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DANI RODRIK
Harvard University

The Real Exchange Rate and Economic Growth

ABSTRACT I show that undervaluation of the currency (a high real exchange rate) stimulates economic growth. This is true particularly for developing countries. This finding is robust to using different measures of the real exchange rate and different estimation techniques. I also provide some evidence that the operative channel is the size of the tradable sector (especially industry). These results suggest that tradables suffer disproportionately from the government or market failures that keep poor countries from converging toward countries with higher incomes. I present two categories of explanations for why this may be so, the first focusing on institutional weaknesses, and the second on product-market failures. A formal model elucidates the linkages between the real exchange rate and the rate of economic growth.

Economists have long known that poorly managed exchange rates can be disastrous for economic growth. Avoiding significant overvaluation of the currency is one of the most robust imperatives that can be gleaned from the diverse experience with economic growth around the world, and one that appears to be strongly supported by cross-country statistical evidence.¹ The results reported in the well-known papers by David Dollar and by Jeffrey Sachs and Andrew Warner on the relationship between outward orientation and economic growth are largely based on indices that capture the degree of overvaluation.² Much of the literature that derives policy recommendations from cross-national regressions is now in disrepute,³ but it

1. Razin and Collins (1997); Johnson, Ostry, and Subramanian (2007); Rajan and Subramanian (2006).

2. Dollar (1992); Sachs and Warner (1995); Rodriguez and Rodrik (2001).

3. Easterly (2005); Rodrik (2005).

is probably fair to say that the admonishment against overvaluation remains as strong as ever. In his pessimistic survey of the cross-national growth literature,⁴ William Easterly agrees that large overvaluations have an adverse effect on growth (although he remains skeptical that moderate movements have determinate effects).

Why overvaluation is so consistently associated with slow growth is not always theorized explicitly, but most accounts link it to macroeconomic instability.⁵ Overvalued currencies are associated with foreign currency shortages, rent seeking and corruption, unsustainably large current account deficits, balance of payments crises, and stop-and-go macroeconomic cycles, all of which are damaging to growth.

I will argue that this is not the whole story. Just as overvaluation hurts growth, so undervaluation facilitates it. For most countries, periods of rapid growth are associated with undervaluation. In fact, there is little evidence of nonlinearity in the relationship between a country's real exchange rate and its economic growth: an increase in undervaluation boosts economic growth just as powerfully as a decrease in overvaluation. But this relationship holds only for developing countries; it disappears when the sample is restricted to richer countries, and it gets stronger the poorer the country. These findings suggest that more than macroeconomic stability is at stake. The relative price of tradable goods to nontradable goods (that is, the real exchange rate) seems to play a more fundamental role in the convergence of developing country with developed country incomes.⁶

I attempt to make the point as directly as possible in figure 1, which depicts the experience of seven developing countries during 1950–2004: China, India, South Korea, Taiwan, Uganda, Tanzania, and Mexico. In each case I have graphed side by side my measure of real undervaluation (defined in the next section) against the country's economic growth rate in the same period. Each point represents an average for a five-year window.

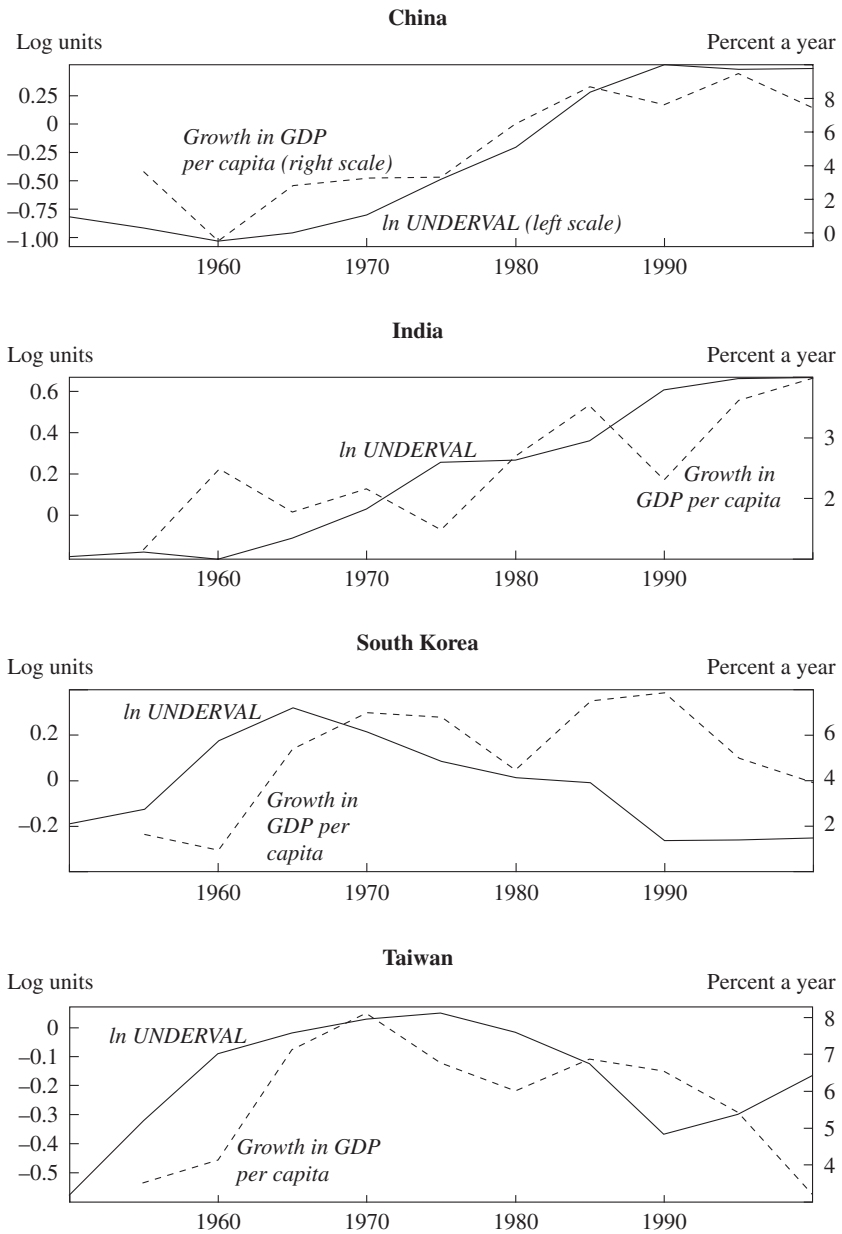
To begin with the most fascinating (and globally significant) case, the degree to which economic growth in China tracks the movements in my index of undervaluation is uncanny. The rapid increase in annual growth of GDP per capita starting in the second half of the 1970s closely parallels the increase in the undervaluation index (from an overvaluation of close to

4. Easterly (2005).

5. See, for example, Fischer (1993).

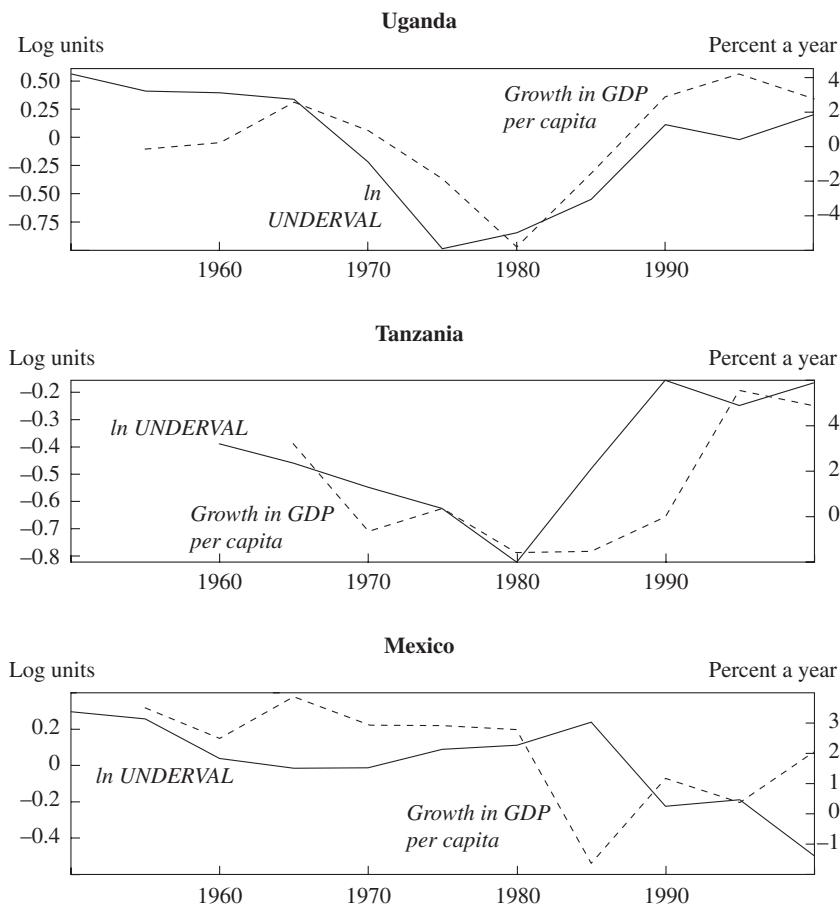
6. Recently, Bhalla (forthcoming), Gala (2007), and Gluzmann, Levy-Yeyati, and Sturzenegger (2007) have made similar arguments.

Figure 1. Undervaluation and Economic Growth in Selected Developing Countries, 1950–2004



(continued)

Figure 1. Undervaluation and Economic Growth in Selected Developing Countries, 1950–2004 (*Continued*)



Sources: Penn World Tables version 6.2, and author's calculations.

100 percent to an undervaluation of around 50 percent⁷), and both undervaluation and the growth rate plateau in the 1990s. Analysts who focus on global imbalances have, of course, noticed in recent years that the yuan is undervalued, as evidenced by China's large current account surplus. They have paid less attention to the role that undervaluation seems to have played in driving the country's economic growth.

7. Recent revisions in purchasing power parity indices are likely to make a big difference to the levels of these undervaluation measures, without greatly affecting their trends over time. See the discussion below.

For India, the other growth superstar of recent years, the picture is less clear-cut, but the basic message is the same as that for China. India's growth in GDP per capita has steadily climbed from slightly above 1 percent a year in the 1950s to 4 percent by the early 2000s, while its real exchange rate has moved from a small overvaluation to an undervaluation of around 60 percent. In the case of the two East Asian tigers depicted in figure 1, South Korea and Taiwan, what is interesting is that the growth slowdowns in recent years were in each case preceded or accompanied by increased overvaluation or reduced undervaluation. In other words, both growth and undervaluation exhibit an inverse-U shape over time.

These regularities are hardly specific to Asian countries. The next two panels in figure 1 depict two African experiences, those of Uganda and Tanzania, and here the undervaluation index captures the turning points in economic growth exceptionally well. A slowdown in growth is accompanied by increasing overvaluation, and a pickup in growth is accompanied by a rise in undervaluation. Finally, the last panel of figure 1 shows a somewhat anomalous Latin American case, that of Mexico. Here the two series seem quite a bit out of sync, especially since 1981, when the correlation between growth and undervaluation turns negative rather than positive. Those familiar with the recent economic history of Mexico will recognize this to be a reflection of the cyclical role of capital inflows in inducing growth in that country. Periods of capital inflows in Mexico are associated with consumption-led growth booms and currency appreciation; when the capital flows reverse, the economy tanks and the currency depreciates. The Mexican experience is a useful reminder that there is no reason a priori to expect a positive relationship between growth and undervaluation. It also suggests the need to go beyond individual cases and undertake a more systematic empirical analysis.

