Equilibrium real exchange rates, misalignment and competitiveness in the Southern Cone

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Abstract

To examine the evolution of competitiveness in the production of traded goods in a particular country, it is necessary not just to disentangle actual from sustained equilibrium real exchange rate (SERER) movements, but also to determine the extent to which movements in SERERs have been driven by changes in sectoral productivity performance or by other factors. This paper presents an analysis of the evolution of the competitiveness in the traded goods sectors in six Latin American countries that takes into account both of these issues. It finds that the competitiveness of the nontraditional traded goods sector has evolved in different ways among these countries during recent years. Since the mid-1990s, it has stabilized in Argentina while improving in Bolivia, Chile, Paraguay, and Uruguay. Results for Brazil are ambiguous.

I.   Introduction

The endogenous growth literature has made economists increasingly aware that the composition of output in an economy can affect its long-run growth rate. In particular, certain types of economic activity have been increasingly perceived as potentially generating important externalities for the rest of the economy, such that the rate of growth of the economy's total factor productivity becomes an increasing function of the share of output in such activities. Manufacturing for export is often considered an activity of this type. The potential spillovers cited as potentially generating positive effects on aggregate productivity growth operate through a variety of channels, including learning by doing, labor training, and "self-discovery," among others.[1] To the extent that such strategic activities are concentrated in the traded goods sector, the implication is that the level of the real exchange rate, through its consequences for the competitiveness of the traded goods sector, may be an important instrument of development policy.[2] Indeed, the perceived use of the real exchange rate in this way by several countries in East and Southeast Asia has fueled some of the most visible disputes in the international economic arena during recent years.

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[1]   See Rajan and Subramanian (2006), Hausmann and Rodrik (2003).
[2]   See Rodrik (2006).

These disputes –such as that between the United States and China– have centered on the use of the nominal exchange rate regime to sustain the real exchange rate at a depreciated level. However, theory suggests that the effects of nominal exchange . rate changes on the real exchange rate are temporary at best. A nominal instrument such as the nominal exchange rate cannot achieve a real objective, such as a desired value of the real exchange rate, over the medium term, since over time domestic price level adjustments would tend to undo the effects of nominal exchange rate changes on the real exchange rate. This is a direct implication of monetary neutrality. This theoretical insight is relevant for the use of the real exchange rate as an instrument of development strategy because resources such as physical capital typically involve incurring irreversible costs when they are assigned to a specific activity. As a consequence, decisions on the allocation of such resources to specific activities tend to depend not on *actual* relative prices, but on their perceived *sustainable* values. This being so, it is not at all clear that we should expect the allocation of investment to the traded goods sector to depend on the level of the real exchange rate that prevails at the time that the investment decision is made. Instead, such investment decisions should depend on the perceived *sustainable* value of the equilibrium real exchange rate (SERER).

It would probably be going too far, however, to claim that nominal exchange rate policy has no role to play in the assignment of resources to industries that have the potential to generate positive production externalities. Precisely because what matters for sectoral resource allocation is the *perceived* sustainable value of the real exchange rate, and because the SERER is not directly observable, nominal exchange rate policy remains relevant. Specifically, it can influence investment decisions through its effects on the severity of the signal-extraction problem faced by economic agents who need to make inferences about the SERER by making that value more or less transparent. The sustainable real exchange rate will be a more effective mechanism for allocating resources between traded and nontraded activities the more readily agents can discriminate between sustainable and unsustainable real exchange rate changes. Repeated episodes of real exchange misalignment create "noise" in the relationship between actual and sustained equilibrium real exchange rates and thus obfuscate the relative price signal conveyed by the SERER. Thus, while nominal exchange rate policy cannot influence the sustainable equilibrium value of the real exchange rate, it can affect the ease with which agents can infer what that value is. To the extent that nominal exchange rate policy avoids repeated episodes of misalignment, economic agents can infer the sustainable equilibrium real exchange rate by observing market prices.[3]

Enhanced competitiveness in the domestic traded goods sector would thus seem to require a relatively depreciated SERER that is closely tracked by the actual real exchange rate. Unfortunately, however, the relationship among the actual real exchange rate, the SERER, and the competitiveness of the traded goods sector is not as simple as this. In particular, a more appreciated or depreciated SERER does not necessarily signal a reduced or enhanced degree of competitiveness in traded goods production. The reason is that changes in productivity in the traded goods sector themselves affect the sustainable equilibrium real exchange rate. This familiar result, usually referred to as the Balassa-Samuelson effect, implies that to examine the evolution of competitiveness in the production of traded goods in a particular country, it is necessary not just to disentangle actual from sustained equilibrium real exchange rate movements, but also to determine the extent to which movements in sustainable equilibrium real exchange rates have been driven by changes in sectoral productivity performance or by other factors.

