.283*					-0.251*	-0.085		
(share of GDP)		(-1.91)					(-1.70)	(-0.58)		
Gross Domestic Saving (Residuals)			0.233***					0.177***		
			(5.38)					(3.71)		
Openness				0.087***			0.081***	0.054**		
(Exports+Imports as share of GDP)				(3.82)			(3.52)	(2.36)		
Ln (RER volatility)					-0.006					
					(-1.31)					
Ln (CPI_t/CPI_{t-1})						-0.021	-0.029**	-0.020		
						(-1.53)	(-2.23)	(-1.58)		
Average years of Education									-0.008	
									(-1.52)	
Ln Terms of Trade										-0.058
										(-1.37)
Rule of Law										
Time Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
$LnUND_t + LnUND_{t-1} + LnUND_{t-2}$	0.017	0.007	0.023	0.005	0.015	0.024	0.007	0.018	0.002	-0.060
Wald statistic	0.61	0.11	1.41	0.05	0.46	1.19	0.10	0.79	0.001	1.09
p-value	(0.436)	(0.744)	(0.236)	(0.826)	(0.497)	(0.275)	(0.749)	(0.374)	(0.940)	(0.296)
Adjusted R-squared	0.32	0.34	0.45	0.39	0.32	0.34	0.42	0.48	0.43	0.10
Number of countries	23	23	23	23	23	23	23	23	22	18
Observations	160	160	160	160	158	157	157	157	130	86

[a] All regressions exclude observations for which Ln(UNDERVAL)<-1.5 and Ln(UNDERVAL)>1.5

Table 9: Dynamic Panel Estimation of the investment growth effects of undervaluation

Dependent variable: GROWTHGFCF (Investment growth)[a]

	All countries	Developed Countries Classif I	Developed Countries Classif II	Developing Countries Classif I	Developing Countries Classif II
	(1)	(2)	(3)	(4)	(5)
(a) Lagged investment growth	0.213***	0.003	-0.005	0.216***	0.234***
	(4.34)	(0.04)	(-0.07)	(4.09)	(4.52)
(b) Ln intial income	-0.080***	-0.131***	-0.111***	-0.089***	-0.083***
	(-6.25)	(-3.66)	(-3.12)	(-6.41)	(-6.09)
(c) Ln $UNDERVAL_t$	0.010	-0.005	-0.102**	0.021*	0.019
	(0.83)	(-0.14)	(-2.12)	(1.66)	(1.53)
(d) Ln $UNDERVAL_{t-1}$	0.031***	0.048	0.097**	0.042***	0.033**
	(2.69)	(1.64)	(2.52)	(2.71)	(2.32)
(e) = [(c)+(d)]/[1-(a)]	0.052	0.045	-0.004	0.079	0.067
Wald statistic	13.92	2.43	0.02	17.42	12.83
p-value	(0.000)	(0.119)	(0.890)	(0.000)	(0.000)
Time dummies	yes	yes	yes	yes	yes
No. of countries	115	23	23	92	96
Observations	452	115	103	337	349
Instrument rank	30	23	23	30	30
J-statistic	23.79	15.50	15.55	23.05	21.10
Sargan Test (p-value)	0.252	0.277	0.274	0.286	0.391

[a]Results obtained using the orthogonal deviations transformation and assuming exogeneity of time dummies. All regressions exclude observations for which Ln(UNDERVAL)<-1.5 and Ln(UNDERVAL)>1.5

Table 10: Panel evidence on investment growth, testing for outliers and asymmetries

Dependent variable: GROWTHGFCF (Investment growth)

	(1)	(2)	(3)	(4)	(5)
	Baseline -1.5<LnUND<1.5	-1.0<LnUND<1.0	-0.5<LnUND<0.5	LnUND>0	LnUND<0
Ln RGDPCH$_{t-1}$	-0.083***	-0.082***	-0.098***	-0.083***	-0.119***
	(-5.88)	(-5.70)	(-6.37)	(-4.12)	(-3.53)
Ln UNDERVAL$_{t}$	0.012	0.008	-0.026	-0.049*	0.053
	(0.86)	(0.54)	(-1.26)	(-1.90)	(1.64)
Ln UNDERVAL$_{t-1}$	0.048***	0.045***	0.078***	0.066***	0.030
	(3.18)	(2.92)	(4.40)	(3.38)	(1.10)
Ln UNDERVAL$_{t-2}$	0.006	0.008	0.011	0.026	-0.012
	(0.47)	(0.61)	(0.75)	(1.31)	(-0.49)
Time Dummies	yes	yes	yes	yes	yes
Country Dummies	yes	yes	yes	yes	yes
LnUND$_{t}$ + LnUND$_{t-1}$ + LnUND$_{t-2}$	0.066	0.061	0.063	0.043	0.072
Wald statistic	15.79	12.82	8.33	2.19	2.81
p-value	(0.000)	(0.000)	(0.004)	(0.139)	(0.094)
Adjusted R-squared	0.23	0.22	0.23	0.40	0.037
Number of countries	130	126	113	104	85
Observations	552	540	463	327	225