In the next section I do just that. First, I construct a time-varying index of real undervaluation, based on data from the Penn World Tables on price levels in individual countries. My index of undervaluation is essentially a real exchange rate adjusted for the Balassa-Samuelson effect: this measure of the real exchange rate adjusts the relative price of tradables to nontradables for the fact that as countries grow rich, the relative prices of nontradables as a group tend to rise (because of higher productivity in tradables). I next show, in regressions using a variety of fixed-effects panel specifications, that there is a systematic positive relationship between growth and undervaluation, especially in developing countries. This indicates that the Asian experience is not an anomaly. I subject these baseline results to a series of robustness tests, employing different data sources, a range of alter-

native undervaluation indices, and different estimation methods. Although ascertaining causality is always difficult, I argue that in this instance causality is likely to run from undervaluation to growth rather than the other way around. I also present evidence that undervaluation works through its positive impact on the share of tradables in the economy, especially industry. Hence developing countries achieve more rapid growth when they are able to increase the relative profitability of their tradables.

These results suggest strongly that there is something “special” about tradables in countries with low to medium incomes. In the rest of the paper I examine the reasons behind this regularity. What is the precise mechanism through which an increase in the relative price of tradables (and therefore the sector’s relative size) increases growth? I present two classes of theories that would account for the stylized facts. In one, tradables are “special” because they suffer disproportionately (that is, compared with nontradables) from the institutional weakness and inability to completely specify contracts that characterize lower-income environments. In the other, tradables are “special” because they suffer disproportionately from the market failures (information and coordination externalities) that block structural transformation and economic diversification. In both cases, an increase in the relative price of tradables acts as a second-best mechanism to partly alleviate the relevant distortion, foster desirable structural change, and spur growth. Although I cannot discriminate sharply between the two theories and come down in favor of one or the other, I present some evidence that suggests that these two sets of distortions do affect tradable activities more than they do nontradables. This is a necessary condition for my explanations to make sense.

In the penultimate section of the paper, I develop a simple growth model to elucidate how the mechanisms I have in mind might work. The model is that of a small, open economy in which the tradable and nontradable sectors both suffer from an economic distortion. For the purposes of the model, whether the distortion is of the institutional and contracting kind or of the conventional market failure kind is of no importance. The crux is the relative magnitude of the distortions in the two sectors. I show that when the distortion in tradables is larger, the tradable sector is too small in equilibrium. A policy or other exogenous shock that can induce a real depreciation will then have a growth-promoting effect. For example, an outward transfer, which would normally reduce domestic welfare, can have the reverse effect because it increases the equilibrium relative price of tradables and can thereby increase economic growth. The model clarifies how changes in relative prices can produce growth effects in the presence of

distortions that affect the two sectors differently. It also clarifies the sense in which the real exchange rate is a “policy” variable: changing its level requires complementary policies (here the size of the inward or outward transfer).

I summarize my findings and discuss some policy issues in the concluding section of the paper.

Undervaluation and Growth: The Evidence

I will use a number of different indices in what follows, but my preferred index of under- or overvaluation is a measure of the domestic price level adjusted for the Balassa-Samuelson effect. This index has the advantage that it is comparable across countries as well as over time. I compute this index in three steps. First, I use data on exchange rates (*XRAT*) and purchasing power parity conversion factors (*PPP*) from the Penn World Tables version 6.2 to calculate a “real” exchange rate (*RER*):⁸

$$\ln RER_{it} = \ln(XRAT_{it}/PPP_{it}),$$

where *i* indexes countries and *t* indexes five-year time periods. (Unless specified otherwise, all observations are simple averages across years.) *XRAT* and *PPP* are expressed as national currency units per U.S. dollar.⁹ Values of *RER* greater than one indicate that the value of the currency is lower (more depreciated) than indicated by purchasing power parity. However, in practice nontradable goods are also cheaper in poorer countries (through the Balassa-Samuelson effect), which requires an adjustment. So in the second step I account for this effect by regressing *RER* on GDP per capita (*RGDPCH*):

$$(1) \quad \ln RER_{it} = \alpha + \beta \ln RGDPCH_{it} + f_t + u_{it},$$

where f_t is a fixed effect for time period and u is the error term. This regression yields an estimate of $\hat{\beta}$ of -0.24 (with a very high t statistic of around 20), suggesting a strong and precisely estimated Balassa-Samuelson effect: when incomes rise by 10 percent, the real exchange rate falls by around 2.4 percent. Finally, to arrive at my index of undervaluation, I take the difference between the actual real exchange rate and the Balassa-Samuelson-adjusted rate:

8. The Penn World Tables data are from Heston, Summers, and Aten (2006).

9. The variable p in the Penn World Tables (called the “price level of GDP”) is equivalent to *RER*. I have used p here as this series is more complete than *XRAT* and *PPP*.

$$\ln UNDERVAL_{it} = \ln RER_{it} - \ln \widehat{RER}_{it},$$

where $\ln \widehat{RER}_{it}$ is the predicted value from equation 1.

Defined in this way, *UNDERVAL* is comparable across countries and over time. Whenever *UNDERVAL* exceeds unity, it indicates that the exchange rate is set such that goods produced at home are relatively cheap in dollar terms: the currency is undervalued. When *UNDERVAL* is below unity, the currency is overvalued. In what follows I will typically use the logarithmic transform of this variable, $\ln UNDERVAL$, which is centered at zero and has a standard deviation of 0.48 (figure 2). This is also the measure used in figure 1.

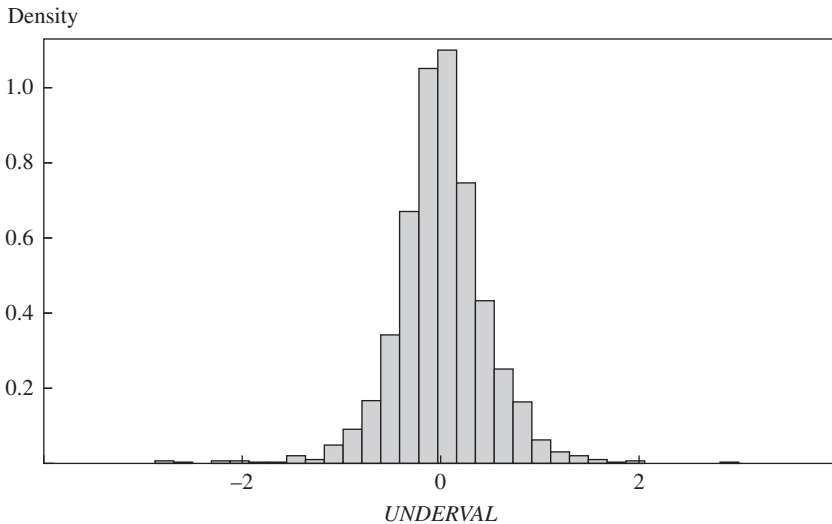
My procedure is fairly close to that followed in recent work by Simon Johnson, Jonathan Ostry, and Arvind Subramanian.¹⁰ The main difference is that these authors estimate a different cross section for equation 1 for each year, whereas I estimate a single panel (with time dummies). My method seems preferable for purposes of comparability over time. I emphasize that my definition of undervaluation is based on price comparisons and differs substantially from an alternative definition that relates to the external balance. The latter is typically operationalized by specifying a small-scale macro model and estimating the level of the real exchange rate that would achieve balance of payments equilibrium.¹¹

One issue of great significance for my calculations is that the World Bank's International Comparison Program has recently published revised PPP conversion factors for a single benchmark year, 2005.¹² In some important instances, these new estimates differ greatly from those previously available and on which I have relied here. For example, price levels in both China and India are now estimated to be around 40 percent above the previous estimates for 2005, indicating that these countries' currencies were not nearly as undervalued in that year as the old numbers suggested (15 to 20 percent as opposed to 50 to 60 percent). This is not as damaging to my results as it may seem at first sight, however. Virtually all my regressions are based on panel data and include a full set of country and time fixed effects. In other words, as I did implicitly in figure 1, I identify the growth effects of undervaluation from changes within countries, not from differences in levels across a cross section of countries. So my results

10. Johnson, Ostry, and Subramanian (2007).

11. See Aguirre and Calderón (2005), Razin and Collins (1997), and Elbadawi (1994) for some illustrations.

12. International Comparison Program (2007).

Figure 2. Distribution of the Undervaluation Measure

Source: Author's calculations.

should remain unaffected if the revisions to the PPP factors turn out to consist of largely one-time adjustments to the estimated price levels of individual countries, without greatly altering their time trends. Even though the time series of revised PPP estimates are not yet available, preliminary indications suggest that this will be the case.

In fact, the revised data yield a cross-sectional estimate of β for 2005 that is virtually the same as the one presented above (-0.22 , with a t statistic of 11). In other words, the magnitude of the Balassa-Samuelson effect is nearly identical whether estimated with the new data or the old.

The Baseline Panel Evidence

My dataset covers a maximum of 188 countries and 11 five-year periods from 1950–54 through 2000–04. My baseline specification for estimating the relationship between undervaluation and growth takes the following form:

$$(2) \text{ growth}_i = \alpha + \beta \ln \text{RGDPCH}_{i,t-1} + \delta \ln \text{UNDerval}_i + f_i + f_t + u_i,$$

where the dependent variable is annual growth in GDP per capita. The equation thus includes the standard convergence term (initial income per capita, $\text{RGDPCH}_{i,t-1}$) and a full set of country and time dummies (f_i and f_t).

My primary interest is in the value of $\hat{\delta}$. Given the fixed-effects framework, what I am estimating is the “within” effect of undervaluation, namely, the impact of changes in under- or overvaluation on changes in growth rates within countries. I present regressions with additional covariates, as well as cross-sectional specifications, in a later subsection.

Table 1 presents the results. When estimated for the panel as a whole (column 1-1), the regression yields a highly significant $\hat{\delta}$ of 0.017. However, as columns 1-2 and 1-3 reveal, this effect operates only for developing countries. In the richer countries in the sample, $\hat{\delta}$ is small and statistically indistinguishable from zero, whereas in the developing countries $\hat{\delta}$ rises to 0.026 and is highly significant. The latter estimate suggests that a 50 percent undervaluation—which corresponds roughly to one standard deviation in *UNDERVAL*—is associated with a boost in annual growth of real income per capita during the same five-year period of 1.3 percentage points (0.50×0.026). This is a sizable effect. I will discuss the plausibility of this estimate later, following my discussion of robustness tests and theoretical explanations.

The results in column 1-4 confirm further that the growth impact of undervaluation depends heavily on a country’s level of development. When *UNDERVAL* is interacted with initial income, the estimated coefficient on the interaction term is negative and highly significant. The estimated coefficients in column 1-4 indicate that the growth effects of a 50 percent undervaluation for Brazil, China, India, and Ethiopia at their current levels of income are 0.47, 0.60, 0.82, and 1.46 percentage points, respectively. The estimates also imply that the growth effect disappears at an income per capita of \$19,635, roughly the level of Bahrain, Spain, or Taiwan.

Interestingly, the estimated impact of undervaluation seems to be independent of the time period under consideration. When I split the developing country data into pre- and post-1980 subperiods (columns 1-5 and 1-6), the value of $\hat{\delta}$ remains basically unaffected. This indicates that the channel or channels through which undervaluation works have little to do with the global economic environment; the estimated impact is, if anything, smaller in the post-1980 era of globalization, when markets in rich countries were considerably more open. So the explanation cannot be a simple export-led growth story.