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[3]   Actually, one can think of mechanisms through which the equilibrium real exchange rate – and thus the size of the traded goods sector - could indeed be influenced by nominal exchange rate policy, but these are second-order effects whose implications for sectoral resource allocation are not necessarily predictable. For example, nominal instruments can affect the stability of the real exchange rate as well as the domestic rate of inflation. The relative-price "noise" created by the former, and the effects on transactions costs created by the latter, may bias the sectoral allocation of output, but it is not clear a priori in which direction.

This paper presents an analysis of the evolution of the competitiveness in the traded goods sectors in six Latin American countries that takes into account the factors mentioned above. The six countries studied are four full members of MERCOSUR (Argentina, Brazil, Paraguay, and Uruguay), plus associate members Bolivia and Chile.[4] The paper has two objectives. First, it seeks to determine the extent to which real exchange rate movements in each of these countries over the past three and a half decades have resulted from changes in the SERER or from repeated episodes of misalignment. This will provide an indication of the likely effectiveness of the real exchange rate as a relative price signal in these countries. Second, it attempts to decompose movements in the SERER into the contributions of productivity changes and those of a variety of other potential influences, permitting us to draw inferences about the extent to which movements in the SERER itself have been competitiveness-enhancing or not in each of these countries.

The plan of the paper is as follows: in the next section I consider some conceptual problems that arise in identifying the sustainable equilibrium real exchange rate concept that is relevant for decisions concerning the allocation of resources to the traded goods sector. Section III then examines the set of factors that could potentially influence the sustainable equilibrium real exchange rate. The empirical methodology for estimating the sustainable equilibrium rate is described in Section IV. The heart of the paper is in Section V, which presents the estimates of the sustainable equilibrium real exchange rate for each of the six countries and uses these results both to identify and interpret the incidence of real exchange rate misalignment for each country over the sample period as well as to identify the factors that have influenced traded-goods competitiveness in each country. Section VI summarizes and concludes.

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[4]   Venezuela became the fifth member of the bloc in 2006.

II. Sustainability in the real exchange rate

The definition of the sustainable equilibrium real exchange rate that is most widely used in policy circles is more than fifty years old, dating to Nurkse (1945). Under Nurkse's definition, the sustainable real exchange rate is taken to be the value of the real exchange rate that is simultaneously compatible with internal balance (full employment and equilibrium in the market for nontraded goods) as well external balance (a current account deficit/surplus that can be financed by "normal" capital inflows/outflows), conditioned on sustainable values of the exogenous variables that influence internal and external balance. The latter are conventionally referred to as equilibrium real exchange rate "fundamentals."[5]

However, while this definition has intuitive appeal, on closer inspection it is not sufficient to pin down an operational concept of sustainable equilibrium for the real exchange rate. Most importantly, it is silent on what constitutes the relevant time frame for the analysis – in other words, on what the term "sustainable" means as applied to the complete set of fundamentals. To be concrete, consider the dynamic structure of a small open economy, in which the reduced-form expression for the real exchange rate that prevails at any given moment of time depends on the current and expected future values of

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[5] While I refer to this definition as "conventional," it is not universal. Some economists, for example, introduce normative concepts to restrict the concept of equilibrium even further, requiring not only that the market for home goods be in equilibrium at full employment, but also that the rate of inflation be low (see Williamson 1998).

policy and nonpolicy exogenous variables as well as on the current values of a set of predetermined variables: say the average nominal wage, the economy's international investment position, and the sectoral capital stocks in the traded and nontraded goods sectors. The term "sustainable" can be unambiguously understood when applied to the exogenous variables, since it can be interpreted as referring to "permanent" values of such variables. But what does it mean when applied to predetermined variables?