Robustness: Sensitivity to Outliers

As noted in the introduction, the literature on the relationship between exchange rate policy and growth has focused to date largely on the delete-

Table 1. Baseline Panel Regressions of Economic Growth on the Undervaluation Measure^a

<i>Independent variable</i>	<i>Sample</i>					
	<i>All countries, 1950–2004</i> 1-1	<i>Developed countries,^b 1950–2004</i> 1-2	<i>Developing countries, 1950–2004</i> 1-3	<i>All countries, 1950–2004</i> 1-4	<i>Developing countries, 1950–79</i> 1-5	<i>Developing countries, 1980–2004</i> 1-6
<i>ln initial income</i>	-0.031*** (-6.67)	-0.055*** (-6.91)	-0.039*** (-5.30)	-0.032*** (-7.09)	-0.062*** (-3.90)	-0.065*** (-4.64)
<i>ln UNDERVAL</i>	0.017*** (5.21)	0.003 (0.49)	0.026*** (5.84)	0.086*** (4.05)	0.029*** (4.20)	0.024*** (3.23)
<i>ln initial income × ln UNDERVAL</i>				-0.0087*** (-3.39)		
<i>No. of observations</i>	1,303	513	790	1,303	321	469

Source: Author's regressions.

a. The dependent variable is annual growth in GDP per capita, in percent. Observations are five-year averages. All regressions include time and country fixed effects. Countries with extreme observations for *UNDERVAL* (Iraq, Laos, and North Korea) have been excluded from the samples. Robust *t* statistics are in parentheses. Asterisks indicate statistical significance at the *10 percent, **5 percent, or ***1 percent level.

b. Developed country observations are those with real GDP per capita exceeding \$6,000.

Table 2. Impact of Excluding Extreme Observations of the Undervaluation Measure^a

	Baseline	Range of UNDERVAL included in sample				
		Greater than -150%	Greater than -100%	Greater than -50%	Greater than -25%	Between 50% and -50%
Coefficient on ln UNDERVAL	0.026	0.029	0.034	0.034	0.028	0.030
<i>t</i> statistic	(5.84)	(6.31)	(7.28)	(5.46)	(4.32)	(3.72)
No. of observations	790	786	773	726	653	619

Source: Author's regressions.

a. See table 1 for details of the specification. All estimated coefficients are statistically significant at the 1 percent level.

restricts the range to undervaluations or overvaluations that are smaller than 50 percent. The remarkable finding is that these sample truncations affect the estimated coefficient on ln UNDERVAL very little. The coefficient obtained when I eliminate all overvaluations greater than 25 percent is nearly identical to that for the entire sample, and the coefficient obtained when I eliminate all under- and overvaluations above 50 percent is still highly significant. Unlike Álvaro Aguirre and César Calderón, and Ofair Razin and Susan Collins, I find little evidence of nonlinearity in the relationship between undervaluation and economic growth.¹⁴

Robustness: Different Real Exchange Rate Measures

There are some potential concerns with relying exclusively on UNDERVAL as a measure of under- or overvaluation. One issue is the uncertain reliability of the price-level measures in the Penn World Tables. As I mentioned above, the most recent revisions have revealed the estimates to be problematic in quite a few countries (even though the implications for changes over time within countries may not be as severe). This suggests the need to check the validity of my results using real exchange rate series constructed from other data sources.

Another worry relates to my adjustment for the Balassa-Samuelson effect. Although this adjustment is proper and introduces no bias when there is a direct feedback from incomes to price levels as indicated in equation 1, it may be problematic under some other circumstances. For example,

14. Aguirre and Calderón (2005); Razin and Collins (1997). I have also tried entering the square of UNDERVAL, distinguishing between positive and negative values of UNDERVAL. I find some evidence that extreme overvaluations (large negative values of UNDERVAL) are proportionately more damaging to growth, but the effect is not that strong, and the main coefficient of interest remains unaffected.

if the Balassa-Samuelson effect is created by a third variable (“productivity”) that affects both income per capita and the price level, the coefficient estimates on *UNDERVAL* may be biased upward (as discussed by Michael Woodford in his comment on this paper). This suggests the need to employ alternative measures of the real exchange rate that do not incorporate the Balassa-Samuelson adjustment. Even though estimates from regressions that use such alternative measures are in turn likely to be biased downward (in the presence of Balassa-Samuelson effects that operate over time within countries), such estimates are still useful insofar as they provide a lower bound on the growth effects of undervaluation.

I therefore use four additional real exchange rate indices in the regressions that follow, to complement the results obtained with *UNDERVAL* above. First, I simply use the inverse of the index of the price level from the Penn World Tables, without the Balassa-Samuelson adjustment:

$$\ln RER_{PWT} = \ln \left(\frac{XRAT}{PPP} \right).$$

This measure has all the problems of the Penn World Tables, since it is constructed from that source, but for purposes of robustness testing it has the virtue that it is not subject to the sort of bias just mentioned. Next I use the real effective exchange rate index of the International Monetary Fund (IMF), $\ln REER_{IMF}$, which is a measure of the value of home currency against a weighted average of the currencies of major trade partners divided by a price deflator or index of costs. This is a multilateral measure of competitiveness and is available for a large number of industrial and developing countries, although the coverage is not nearly as complete as that of the Penn World Tables. The third index is a simple bilateral measure of the real exchange rate with the United States, constructed using wholesale price indices:

$$\ln RER_{WPI} = \ln \left(\frac{E \times PPI_{US}}{WPI} \right),$$

where E is the home country’s nominal exchange rate against the U.S. dollar (in units of home currency per dollar), PPI_{US} is the producer price index for the United States, and WPI is the home country’s wholesale price index. All of the data are from the IMF’s International Financial Statistics (IFS). Since the IFS does not report wholesale price indices for many countries, I use as my final index a bilateral real exchange rate constructed using consumer prices:

$$\ln RER_{CPI} = \ln \left(\frac{E \times PPI_{US}}{CPI} \right),$$

where *CPI* is the home country's consumer price index. Note that the levels of the last three measures are not comparable across countries, but this is of no consequence for the panel regressions, which track the effects of changes in real exchange rates within countries.

Table 3 reports the results, for the full sample and the developing country sample separately, of rerunning the baseline specification from table 1 (columns 1-1 and 1-3), substituting in turn each of the above measures for *UNDERVAL*. The numbers tell a remarkably consistent story, despite the differences in data sources and in the construction of the index. When the regression is run on the full sample, the growth impact of a real depreciation is small and often statistically insignificant. But when the sample is restricted to developing countries (again defined as those with real GDP per capita below \$6,000), the estimated effect is strong and statistically significant in all cases. (Only the estimate using *REER_{IMF}* misses the 5 percent significance threshold, and that narrowly.) The coefficient estimates range between 0.012 and 0.029 (using *RER_{CPI}* and *RER_{WPI}*, respectively) and bracket the estimate with *UNDERVAL* reported earlier (0.026). Note in particular that the coefficient estimate with *RER_{PWT}* is highly significant and, as expected, smaller than the estimate with *UNDERVAL* (0.016 versus 0.026). It is hard to say how much of this difference is due to the lack of correction for the Balassa-Samuelson effect (and hence a downward bias in the estimation when using *RER_{PWT}*) and how much to the correction of a previous bias in the estimation with *UNDERVAL*. Even if the "correct" estimate is the lower one of 0.016, it still establishes a strong enough relationship between real undervaluation and economic growth to command attention: a 50 percent undervaluation would boost annual growth of income per capita by 0.8 percentage point.

Robustness: Additional Covariates

The specifications reported thus far are rather sparse, including only a convergence factor, fixed effects, and the undervaluation measure itself. Of course, the fixed effects serve to absorb any growth determinants that are time-invariant and country-specific, or time-specific and country-invariant. But it is still possible that some time-varying country-specific determinants correlated with *UNDERVAL* have been left out. The regressions reported in table 4 therefore augment the baseline specification with additional covariates. I include measures of institutional quality ("rule of

Table 3. Panel Regressions of Economic Growth on Undervaluation Using Alternative Real Exchange Rate Measures^a

Independent variable	Real exchange rate measure and sample							
	ln RER _{PWT} ^b		ln REER _{IMF} ^c		ln RER _{WPI}		ln RER _{CPI}	
	All countries ^d	Developing countries ^e	All countries	Developing countries	All countries ^d	Developing countries	All countries ^d	Developing countries
ln initial income	-0.029*** (-6.02)	-0.033*** (-4.43)	-0.041*** (-3.63)	-0.049** (-2.51)	-0.041*** (-5.32)	-0.031 (-1.63)	-0.033*** (-7.37)	-0.033*** (-4.81)
ln UNDERVAL	0.006** (1.97)	0.016*** (3.74)	0.005 (0.94)	0.015* (1.92)	0.003 (1.54)	0.029*** (2.95)	0.003* (1.72)	0.012*** (2.83)
No. of observations	1,293	790	476	206	440	162	987	557

Source: Author's regressions.

a. The dependent variable is annual growth in GDP per capita, in percent. Observations are averages over five-year periods. All regressions include time and country fixed effects. Robust *t* statistics are in parentheses. Asterisks indicate statistical significance at the *10 percent, **5 percent, or ***1 percent level.

b. Sample excludes Iraq, Laos, and North Korea, which have extreme observations for UNDERVAL.

c. Sample excludes Nicaragua, which has extreme observations for UNDERVAL.

d. Sample excludes the United States, as it is the base country with an invariant real exchange rate index.

e. Developed country observations are those with real GDP per capita exceeding \$6,000.

Table 4. Panel Regressions of Economic Growth on Undervaluation and Additional Covariates, Developing Countries Only^a

<i>Independent variable</i>	<i>Regression</i>						
	4-1 ^b	4-2	4-3	4-4	4-5	4-6	4-7
In initial income	-0.039*** (-5.30)	-0.015*** (-6.40)	-0.037*** (-5.17)	-0.033*** (-4.51)	-0.036*** (-5.06)	-0.045*** (-6.65)	-0.046*** (-4.33)
In <i>UNDERVAL</i>	0.026*** (5.84)	0.063*** (3.33)	0.025*** (4.51)	0.021*** (4.01)	0.018*** (3.66)	0.019*** (4.06)	0.016*** (2.87)
Rule of law ^c		0.007 (0.010)					
Government consumption as percent of GDP ^d			-0.076** (-2.00)	-0.042 (-1.32)			
In terms of trade ^d				0.013* (1.93)	0.005 (0.71)		
ln (1 + inflation rate ^d)					-0.030*** (-3.23)	-0.027*** (-3.34)	-0.023*** (-3.16)
Gross domestic saving as percent of GDP ^d						0.099*** (4.34)	0.124*** (4.40)
Average years of education × 100 ^e							0.030 (0.87)
No. of observations	790	191	626	546	478	529	335

Source: Author's regressions.

a. The dependent variable is annual growth in GDP per capita, in percent. Observations are averages over five-year periods. All regressions include time and country fixed effects. Robust *t* statistics are in parentheses. Asterisks indicate statistical significance at the *10 percent, **5 percent, or ***1 percent level.

b. Baseline estimate from table 1, column 1-3.

c. From Kaufmann, Kraay, and Mastruzzi (2008). Higher values indicate stronger rule of law.

d. From World Bank, World Development Indicators.

e. From Barro and Lee (2000).

law”), government consumption, the external terms of trade, inflation, human capital (average years of education), and saving rates.¹⁵ One limitation here is that data for many of the standard growth determinants are not available over long stretches of time, so that many observations are lost as regressors are added. For example, the “rule of law” index starts only in 1996. Therefore, rather than include all the additional regressors simultaneously, which would reduce the sample size excessively, I tried various combinations, dropping those variables that seem to enter insignificantly or cause too many observations to be lost.

The bottom line is that including these additional regressors does not make much difference to the coefficient on *UNDERVAL*. The estimated coefficient ranges somewhat widely (from a high of 0.063 to a low of 0.016) but remains strongly significant throughout, with the *t* statistic never falling below 2.8. The variation in these estimates seems to derive in any case as much from changes in the sample as from the effect of the covariates. Indeed, given the range of controls considered and the significant changes in sample size (from a low of 191 to a high of 790), the robustness of the central finding on undervaluation is quite striking. Note in particular that *UNDERVAL* remains strong even when the regression controls for changes in the terms of trade or government consumption (or both together), or for saving rates, three variables that are among the main drivers of the real exchange rate (see below).

Robustness: Cross-Sectional Regressions

As a final robustness check, I ran cross-sectional regressions using the full sample in an attempt to identify the growth effects of undervaluation solely through differences across countries. The dependent variable here is the growth rate of each country averaged over a twenty-five-year period (1980–2004). Undervaluation is similarly averaged over the same quarter century, and initial income is GDP per capita in 1980. Regressors include all the covariates considered in table 4 (except for the terms of trade) along with dummies for developing country regions as defined by the World Bank.

The results (table 5) are quite consistent with those in the vast empirical literature on cross-national growth. Economic growth over long time horizons tends to increase with human capital, quality of institutions, and

15. The data source for most of these variables is the World Bank’s World Development Indicators. Data for the “rule of law” come from the World Bank governance dataset (Kaufmann, Kraay, and Mastruzzi, 2008), and those for human capital (years of education) from Barro and Lee (2000).

Table 5. Cross-Sectional Regressions of Economic Growth on Undervaluation and Other Variables^a

<i>Independent variable</i>	<i>Regression</i>						
	5-1	5-2	5-3	5-4	5-5	5-6	5-7
In initial income ^b	-0.014*** (-4.20)	-0.013*** (-3.59)	-0.013*** (-3.51)	-0.016*** (-6.18)	-0.018*** (-6.00)	-0.017*** (-7.74)	-0.013*** (-6.80)
In <i>UNDERVAL</i>	0.022*** (5.95)	0.021*** (4.45)	0.020*** (4.32)	0.022*** (5.31)	0.021*** (4.93)	0.020*** (5.12)	0.019*** (5.32)
Average years of education × 100	0.250** (2.06)	0.210* (1.67)	0.224* (1.75)	0.143 (1.57)	0.114 (1.18)	0.143 (1.18)	0.114 (1.18)
Rule of law	0.019*** (8.19)	0.021*** (8.09)	0.020*** (6.40)	0.020*** (8.28)	0.020*** (6.91)	0.020*** (7.34)	0.021*** (7.90)
Government consumption as percent of GDP		-0.060* (-1.82)	-0.063* (-1.89)				
ln (1 + inflation rate)			-0.008 (-0.92)				
Gross domestic saving as percent of GDP				0.072*** (3.52)	0.070*** (3.12)	0.053*** (3.93)	
Sub-Saharan Africa dummy					-0.004 (-0.87)	-0.014*** (-3.28)	-0.009** (-2.08)
Latin America dummy					0.002 (0.35)	-0.006 (-0.16)	-0.002 (-0.43)
Asia dummy ^c					0.000 (0.06)	-0.009** (-2.22)	-0.001 (0.16)
<i>R</i> ²	0.57	0.56	0.57	0.68	0.69	0.55	0.48
No. of observations	104	102	102	102	104	147	155

Source: Author's regressions.

a. The dependent variable is average annual growth in income per capita over 1980–2004. World regions are as defined by the World Bank. Robust *t* statistics are in parentheses. Asterisks indicate statistical significance at the *10 percent, **5 percent, or ***1 percent level.

b. Initial income is GDP per capita in 1980.

c. "Asia" is East Asia and South Asia.

saving, and to decrease with government consumption and inflation. The Africa dummy tends to be negative and statistically significant. Interestingly, the Asia dummy is negative and significant in one regression that controls for saving rates (column 5-6) and not in the otherwise identical regression that does not (column 5-7). Most important for purposes of this paper, the estimated coefficient on *UNDerval* is highly significant and virtually unchanged in all these specifications, fluctuating between 0.019 and 0.022. It is interesting—and comforting—that these coefficient estimates and those obtained from the panel regressions are so similar.

Given the difficulty of controlling for all the country-specific determinants of growth, there are good reasons to distrust estimates from cross-sectional regressions of this kind. That is why panels with fixed effects are my preferred specification. Nevertheless, the results in table 5 represent a useful and encouraging robustness check.

Causality

Another possible objection to these results is that the relationship they capture is not truly causal. The real exchange rate is the relative price of tradables to nontradables in an economy and as such is an endogenous variable. Does it then make sense to put it (or some transformation) on the right-hand side of a regression equation and talk about its effect on growth? Perhaps it would not in a world where governments did not care about the real exchange rate and left it to be determined purely by market forces. But we do not live in such a world: except in a handful of developed countries, most governments pursue a variety of policies with the explicit goal of affecting the real exchange rate. Fiscal policies, saving incentives (or disincentives), capital account policies, and interventions in currency markets are part of the array of such policies. In principle, moving the real exchange rate requires changes in real quantities, but economists have long known that even policies that affect only nominal magnitudes can do the trick—for a while. One of the key findings of the open-economy macroeconomic literature is that except in highly inflationary environments, nominal exchange rates and real exchange rates move quite closely together. Eduardo Levy-Yeyati and Federico Sturzenegger have recently shown that sterilized interventions can and do affect the real exchange rate in the short to medium term.¹⁶ Therefore, interpreting the above results as saying something about the growth effects of different exchange rate management strategies seems plausible.

16. Levy-Yeyati and Sturzenegger (2007).

Of course, one still has to worry about the possibility of reverse causation and about omitted variables bias. The real exchange rate may respond to a variety of shocks besides policy shocks, and these may confound the interpretation of δ . The inclusion of some of the covariates considered in tables 4 and 5 serves to diminish concern on this score. For example, an autonomous reduction in government consumption or an increase in domestic saving will both tend to produce a real depreciation, *ceteris paribus*. To the extent that such policies are designed to move the real exchange rate in the first place, they are part of what I have in mind when I talk of “a policy of undervaluation.” But to the extent they are not, the results in tables 4 and 5 indicate that undervaluation is associated with faster economic growth even when those policies are controlled for.

A more direct approach is to treat *UNDERVAL* explicitly as an endogenous regressor; this is done in table 6. Note first that a conventional instrumental variables approach is essentially ruled out here, because it is difficult to think of exogenous regressors that influence the real exchange rate without plausibly also having an independent effect on growth. I will report results of regressions on the determinants of *UNDERVAL* in table 10; all of the regressors used there have been used as independent variables in growth regressions. Here I adopt instead a dynamic panel approach using the generalized method of moments (GMM) as the estimation method.¹⁷ These models use lagged values of regressors (in levels and in differences) as instruments for right-hand-side variables and allow lagged endogenous (left-hand-side) variables as regressors in short panels.¹⁸ Table 6 presents results for both the “difference” and the “system” versions of GMM. As before, the estimated coefficients on *UNDERVAL* are positive and statistically significant for the developing countries (if somewhat at the lower end of the range reported earlier). They are not significant for the developed countries. Hence, when *UNDERVAL* is allowed to be endogenous, the resulting pattern of estimated coefficients is quite in line with the results reported above, which is reassuring.

It is worth reflecting on the sources of endogeneity bias a bit more. Many of the plausible sources of bias that one can think of would induce a negative relationship between undervaluation and growth, not the positive relationship I have documented. So to the extent that endogenous mechanisms are at work, it is not clear that they generally create a bias that works

17. I follow here the technique of Arellano and Bond (1991) and Blundell and Bond (1998).

18. See Roodman (2006) for an accessible user’s guide.

Table 6. Generalized Method of Moments Estimates of the Effect of Undervaluation on Growth^a

<i>Independent variable</i>	<i>Full sample</i>		<i>Developed economies only</i>		<i>Developing economies only</i>	
	<i>Two-step difference</i>	<i>Two-step system</i>	<i>Two-step difference</i>	<i>Two-step system</i>	<i>Two-step difference</i>	<i>Two-step system</i>
Lagged growth	0.187*** (4.39)	0.308*** (5.45)	0.273*** (5.34)	0.271*** (4.48)	0.200*** (3.95)	0.293*** (4.55)
ln initial income	-0.038*** (-4.86)	0.001 (1.17)	-0.043*** (-5.21)	-0.016*** (-4.11)	-0.037*** (-4.72)	-0.006** (-2.34)
ln <i>UNDERVAL</i>	0.011 (1.74)	0.011** (2.14)	0.017 (1.55)	0.005 (0.60)	0.014** (2.28)	0.013** (2.26)
No. of countries	156	179	79	89	112	125
Average no. of observations per country	6.04	6.27	6.22	5.18	6.07	5.29
Hansen test of overidentifying restrictions, $p > \chi^2$	0.067	0.101	0.893	0.762	0.332	0.253

Source: Author's regressions.

a. The dependent variable is annual growth in GDP per capita, in percent. Observations are averages over five-year periods. Results are generated using the `xtabond2` command in Stata, with small sample adjustment for standard errors, forward orthogonal deviations, and assuming exogeneity of initial income and time dummies (see Roodman 2005). All regressions include time fixed effects. Extreme observations are excluded as noted in table 1. Robust t statistics are in parentheses. Asterisks indicate statistical significance at the *10 percent, **5 percent, or ***1 percent level.

against my findings. Economic growth is expected to cause a real appreciation on standard Balassa-Samuelson grounds (which I control for by using *UNDERVAL*). Shocks that cause a real depreciation tend to be shocks that are bad for growth on conventional grounds—a reversal in capital inflows or a terms of trade deterioration, for example. Good news about the growth prospects of an economy is likely to attract capital inflows and thus bring about a real appreciation. So, on balance, it is unlikely that the positive coefficients reported here result from the reverse effect of growth on the real exchange rate.

Evidence from Growth Accelerations

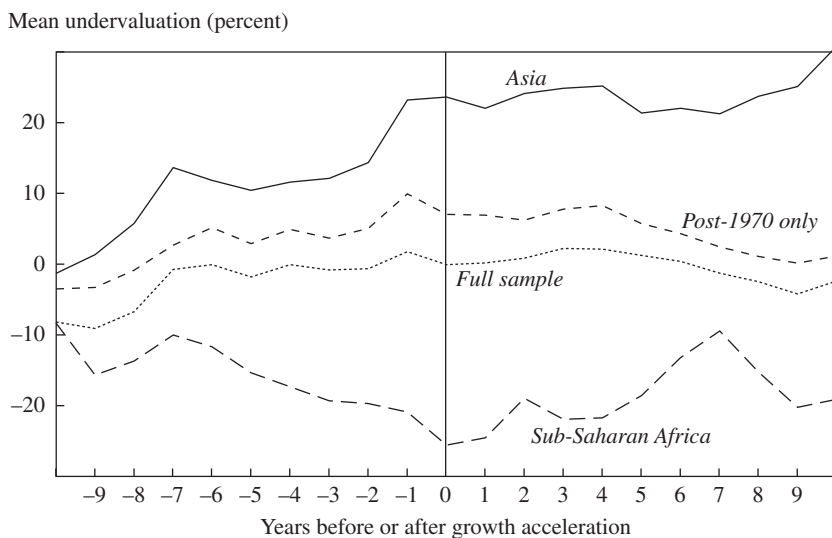
A different way to look at the cross-national evidence is to examine countries that have experienced noticeable growth accelerations and ask what happened to *UNDERVAL* before, during, and after these episodes. This way of parsing the data throws out a lot of information but has the virtue that it focuses attention on a key question: have those countries that managed to engineer sharp increases in economic growth done so on the back of undervalued currencies?¹⁹

Ricardo Hausmann, Lant Pritchett, and I identified 83 distinct instances of growth acceleration in which annual growth in GDP per capita rose by 2 percentage points or more and the spurt was sustained for at least eight years.²⁰ Figure 4 shows the average values of *UNDERVAL* in each of these episodes for a 21-year window centered on the year of the acceleration (the 10-year periods before and after the acceleration plus the year of the acceleration). The figure shows some interesting patterns in the trend of *UNDERVAL* but is especially telling with respect to the experience of different subgroups.