The difficulty in that context is that variables such as the capital stock, the economy's international investment position, and the nominal wage can all be expected to approach their steady-state values at different rates. Does the term "sustainable" refer to the *current* values of the more slowly-adjusting predetermined variables (which are "sustained" in the sense that they will change very slowly over time), or does it refer to the *steady-state* values of such variables (which are "sustained" in the equilibrium sense that they will not change in the absence of disturbances)?

We can imagine, for example, the nominal wage adjusting fairly quickly, capital stocks adjusting relatively slowly, and the country's international investment position adjusting at an intermediate rate. In that case, we can think of several alternative concepts of equilibrium real exchange rates:

a) An *instantaneous* equilibrium, referring to the real exchange rate that prevails for given values of the nominal wage, the international investment position, and sectoral capital stocks. This concept of equilibrium is conditioned on sustainable values of the exogenous values, as well as on *current* values of all of the predetermined variables.

b) A *short-run* equilibrium, referring to that value of the real exchange rate that would be observed when the nominal wage has competed its adjustment, but the country's international investment position and its capital stocks have not. This concept of equilibrium would be conditioned on sustainable values of the exogenous variables, as well as on prevailing values of the international investment position and capital stocks.

c) A *medium-run* equilibrium, reflecting full adjustment of the nominal wage and the international investment position, but not of sectoral capital stocks. This equilibrium is conditioned on sustainable values of the exogenous variables, as well as on prevailing values of the sectoral capital stocks.

d) A *steady-state* equilibrium, which is the equilibrium value of the real exchange rate that obtains after *all* the predetermined variables have adjusted to their steady-state values. In this case, the set of fundamentals consists only of the sustainable values of the exogenous variables.

All of these are meaningful equilibrium concepts. As a thought experiment, we can imagine that, from some arbitrary initial situation, all of an economy's exogenous variables are suddenly adjusted –once and for all– to sustainable levels. Given the nominal wage, the economy's net international investment position, and the sectoral capital stocks, the economy would immediately generate an equilibrium real exchange rate, defined above as an instantaneous equilibrium RER. But there is no reason to believe that that real exchange rate would be compatible with full employment, with a current account balance exactly sufficient to sustain the country's net international investment position, or with steady-state values of sectoral capital stocks. If the resulting equilibrium does not imply full utilization of productive capacity, the nominal wage would adjust over time until the economy achieves full employment, thereby generating a new equilibrium real exchange rate, identified above as the short-run equilibrium RER. But again, there is no reason to believe that at full employment (internal balance), the current account would be such as to sustain the country's international investment position indefinitely, or that sectoral capital stocks would be at their steady-state levels. As the international investment position

adjusts, the equilibrium real exchange rate would continue to change, until the international investment position stabilizes. This is what is defined above as a medium-term equilibrium. But sectoral capital stocks may still not have reached their steady-state values at that point, leading to further real exchange rate adjustments. Only when all the predetermined variables have completed their adjustments would we literally reach an unchanging steady state equilibrium real exchange rate.

Thus the relevant question is which time horizon we are interested in. Since the Nurksian definition appears to capture the equilibrium notion that has been of interest to policymakers for over half a century, we can use it as a guide for a first cut at the issue. By specifying that the equilibrium concept in question requires a condition of full employment, the Nurksian definition appears to rule out the instantaneous equilibrium concept (a) as capturing the policy-relevant horizon. Because it refers to a business cycle equilibrium, rather than a Solowian steady state, it also appears the rule out the steady-sate concept (d). But the two intermediate concepts of equilibrium appear to remain in play under the Nurksian definition.

The choice between the two would appear to depend on the specific policy question that motivates interest in the concept of a sustainable equilibrium real exchange rate. Since our concern is with effects on competitiveness and the allocation of resources to the traded goods sector, we should choose the concept of sustainability that corresponds to the time horizon relevant to investment decisions in the traded goods sector. Unfortunately, there is little guidance available on whether that horizon is or is not long enough to allow for full adjustment on the country's net international investment position. If the horizon is sufficiently short, then the relevant measure of equilibrium should be conditioned on the prevailing level of the country's net international investment position. If the horizon is long enough, it should not. Since a choice has to be made, in what follows I will include the international investment position among the set of fundamentals, acknowledging that this implies the assumption that firms potentially investing in the traded goods sector consider the relevant concept of real exchange rate sustainability to be a relatively short one i.e., one that is consistent with the economy returning to full employment, but that may nonetheless leave the country's current account balance in a position that is not sustainable indefinitely.