For the full sample of growth accelerations, a noticeable, if moderate, decline in overvaluation occurs in the decade before the onset of the growth spurt. The increase in *UNDERVAL* is on the order of 10 percentage points and is sustained into the first five years or so of the episode. Since these growth accelerations include quite a few rich countries in the 1950s and 1960s, figure 4 also shows results for only those growth accelerations in the sample that occurred after 1970. There is a much more distinct trend in *UNDERVAL* for this subsample: the growth spurt takes place after a decade of steady increase in *UNDERVAL* and immediately after the index reaches its peak value (at an undervaluation of 10 percent). Finally, figure 4 also

19. A similar exercise was carried out for a few, mostly Asian, countries by Hausmann (2006).

20. Hausmann, Pritchett, and Rodrik (2005).

Figure 4. Relative Timing of Undervaluations and Growth Accelerations

Source: Author's calculations.

shows results for the Asian and Sub-Saharan African countries separately. The Asian countries reveal the most pronounced trend, with an average undervaluation of more than 20 percent at the start of the growth acceleration. Moreover, the undervaluation is sustained into the growth episode, and in fact it increases further by the end of the decade. In the African growth accelerations, in contrast, the image is virtually the mirror opposite. Here the typical growth acceleration takes place after a decade of increased overvaluation, and its timing coincides with the peak of the overvaluation. As is well known, the Asian growth accelerations have proved significantly more impressive and lasting than African ones. The contrasting behavior of the real exchange rate may offer an important clue as to the sources of the difference.

Size of the Tradable Sector as the Operative Channel

The real exchange rate is a relative price, the price of tradable goods in terms of nontradable goods:

$$RER = P_T / P_N.$$

An increase in *RER* enhances the relative profitability of the tradable sector and causes it to expand (at the expense of the nontradable sector).

I now provide some evidence that these compositional changes in the structure of economic activity are an important driving force behind the empirical regularity I have identified. I show two things in particular. First, undervaluation has a positive effect on the relative size of the tradable sector, and especially of industrial economic activities. Second, the effects of the real exchange rate on growth operate, at least in part, through the associated change in the relative size of tradables. Countries where undervaluation induces resources to move toward tradables (again, mainly industry) grow more rapidly.

The first four columns in table 7 report standard panel regressions where five-year-average sectoral shares (in real terms) are regressed on income, a complete set of fixed effects, and my measure of undervaluation. I initially lumped agriculture and industry together in constructing the dependent variable, since both are nominally tradable, but as these regressions show, they have quite a different relationship with real exchange rates. Whether measured by its share in GDP or its share in employment, the relative size of industry depends strongly and positively on the degree of undervaluation as shown in the first two columns.²¹ Simply put, undervaluation boosts industrial activities. Agriculture, on the other hand, does not have a positive relationship with undervaluation. Its GDP share actually depends negatively on the undervaluation measure (third column). This difference may reflect the prevalence of quantitative restrictions in agricultural trade, which typically turn many agricultural commodities into nontradables at the margin.

The last two columns of table 7 report results of two-stage panel growth regressions (with, as before, a full set of fixed effects) that test whether the effect of undervaluation on growth operates through its impact on the relative size of industry. The strategy consists of identifying whether the component of industrial shares directly “caused” by undervaluation—that is, industrial shares as instrumented by undervaluation—enters positively and significantly in the growth regressions. The answer is affirmative. These results indicate that undervaluation causes resources to move toward industry and that this shift in resources in turn promotes economic growth.²²

21. Blomberg, Frieden, and Stein (2005) report some evidence that countries with larger manufacturing sectors have greater difficulty in sustaining currency pegs. But it is not immediately evident which way this potential reverse causality cuts.

22. See also the supporting evidence in Rajan and Subramanian (2006), who find that real appreciations induced by aid inflows have adverse effects on the relative growth rate of exporting industries as well as on the growth rate of the manufacturing sector as a whole. Rajan and Subramanian argue that this is one of the more important reasons why aid fails to

Table 7. Panel Regressions Estimating the Effect of Undervaluation on Tradables^a

<i>Independent variable</i>	<i>Dependent variable</i>				
	<i>Industry share in GDP</i>	<i>Industry share in employment</i>	<i>Agriculture share in GDP</i>	<i>Agriculture share in employment</i>	<i>Growth (TSLS estimation)^b</i>
In current income	0.079*** (9.99)	0.025 (1.51)	-0.110*** (-12.50)	-0.128*** (-4.94)	
In initial income					-0.134*** (-8.33)
In <i>UNDERVAL</i>	0.024*** (3.62)	0.042*** (4.87)	-0.016** (-2.25)	-0.010 (-0.48)	-0.071*** (-4.39)
Industry share in GDP					1.716*** (7.59)
Industry share in employment					1.076*** (6.15)
No. of observations	985	469	985	469	459

Source: Author's regressions.

a. Observations of the dependent variable are five-year averages. All regressions include time and country fixed effects. Robust *t* statistics are in parentheses. Asterisks indicate statistical significance at the *10 percent, **5 percent, or ***1 percent level.

b. Industry shares, in constant local currency units, are regressed on *ln UNDERVAL*, in income, and lagged *ln* income in the first stage of a two-stage least squares (TSLS) regression.

The estimates in table 7 also provide a useful check on the quantitative magnitudes involved. They break the undervaluation-growth relationship into two separate links, one from undervaluation to the size of tradables (that is, industry) and the other from the size of industry to economic growth. If undervaluation has a potent effect on growth, that is because each of these two links is estimated to be quite strong. A 50 percent undervaluation is estimated to increase the share of industry in total employment by 2.1 percentage points (0.042×0.50), which is quite large given that the typical share of industry in total employment in developing countries is around 20 percent. An increase in the industrial employment share is in turn estimated to raise growth roughly one for one.

Understanding the Importance of the Real Exchange Rate

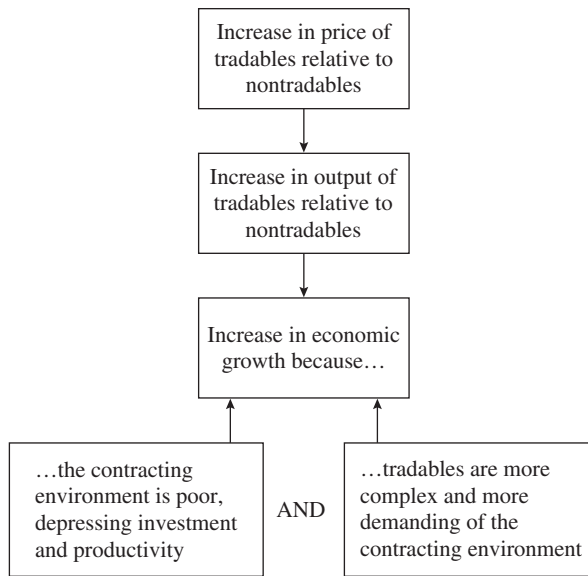
Why might an increase in the relative price of tradables and the associated expansion of tradable economic activities have a causal impact on economic growth, as my results suggest? There is no generally accepted theory that would explain these regularities in the data.²³ Any such theory would have to explain why tradables are “special” from the standpoint of growth. That is the sense in which my results open an important window on the mechanisms behind the growth process. If the role that tradables play in driving growth can be understood, it may be possible to identify policies that will promote (and those that will hamper) growth.

Although any of a large number of stories might account for the role of tradables, two clusters of explanations deserve attention in particular. One focuses on weaknesses in the contracting environment, and the other on market failures in modern industrial production. Both types of explanation have been common in the growth and development literature, but in the present context something more is needed. One has to argue that tradables

induce growth in recipient countries. Gluzmann, Levy-Yeyati, and Sturzenegger (2007), by contrast, find little role for the tradables channel and argue that real undervaluations promote growth through redistributions of income that raise domestic saving (and ultimately investment). However, their argument seems to require that the current account be invariant to the real exchange rate, which is contradicted by considerable evidence. See also Galvarriato and Williamson (2008) on the role played by favorable relative prices in the rapid industrialization of Latin American countries such as Brazil and Mexico after 1870, and Freund and Pierola (2008) on the significance of currency undervaluation in stimulating export surges.

23. In Rodrik (1986) I argued that manipulating the real exchange rate could play a welfare-enhancing role if this served to improve the internal terms of trade of sectors subject to dynamic learning externalities. Gala (2007) suggests that undervaluation is good for growth because activities subject to increasing returns tend to be located in the tradable rather than the nontradable sector.

Figure 5. Undervaluation as a Second-Best Mechanism for Alleviating Institutional Weakness



Source: Author's model described in the text.

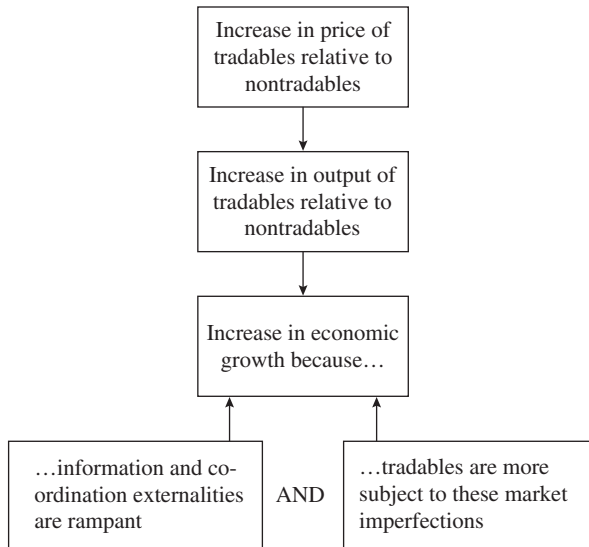
suffer disproportionately from these shortcomings, so that absent a compensating policy, developing economies devote too few of their resources to tradables and thus grow less rapidly than they should. Real undervaluation can then act as a second-best mechanism for spurring growth of tradables and for generating more rapid overall economic growth.

The two clusters of explanations are represented schematically in figures 5 and 6. I discuss them in turn in the rest of this section. The mechanics of how changes in relative prices can generate growth in the presence of sectorally differentiated distortions is discussed in the following section.

Explanation 1: Bad Institutions "Tax" Tradables More

The idea that poor institutions keep incomes low and explain, at least in part, the absence of economic convergence is by now widely accepted.²⁴ Weak institutions reduce the ability of private investors to appropriate the returns on their investment through a variety of mechanisms: contractual

24. North (1990); Acemoglu, Johnson, and Robinson (2001).

Figure 6. Undervaluation as a Second-Best Mechanism for Alleviating Market Failure

Source: Author's model described in the text.

incompleteness, hold-up problems, corruption, lack of property rights, and poor contract enforcement. The resulting wedge between private and social returns in turn blunts the incentives for capital accumulation and technological progress alike.

Now suppose that this problem is more severe in tradables than in nontradables. This is a plausible supposition since production systems tend to be more complex and roundabout in tradables, placing a greater premium on the ability to specify contracts and on reliable third-party enforcement of contracts. A barber needs to rely on little more than a few tools, a chair, and his skill and ingenuity to sell his services. A manufacturing firm needs the cooperation of multitudes of suppliers and customers, plus financial and legal support. When the institutions that foster these relationships are weak, the result is to impose a higher “tax” on tradables—especially modern tradables. This results in both a static misallocation of resources that penalizes tradables, and a dynamic distortion in the form of investment in tradables that is lower than socially optimal. An increase in the relative price of tradables can improve static efficiency and enhance growth in second-best fashion by eliciting more investment in tradables at the margin (as I will show in the following section).

A fair amount of empirical work, both across countries and across industries, presents suggestive evidence on the disproportionate cost borne by tradables—as a whole or in part—in the presence of weak institutions:

—Across countries, lower quality of institutions (as measured by indices of the rule of law, contract enforcement, or control of corruption) is associated with lower ratios of trade to GDP (“openness”).²⁵

—Across different categories of tradable goods, more “institution-intensive” tradables are prone to larger effects. Pierre-Guillaume Méon and Khalid Sekkat find that the relationship they identify holds for manufactured exports but not for nonmanufactured exports; Priya Ranjan and Jae Young Lee find that the effect is stronger for differentiated goods than for homogeneous goods.²⁶

—Institutional weakness interacts with the contract intensity of goods to play a role in determining comparative advantage. Andrei Levchenko; Daniel Berkowitz, Johannes Moenius, and Katharina Pistor; and Nathan Nunn find that countries with poor institutions have comparative disadvantage in products that are more institutions-intensive, more complex, or more relationship-intensive.²⁷

To provide more direct evidence, I used unpublished data kindly provided by Nathan Nunn to compare directly the contract-intensiveness of tradables and nontradables. Nunn investigated whether differences in institutional quality across countries help determine patterns of comparative advantage.²⁸ He reasoned that relationship-specific intermediate inputs, defined as inputs that are not sold on exchanges or do not have reference prices,²⁹ are more demanding of the contractual environment. Nunn used measures of relationship specificity for tradables alone, since his main concern was with comparative advantage. But he collected similar data for services as well, which are what I use to carry out the tradables-nontradables comparison.

The top panel of table 8 shows the shares of intermediate goods that are relationship-specific in tradables and nontradables industries. (These numbers are based on the U.S. input-output tables.) At first sight, these numbers seem to conflict with what my argument requires, in that they show that the

25. See, for example, Anderson and Mercouiller (2002), Rodrik, Subramanian, and Trebbi (2004), Rigobon and Rodrik (2005), Méon and Sekkat (2006), Berkowitz, Moenius, and Pistor (2006), and Ranjan and Lee (2004).

26. Méon and Sekkat (2006); Ranjan and Lee (2004).

27. Levchenko (2004); Berkowitz, Moenius, and Pistor (2006); Nunn (2007).

28. Nunn (2007).

29. As in Rauch (1999).

Table 8. Illustrative Calculations on the Importance of Relationship Specificity of Inputs for Traded and Nontraded Goods

Percent	<i>Tradables</i>	<i>Nontradables</i>
<i>Tradables use intermediate goods that tend to be less relationship specific . . .</i>		
Share of intermediates not sold on exchanges and not reference-priced ^a	49.6	75.1
Share of intermediates not sold on exchanges ^a	87.3	96.4
<i>. . . but tradables rely more on intermediate inputs . . .</i>		
Share of intermediates in total output ^b	64.3	35.1
Share of interindustry sales in total output ^b	58.4	29.4
<i>. . . so, on balance, relationship-specific intermediate goods account for a much larger share of output in tradables.</i>		
Share in gross output of intermediates not sold on exchanges and not reference-priced ^c	17.9	7.5
Share in gross output of intermediates not sold on exchanges ^c	31.5	9.7

Source: Author's calculations.

a. Unweighted averages, from the U.S. input-output tables, calculated using data provided by Nathan Nunn, based on Nunn (2007).

b. From the Brazilian input-output tables for 1996, available on the website of the OECD Directorate for Science, Technology, and Industry (www.oecd.org/sti).

c. Sums of the products of the underlying data in the top two panels weighted by U.S. value-added shares.

inputs used in tradables are less relationship-specific, and hence less demanding of the institutional environment. But this is misleading because it overlooks the fact that tradables tend to have much higher intermediate input shares in gross output. This is shown in the middle panel of the table (this time relying on Brazil's input-output tables). Putting the two pieces together yields the results in the bottom panel of table 8, which show that, on balance, tradable goods rely on relationship-specific inputs to a much greater extent. The numbers for the two sets of goods differ by a factor of between two and three.

Hence the evidence that institutional and contracting shortcomings, the bane of every developing society, impose a higher "tax" on the tradable sector than on the nontradable sector is fairly compelling. But if this story is correct, its implications should also be evident in the growth regressions. Specifically, the growth impact of undervaluation should be greater in those countries where this "taxation" is greatest, namely, the countries

with the weakest institutions. Although GDP per capita does track institutional quality closely, it is not a perfect proxy. So the question is whether one can detect the differential impact in settings with different institutional environments.

To attempt this more direct test, I used the World Bank governance indices to divide the countries in the full sample into three subgroups based on their “adjusted” institutional quality (above average, around average, and below average).³⁰ The exercise was conducted as follows. For each country I took a simple average of the World Bank’s rule of law, government effectiveness, regulatory quality, and corruption indices over 1996–2004 (starting from the earliest year for which these indices are available). I then regressed these indices on log GDP per capita, generating a predicted value based on this cross section. Taking the difference between actual and predicted values, I ranked countries according to their “adjusted” levels of institutional quality. I then divided the sample into three subgroups of equal size.

The middle three columns of table 9 show the results of my benchmark specification when the regression is run for each subgroup separately. (For comparison, the first column repeats the baseline results from column 1-1 of table 1.) The results are broadly consistent with the theoretical expectation. The positive effect of undervaluation is strongest in the below-average group and virtually nil in the above-average group. In other words, when initial income is taken into account, undervaluation works most potently in those countries where institutions perform the least well. In the last column in table 9, I instead interact dummies for the subgroups with *UNDERVAL* (taking the above-average group as the omitted category), and the results are very similar.

The analytics of how institutional weakness interacts with undervaluation to influence growth will be developed further in the next section. But first I turn to the second category of explanations.

Explanation 2: Market Failures Predominate in Tradables

The second hypothesis for why the real exchange rate matters is that tradables are particularly prone to the market failures with which development economists have long been preoccupied. A short list of such market failures would include

—learning externalities: valuable technological, marketing, and other information spills over to other firms and industries;

30. For the latest version of these indices see Kaufmann, Kraay, and Mastruzzi (2008).

Table 9. Institutional Quality and the Impact of Undervaluation on Growth^a

<i>Independent variable</i>	<i>Baseline (all countries)</i>	<i>Countries where institutional quality is</i>			<i>Interactions with group dummies (all countries)</i>
		<i>Above average</i>	<i>Around average</i>	<i>Below average</i>	
ln initial income	-0.031*** (-6.67)	-0.036*** (-5.59)	-0.017** (-2.32)	-0.060*** (-4.73)	-0.031*** (-6.90)
ln <i>UNDERVAL</i>	0.017*** (5.21)	0.004 (1.17)	0.022*** (3.98)	0.028*** (4.42)	0.005 (1.45)
ln <i>UNDERVAL</i> × around-average institutions					0.019*** (2.86)
ln <i>UNDERVAL</i> × below-average institutions					0.019** (2.36)
No. of observations	1,303	513	434	356	1,303

Source: Author's regressions.

a. The dependent variable is annual growth in GDP per capita, in percent. Observations are five-year averages. All regressions include time and country fixed effects. Robust *t* statistics are in parentheses. Asterisks indicate statistical significance at the *10 percent, **5 percent, or ***1 percent level.

—coordination externalities: getting new industries off the ground requires lumpy and coordinated investments upstream, downstream, or sideways;

—credit market imperfections: entrepreneurs cannot finance worthwhile projects because of limited liability and asymmetric information;

—wage premiums: monitoring, turnover, and other costs keep wages above market-clearing levels, and employment remains low.

These and similar problems can plague all kinds of economic activity in developing countries, but arguably their effects are felt much more acutely in tradables. If so, output and investment in tradables will be suboptimal. A real depreciation would promote capacity expansion in tradables and increase growth. Note that once again this is a second-best argument for undervaluation. First-best policy would consist of identifying distinct market failures and applying the appropriate Pigovian remedies. Undervaluation is in effect a substitute for industrial policy.

What is the evidence? By their very nature, the types of market failures listed above are difficult to identify, and so it is practically impossible to provide direct evidence that some kinds of goods are more prone to these market failures than others. But the basic hypothesis is quite plausible, and a close look at the processes behind economic development yields plenty

of indirect and suggestive evidence. Economic development consists of structural change, investment in new activities, and the acquisition of new productive capabilities. As countries grow, the range of tradable goods that they produce expands.³¹ Rich countries are rich not just because they produce traditional goods in greater abundance, but also because they produce different goods.³² The market failures listed above are likely to be much more severe in new lines of production—those needed to increase economy-wide productivity—than in traditional ones. New industries require “cost discovery,”³³ learning-by-doing, and complementary economic activities to get established. They are necessarily risky and lack track records. These features make them fertile ground for learning and coordination externalities. The recent findings of Caroline Freund and Martha Pierola are particularly suggestive in this connection: currency undervaluation appears to play a very important role in inducing producers from developing countries to enter new product lines and new markets, and this seems to be the primary mechanism through which they generate export surges.³⁴

Discussion

Unfortunately, it is not easy to distinguish empirically between the two broad hypotheses I have outlined. In principle, if one could identify the goods that are most affected by each of these two categories of imperfections—contractual and market failures—one could run a horse race between the two hypotheses by asking which goods among them are more strongly associated with economic growth. Nunn’s data are a useful beginning for ranking goods by degree of contract intensity.³⁵ Perhaps an analogous set of rankings could be developed for market failures using the commodity categorization in Hausmann and Rodrik,³⁶ which are loosely based on the prevalence of learning externalities. But ultimately I doubt that one can make a sufficiently fine and reliable distinction among goods to allow discrimination between the two stories in a credible manner. Rich countries differ from poor countries both because they have better institutions and because they have learned how to deal with market imperfections. Producers of tradable goods in developing economies suffer on both counts.

31. Imbs and Wacziarg (2003).

32. Hausmann, Hwang, and Rodrik (2007).

33. Hausmann and Rodrik (2003).

34. Freund and Pierola (2008).

35. Nunn (2007).

36. Hausmann and Rodrik (2003).

A Simple Model of Real Exchange Rates and Growth

I argued in the previous section that when tradables are affected disproportionately by preexisting distortions, a real depreciation can be good for growth. I now develop a simple model to illustrate the mechanics behind this hypothesis. I will consider an economy in which there exist “taxes” on both the tradable and the nontradable sectors that drive a wedge between the private and the social marginal benefits. When the tax on tradables is larger (in ad valorem terms) than the tax on nontradables, the economy’s resources will be misallocated, the tradable sector will be too small, and growth will be suboptimal. Under these circumstances a real depreciation can promote growth.

Consumption and Growth

In the model, consumers consume a single final good, which as shown below is produced using a combination of tradable and nontradable inputs. Their intertemporal utility function is time-separable and logarithmic and takes the form

$$u = \int \ln c_t e^{-\rho t} dt,$$

where c_t is consumption at time t and ρ is the discount rate. Maximizing utility subject to an intertemporal budget constraint yields the familiar growth equation

$$(3) \quad \dot{c}_t / c_t = r_t - \rho,$$

where r is the real interest rate (or the marginal product of capital). The economy’s growth is increasing in r , and this is the feature that I will exploit in the rest of this section.