III. Fundamental determinants of equilibrium real exchange rates

My empirical approach to the estimation of the SERER in this paper will be based on a single-equation reduced form methodology to estimate the empirical effects of changes in the fundamentals on the SERER. Thus the logical first step is to identify the exogenous variables that may potentially influence the internal and external balance conditions.

As outlined in the next section, the strategy will be to begin with a comprehensive set of the potential fundamentals that are suggested by theory, and let the data determine which ones turn out to be empirically relevant for each of the countries under consideration. The set of potential fundamentals is drawn from the extensive existing literature on determinants of the SERER.[6] In this section I describe the set of fundamentals suggested by this literature, and explain the conventional view regarding the effect of each individual fundamental on the sustainable equilibrium real exchange rate. The set includes the following:

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[6] A recent overview is provided in Montiel (1999).

1)   Domestic supply-side factors

The most venerable theory regarding long-run real exchange rate determination is the Balassa-Samuelson effect, mentioned above. This effect relies on differential productivity levels between a country and its trading partners, and makes the implicit assumption that productivity growth is biased in favor of the traded goods sector. Thus, a country with higher productivity levels than its trading partners will also exhibit a higher productivity differential in the traded goods sector than in the nontraded goods sector. Because higher productivity in traded goods allows that sector to bid labor away from the nontraded goods sector, costs rise in the nontraded goods sector, and a higher relative price of nontraded goods is required to retain profitability in that sector. The implication that the relative price of nontraded goods is higher implies that the CPI-based real exchange rate must be more appreciated in countries with higher productivity levels.[7] [8]

2)   Domestic demand-side factors

The level of government spending on nontraded goods affects the long-run equilibrium real exchange through the effects of government spending on the demand for nontraded goods. Additional government demand for nontraded goods causes an equilibrium increase in the relative price of such goods and thus an appreciation of the equilibrium CPI-based real exchange rate. This effect could come about, of course, either as the result of an increase in government spending on all goods or from a shift in government spending from traded to nontraded goods. A conventionally-used proxy for government demand for nontraded goods is the share of government consumption in GDP, on the grounds that the bulk of such spending is devoted to nontraded services.[9]

3)   The country's international investment position

As indicated in the previous section, each economy's net international investment position will be included among the set of potential fundamentals in the estimation below. The net investment position affects the real exchange rate through its impact on household wealth. A larger net investment position implies a higher level of household wealth and hence an increase in the sustainable level of consumption expenditure and a higher demand for nontraded goods, requiring an increase in their relative price. Hence, a larger net international investment position relative to the size of the domestic economy should be associated with a more appreciated equilibrium real exchange rate.[10]

4)   The international economic environment

The international economic environment can have important effects on a country's equilibrium real exchange rate. Most familiarly, changes in an economy's external terms of trade

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[7]   Many researchers have investigated this phenomenon in developing countries. See, for example, Ito, Isard, and Symansky (1997), and Alquist and Chinn (2002).

[8]   The strength of the Balassa-Samuelson effect, as well as of some of the other fundamentals discussed below that affect the real exchange rate at least in part through their effects on the cost of labor in the nontraded goods sector, can be expected to be muted when the formal economy can draw on additional labor from external sources. These may include the informal sector, subsistence agriculture, or immigration. The first of these may be important in Latin America, where informal sector employment has been estimated to account for nearly half of the non-rural labor force.

[9]   The role of government spending in altering the equilibrium real exchange rates has been emphasized in several papers by Menzie Chinn (see Chinn and Johnston 1996, Chinn 1997, and Chinn 2000).