Production

I assume that the economy produces the single final good using tradable and nontradable goods (y_T and y_N , respectively) as the sole inputs. Production of the final good (y) is a Cobb-Douglas aggregate of these two inputs. In addition, to allow for endogenous growth (while maintaining perfect competition throughout), I assume that capital produces external economies in the production of the final good. With these assumptions, the production function of the representative final-good producer can be written as follows:

$$(4) \quad y = \bar{k}^{1-\phi} y_T^\alpha y_N^{1-\alpha},$$

where k is the economy's capital stock at any point in time (treated as exogenous by each final-goods producer), and α and $1 - \alpha$ are the shares of tradable and nontradable goods, respectively, in the production costs of the final good ($0 < \alpha < 1$). For convenience, I choose the exponent on k to be a parameter $(1 - \phi)$ that will make aggregate output linear in capital—as will be shown shortly—and which therefore considerably simplifies the comparative dynamics of the model. I also omit time subscripts to simplify the notation.

Tradables and nontradables are in turn produced using capital alone and subject to decreasing returns to scale. These production functions take the following simple form:

$$(5) \quad q_T = A_T k_T^\phi = A_T (\theta_T \bar{k})^\phi$$

$$(6) \quad q_N = A_N k_N^\phi = A_N [(1 - \theta_T) \bar{k}]^\phi,$$

where k_T and k_N denote the capital stock employed in the tradables and the nontradables sectors, respectively; θ_T is the share of total capital employed in tradables and $0 < \theta_T < 1$; and $0 < \phi < 1$. To justify decreasing returns to capital in the sectoral production functions (that is, $\phi < 1$), one can suppose that there are other, sector-specific factors of production employed in each sector that are fixed in supply.

By definition, nontradables that are used as inputs in the final-goods sector can only be sourced domestically. And since nontradables do not enter consumption directly,

$$(7) \quad q_N = y_N.$$

With respect to tradables, I allow the economy to receive a transfer from the rest of the world (or to make a transfer to it). Let b stand for the magnitude of the inward transfer. Then the material-balances equation in tradables is given by

$$q_T + b = y_T.$$

It will be more convenient to express b as a share γ of total domestic demand for tradables. That is, $b = \gamma y_T$. The equality between demand and supply in tradables then becomes

$$(8) \quad \frac{1}{1 - \gamma} q_T = y_T.$$

When the economy makes an outward transfer, γ will be negative. I will use γ as a shifter that alters the equilibrium value of the real exchange rate.

Using equations 4 through 8, one can express the aggregate production function as

$$(9) \quad y = (1 - \gamma)^{-\alpha} A_T^\alpha A_N^{1-\alpha} \theta_T^{\alpha\phi} (1 - \theta_T)^{(1-\alpha)\phi} \bar{k}.$$

Net output \tilde{y} differs from gross output insofar as the economy makes a payment to the rest of the world for the transfer b (or receives a payment from it if b is negative). I express this payment in general form, assuming that it is a share σ of the transfer's contribution to gross output; that is, $\sigma \times (\partial y / \partial b) \times b = \sigma \times (\partial y / \partial y_T) \times \gamma y_T = \sigma \times (\alpha / y_T) y \times \gamma y_T = \sigma \alpha \gamma y$. Net output \tilde{y} equals $y - \sigma \alpha \gamma y = (1 - \sigma \alpha \gamma) y$. Therefore, using equation 9,

$$(10) \quad \tilde{y} = (1 - \sigma \alpha \gamma) (1 - \gamma)^{-\alpha} A_T^\alpha A_N^{1-\alpha} \theta_T^{\alpha\phi} (1 - \theta_T)^{(1-\alpha)\phi} \bar{k}.$$

This way of expressing the payment for the transfer allows a wide variety of scenarios. The transfer's contribution to net output is maximized when $\sigma = 0$, that is, when b is a pure transfer (a grant). The contribution becomes smaller as σ increases.

Note that the production function ends up being of the Ak type, that is, linear in capital. This results in an endogenous growth model with no transitional dynamics. The (net) marginal product of capital r is $\partial \tilde{y} / \partial \bar{k}$, or

$$(11) \quad r = (1 - \sigma \alpha \gamma) (1 - \gamma)^{-\alpha} A_T^\alpha A_N^{1-\alpha} \theta_T^{\alpha\phi} (1 - \theta_T)^{(1-\alpha)\phi},$$

which is independent of the capital stock but depends on the allocation of capital between tradables and nontradables, θ_T , as well as on the net value of the transfer from abroad.

Since the economy's growth rate will depend on r , it is important to know precisely how r depends on θ_T . Log-differentiating equation 11 with respect to θ_T yields

$$\frac{d \ln r}{d \theta_T} \propto \left[\left(\frac{\alpha}{\theta_T} \right) - \left(\frac{1 - \alpha}{1 - \theta_T} \right) \right],$$

with

$$\frac{d \ln r}{d \theta_T} = 0 \Leftrightarrow \theta_T = \alpha.$$

In other words, the return to capital is maximized when the share of the capital stock that the economy allocates to tradables (θ_T) is exactly equal to

the input share of tradables in final production (α). This rate of return, and ultimately the economy's growth rate, will be suboptimal when tradables receive a smaller share of capital. I next analyze the circumstances under which such inefficiencies obtain.

Sectoral Allocation of Capital

The allocation of capital between the tradable and the nontradable sectors will depend both on the relative demand for the two goods and on the relative profitability of producing them. Consider the latter first. In equilibrium, capital will be allocated such that its (private) value marginal product is equalized in the two sectors. As discussed previously, I presume that each sector faces an "appropriability" problem, arising from either institutional weaknesses or market failures or both. I model this by assuming that private producers can retain only a share $1 - \tau_i$ of the value of producing each good $i = T, N$. In other words, τ_T and τ_N are the effective "tax" rates faced by producers in their sector. Let the relative price of tradables p_T/p_N be denoted by R . This is my index of the "real exchange rate." The equality between the value marginal product of capital in the two sectors can then be expressed as

$$(1 - \tau_T) R \phi A_T (\theta_T \bar{k})^{\phi-1} = (1 - \tau_N) \phi A_N [(1 - \theta_T) \bar{k}]^{\phi-1},$$

which simplifies to

$$(12) \quad \left(\frac{\theta_T}{1 - \theta_T} \right)^{\phi-1} = \left(\frac{1 - \tau_N}{1 - \tau_T} \right) \frac{1}{R} \frac{A_N}{A_T}.$$

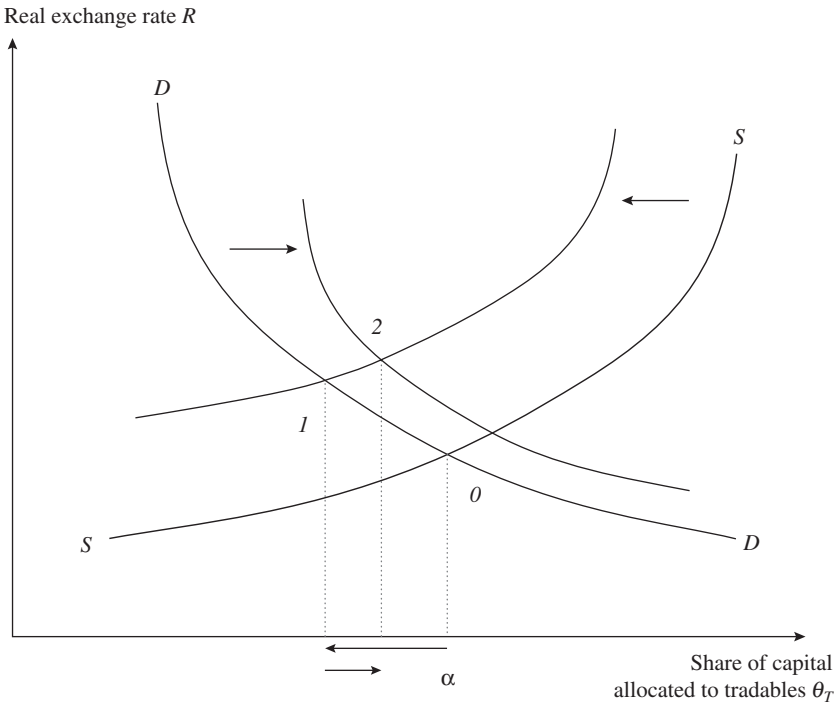
This is a supply-side relationship which says that the share of capital allocated to tradables increases with the relative profitability of the tradable sector. This relative profitability in turn increases with R , τ_N , and A_T and decreases with τ_T and A_N (remember that $\phi - 1 < 0$). The SS schedule is positively sloped between θ_T and R , as is shown in figure 7.

Now turn to the demand side. In view of the Cobb-Douglas form of the production function for the final good, the demands for the two intermediate goods are given by

$$\begin{aligned} \alpha y &= p_T y_T = p_T \left(\frac{1}{1 - \gamma} \right) q_T = p_T \left(\frac{1}{1 - \gamma} \right) A_T (\theta_T \bar{k})^\phi \\ (1 - \alpha) y &= p_N y_N = p_N q_N = p_N A_N [(1 - \theta_T) \bar{k}]^\phi. \end{aligned}$$

Taking the ratios of these two expressions and rearranging terms,

Figure 7. Allocation of Capital and the Real Exchange Rate in Equilibrium



Source: Author's model described in the text.

$$(13) \quad \left(\frac{\theta_T}{1 - \theta_T} \right)^\varphi = (1 - \gamma) \left(\frac{\alpha}{1 - \alpha} \right) \frac{1}{R} \frac{A_N}{A_T}.$$

This is a demand-side relationship between θ_T and R and is shown as the DD schedule in figure 7. This schedule is negatively sloped since an increase in R makes tradables more expensive and reduces the demand for capital in that sector. Note that a reduction in γ (a smaller inward transfer) shifts this schedule to the right: it increases θ_T at a given R or increases R at a given θ_T .

Equilibrium and Implications

The equilibrium levels of θ_T and R are given by the point of intersection of the SS and DD schedules. Several things should be noted about the nature of this equilibrium. To begin with, suppose that the economy is at an initial position where there is no transfer from abroad ($\gamma = 0$). If there

are no appropriability problems in either of the intermediate-goods sectors, such that $\tau_T = \tau_N = 0$, then it is relatively easy to confirm that the equilibrium is one where $\theta_T = \alpha$ (point 0 in figure 7). This ensures that the returns to capital and growth are maximized. Now suppose that τ_T and τ_N are positive but that their magnitude is identical ($\tau_T = \tau_N > 0$). One can see from equation 11 that the equilibrium remains unaffected. As long as the distortion affects tradables and nontradables equally, θ_T remains at its growth-maximizing level.

Things are different when $\tau_T \neq \tau_N$. Suppose that $\tau_T > \tau_N$, which I have argued is the more likely situation. Relative to the previous equilibrium, this entails a leftward shift in the SS schedule. In the new equilibrium (point 1 in figure 7), θ_T is lower (and R is higher). Because $\theta_T < \alpha$, the economy pays a growth penalty as a result of the tradable sector being too small. Note that the endogenous real depreciation plays a compensatory role, but only a partial one.

Starting from this new equilibrium (where $\tau_T > \tau_N$ and $\theta_T < \alpha$), it is entirely possible that a negative transfer would improve the economy's growth. That is because a reduction in γ leads to an increase in the equilibrium level of the real exchange rate and moves θ_T closer to α . In terms of figure 7, a fall in γ shifts the DD schedule to the right and causes both R and θ_T to rise (point 2). Whether growth also increases ultimately remains uncertain, because the reduction in γ also has a direct negative effect on growth (see equation 11). But if σ is sufficiently high, one can always generate cases where this is on balance growth promoting. In such cases, the real depreciation generated by the negative external transfer becomes a second-best instrument to offset the growth costs of the differential distortion of tradables.

Policy Implications

The main point of this paper can be stated succinctly. Tradable economic activities are "special" in developing countries. These activities suffer disproportionately from the institutional and market failures that keep countries poor. A sustained real depreciation increases the relative profitability of investing in tradables and acts in second-best fashion to alleviate the economic cost of these distortions. It speeds up structural change in the direction that promotes growth. That is why episodes of undervaluation are strongly associated with more rapid economic growth.

Are my quantitative estimates of the growth effects of undervaluation plausible? For developing countries my estimates of $\hat{\delta}$ range from 0.063

(albeit in a highly reduced sample, in column 4-2 of table 4) to 0.012 (in the last column of table 3) and cluster around 0.020. If one takes the last number as a central estimate, the implication is that an undervaluation of, say, 20 percent boosts annual growth by 0.4 percentage point. Can the channel I have focused on deliver effects of this magnitude? Remember that the mechanism that generates growth here is structural change. So the answer obviously depends on the size of the gaps between social marginal products in tradable (especially industrial) and nontradable sectors. I have already given some reasons for why these gaps can be quite large. A long tradition of thought on economic dualism in developing countries takes the persistence of large differences between marginal products in the advanced, “formal” parts of the economy (such as industry) and marginal products elsewhere as the very essence of underdevelopment. Detailed industry studies carried out recently by the McKinsey Global Institute provide some striking, if indirect, evidence on the magnitude of these gaps.³⁷ They find that productivity levels in the most advanced firms and sectors of developing economies are not too distant from the frontier in the rich economies. Since average productivity in these developing economies is a fraction of that prevailing in the rich economies, the implied intersectoral differences within developing economies are quite large. This paper’s distinction between tradable and nontradable sectors maps directly onto this dualistic structure, since most (nonagricultural) tradable activities in a typical developing country are formal whereas most nontradable activities (except for public services) are informal.³⁸

There is an obvious parallel between the argument I have developed here and the results presented in a recent paper by Eswar Prasad, Raghuram Rajan, and Arvind Subramanian,³⁹ who note that fast-growing developing countries have tended to run current account surpluses rather than deficits.

37. See, for example, McKinsey Global Institute (2001, 2003).

38. A simple finger exercise can be helpful here. Denote the productivity premium in industry by ψ and the share of employment in industry by λ_i . Some straightforward algebra can establish that the growth effect of reallocating labor to industry in the amount $d\lambda_i$ is given by growth impact = $[\psi/(1+\psi\lambda_i)]d\lambda_i$. A reasonable assumption on the industrial premium (at the margin) would be that $\psi = 50$ percent, and a typical industrial share of labor is $\lambda_i = 0.20$. Note from the second column of table 7 that a 20 percent undervaluation would be associated with an increase of 0.84 percentage point in industry’s share of total employment ($d\lambda_i = 0.042 \times 0.2 = 0.0084$). Applying the formula, an increase in the industrial labor share of 0.84 percentage point would be expected to generate additional growth equal to 0.38 percentage point, which is virtually identical to the result obtained using the coefficient estimates from the growth regressions (0.4 percentage point).

39. Prasad, Rajan, and Subramanian (2007).

This runs counter to the view that developing countries are constrained by external finance, and to the presumption that capital inflows supplement domestic saving and enable more rapid growth.⁴⁰ One of the explanations that Prasad and his coauthors advance is that capital inflows cause a real appreciation and hurt growth through reduced investment incentives in manufactures. They also provide some evidence on this particular channel. Even though these authors focus on the costs of overvaluation rather than the benefits of undervaluation, their concern with the real exchange rate renders their paper complementary to this one.

A maintained hypothesis in this paper thus far has been that the real exchange rate is a policy variable. Strictly speaking, this is not true, as the real exchange rate is a relative price and is determined in general equilibrium along with all other relative prices. But governments have a variety of instruments at their disposal to influence the real exchange rate, and the evidence is that they use them. Maintaining a real undervaluation requires either higher saving relative to investment or lower expenditure relative to income. This can be achieved through fiscal policy (a large structural surplus), incomes policy (redistribution of income to high savers through real wage compression), saving policy (compulsory saving schemes and pension reform), capital account management (taxation of capital account inflows, liberalization of capital outflows), or currency intervention (building up foreign exchange reserves). Experience in East Asia as well as elsewhere (for example, Tunisia) shows that countries that target the real exchange rate (that is, follow a policy of “competitiveness”) can have a fair amount of success.

Table 10 presents some systematic evidence on how policy choices feed into the real exchange rate and undervaluation. The table shows the results of regressing *UNDERVAL* on a series of independent variables in a panel with fixed effects. The baseline specification (column 10-1) includes the following regressors: the terms of trade, government consumption (as a percent of GDP), an index of capital account liberalization (*KAOPEN*), and a set of dummy variables capturing the exchange rate regime in force. *KAOPEN* comes from Menzie Chinn and Hiro Ito and is a continuous variable designed to capture the extent and intensity of capital controls.⁴¹ It increases as a country’s capital account regime becomes more liberal. The exchange rate regime indicators come from Ethan Ilzetzki, Carmen Reinhart, and Kenneth Rogoff and are entered as separate dummy vari-

40. Rodrik and Subramanian (forthcoming).

41. Chinn and Ito (2006).

Table 10. Panel Regressions of Undervaluation on Selected Policy and Other Variables^a

<i>Independent variable</i>	<i>Regression</i>			
	<i>10-1</i>	<i>10-2</i>	<i>10-3</i>	<i>10-4</i>
In terms of trade	-0.139*** (-3.52)	-0.164*** (-4.14)	-0.167*** (-4.09)	-0.115*** (-2.86)
Government consumption as share of GDP	-0.793*** (-4.35)	-0.680*** (-3.53)	-0.519*** (-2.61)	-0.045 (-0.23)
Capital account openness (<i>KAOPEN</i>) ^b	-0.031*** (-5.70)	-0.029*** (-5.39)	-0.026*** (-4.56)	-0.031*** (-5.98)
<i>Exchange rate regime dummies:</i> ^c				
Crawl or managed float	0.068*** (4.86)	0.065*** (4.64)	0.065*** (4.47)	0.071*** (4.87)
Float	0.027 (0.85)	0.028 (0.89)	0.058* (1.83)	0.026 (0.82)
Currency in free fall	0.161*** (4.97)	0.158*** (4.86)	0.172*** (5.21)	0.162*** (4.80)
Dual market with missing parallel market data	0.065 (1.12)	0.067 (1.19)	0.063 (1.17)	0.021 (0.39)
Gross domestic saving as share of GDP		0.310*** (3.55)	0.355*** (3.80)	0.492*** (5.10)
FDI inflows as share of GDP			-0.376*** (-3.11)	-0.382*** (-3.04)
ln (1 + inflation rate)				0.039 (1.10)
No. of observations	3,153	3,147	2,994	2,757

Source: Author's regressions.

a. The dependent variable is $\ln \text{UNDERVAL}$. All regressions include time and country fixed effects. See the text for definitions and sources of capital account openness and classifications of exchange rate regimes. Extreme observations are excluded as noted in table 1. Robust t statistics are in parentheses. Asterisks indicate statistical significance at the *10 percent, **5 percent, or ***1 percent level.

b. From Chinn and Ito (2006). Higher values indicate greater openness.

c. Classification of exchange rate regimes is from Ilzetki, Reinhart, and Rogoff (2008). Countries with a rigid exchange rate regime are the excluded category.

ables identifying distinct regimes.⁴² So, for example, the “Crawl or managed float” dummy takes the value of one when the country is classified as having a currency regime with a preannounced crawl, a de facto crawl, or a managed float and is zero otherwise. The excluded category is the set of observations with a rigid exchange rate (a fixed peg, a currency board, or a currency union).⁴³ The remaining columns in the table augment the base-

42. Ilzetki, Reinhart, and Rogoff (2008). The data for the indicators are available at www.economics.harvard.edu/faculty/rogoff/files/ERA_Background_Material.htm.

43. “Crawl or managed float” corresponds to categories 2 and 3 in Ilzetki, Reinhart, and Rogoff’s (2008) “coarse” classification, and “rigid” corresponds to their category 1.

line specification by adding domestic saving, inflation, and foreign direct investment (FDI) inflows as regressors. Among the variables considered, government consumption, capital account openness, the exchange rate regime, and inflation can be considered direct policy variables, whereas domestic saving and FDI inflows are indirectly affected by policy. The terms of trade are exogenous for most countries but are expected to have a determinate effect on the real exchange rate.

The results in table 10 are quite strong. As expected, positive terms of trade shocks are bad for undervaluation. More important for the present discussion, fiscal policies, capital account policies, and the choice of exchange rate regime all have quite significant effects on undervaluation. Increases in government consumption tend to produce a real appreciation, as do policies that liberalize the capital account. The coefficient on *KAOPEN* implies that going from the Chinese level of capital account restrictions in 2006 (*KAOPEN* = -1.13) to the Mexican level (*KAOPEN* = 1.19) is associated with a decrease in *UNDERVAL* of around 7 percent. (Note that these effects are identified in these regressions from the variation within countries, not across countries, and are therefore more credible.) The operative channel, presumably, is that opening up the capital account invites inflows, which in turn cause the real appreciation.

The coefficients on the exchange rate regime dummies are also quite interesting. The central finding here is that regimes in which the exchange rate is actively managed—crawling pegs or managed floats—produce larger undervaluations than do fixed-rate regimes, with a difference of around 7 percent. Unsurprisingly, periods in which the currency is in a “free fall” as defined by Ilzetzki, Reinhart, and Rogoff are also good for undervaluation.⁴⁴ A pure float, by contrast, does not seem to generate significantly different levels of undervaluation.

The results in table 10 also show that high saving is good for undervaluation, whereas FDI inflows are bad. Both of these findings are in line with theoretical expectations. Finally, the level of inflation does not have a strong association with undervaluation, indicating that undervaluation need not come at the cost of inflation. In short, policy choices, particularly on the fiscal and external fronts, matter, and they do so in the manner suggested by straightforward economic logic.

44. Ilzetzki, Reinhart, and Rogoff (2008). It is worth noting that the growth effects of undervaluation, as detailed earlier in the paper, do not seem to depend on the type of exchange rate regime the country happens to have at the time. In particular, the results remain unchanged when the countries whose currencies are in a “free fall” are excluded from the sample.

It is worth emphasizing once again that real exchange rate policy is only second-best in the context of the economic distortions discussed here. One of the side effects of maintaining a real overvaluation is a surplus on the current account (or a smaller deficit). This obviously has effects on other countries. Were all developing countries to follow this strategy, the developed countries would have to accept living with the corresponding deficits. This is a major issue of contention in U.S.-China economic relations at present. Moreover, when some developing countries (for example, the Asian economies) follow this strategy while others do not, the growth penalty incurred by the latter becomes larger as their tradable sector shrinks even further under the weight of Asian competition.

Conceptually, the first-best strategy is clear, if fraught with practical difficulties: eliminating the institutional and market failures in question would do away with the policy dilemmas. But recommending this strategy amounts to telling developing countries that the way to get rich is to get rich. A more practical approach is to subsidize tradables production directly, rather than indirectly through the real exchange rate. Real undervaluation is equivalent to a production subsidy plus a consumption tax on tradables. The direct strategy of subsidizing production of tradables achieves the first without the second. Hence it avoids the spillovers to other countries. A production subsidy on tradables boosts exports and imports simultaneously (provided the exchange rate, or wages, or both are allowed to adjust to equilibrate the current account balance) and therefore need not come with a trade surplus.

However, it goes without saying that production subsidies have their own problems. Fine-tuning them to address the perceived distortions would amount to a highly intricate form of industrial policy, with all the attendant informational and rent-seeking difficulties. Even if that were not a problem, the strategy would come into conflict with existing World Trade Organization rules that prohibit export subsidies. There is, it appears, no easy alternative to exchange rate policy.

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