[10]   For applications, see Gagnon (1996), and Lane and Milesi-Ferretti (2002).

and in the availability of external transfers can both be expected to influence the long-run equilibrium real exchange rate. As is familiar from the "Dutch disease" literature, improvements in the terms of trade tend to appreciate the equilibrium real exchange rate, both by increasing demand for nontraded goods as well as by causing the traded goods sector to absorb resources that would otherwise have been employed in the nontraded goods sector.   Both effects require an increase in the relative price of nontraded goods.[11] The effects of changes in the flow of international transfers on the equilibrium value of the real exchange rate have also recently received increased attention, in the form of studies on the effects of aid receipts and of workers' remittances on the real exchange rate (Rajan and Subramanian 2006, Izquierdo and Montiel 2006). Such effects would operate through the implications of such flows for domestic aggregate demand, and thus on the demand for nontraded goods. Through these channels, an increase in the size of aid and/or remittance flows relative to that of the domestic economy should be expected to appreciate the equilibrium real exchange rate.

5)   Commercial policy

Finally, trade liberalization can be expected to be associated with long-run real depreciation. A reduction in import tariffs would tend to release resources from the importable sector that would be absorbed by the exportable and nontraded goods sectors, thus increasing the supply of nontraded goods and lowering their relative price. The lower domestic prices of both importable and nontraded goods implies a depreciation of the CPI-based real exchange rate. Unfortunately, trade liberalization is notoriously difficult to measure empirically. The most commonly-used proxy, the ratio of the sum of exports and imports to GDP, is an indicator of commercial openness, not necessarily of commercial policy.   However, in the absence of readily-available superior alternatives, it will be the empirical proxy used here.

It may be worth noting that capital inflows do not appear among this list of fundamental determinants of long-run equilibrium real exchange rates. The reason is that capital inflows are an endogenous phenomenon, likely to materialize as a consequence of change in some other fundamental variable and thus having an association with the real exchange rate that is determined by the source of the shock that generates the inflow. Candidates for this role are all of the fundamentals described above.

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[11]   On the effects of changes in the terms of trade on equilibrium real exchange rates, see De Gregorio and Wolf (1994), as well as Chaudhuri and Daniel (1998).

IV. Estimation of the equilibrium real exchange rate: methodology

Having identified the eligible set of fundamentals, the next task is to describe the empirical methodology for extracting an estimate of the sustainable equilibrium real exchange rate from this set. This section provides a step-by-step description of the methodology, which is implemented in the section that follows.

1. The (natural log of the) real effective exchange rate (RER) in each of the six countries is tested for the presence of a unit root, using both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. If the null can be rejected, so the series can be taken to be trend stationary, then a reasonable estimate of the SERER can be obtained by fitting a constant and a trend to the available series -i.e., by using a PPP- based estimate of the equilibrium real exchange rate.

2. If the null that the series contains a unit root cannot be rejected, however, then permanent changes in the RER during the sample period must have been driven by corresponding permanent changes in some subset of its potential fundamental determinants. Since nonstationary behavior of the RER must be driven by nonstationary behavior in the fundamentals, the next step is to narrow the subset of the fundamentals driving the unit root process in the RER by identifying the subset of nonstationary fundamentals. This is done by testing each of the six potential fundamentals individually for the presence of a unit root, following the same procedure as for the real exchange rate itself.

3. To identify which among this restricted set of nonstationary fundamentals was responsible for driving the behavior of the RER over the sample period, cointegrating relationships are estimated between the RER and the set of nonstationary fundamentals. This cointegrating relationship is interpreted as a reduced-form expression for the sustainable equilibrium real exchange rate.

Unfortunately, this is not a trivial step in the process, because the large number of potential fundamentals and the low power of unit root tests in samples spanning the relatively short periods available for the countries under study jointly imply that there tends to be a large number of nonstationary fundamentals eligible for inclusion in the cointegrating equation. Moreover, the possibility of including constants and time trends in the cointegrating relationship adds to the variety of possible specifications for the cointegrating equation. For each set of potential fundamentals, it is possible to make several choices concerning the inclusion of constants and trends in the cointegrating equation (CE) e.g., no constant or trend, a constant but no trend, both a constant and a linear trend. Unfortunately, theory does not provide much guidance on the choice among these specifications. The upshot is that it is generally possible to find a large number of cointegrating relationships between the real exchange rate and some subset of the nonstationary fundamentals. Thus, some algorithm is required for choosing among these possibilities.

The approach adopted here is one that heavily penalizes specification error by being as inclusive as possible, while at the same time relying heavily on theory by requiring that the final equation be consistent with conventional theoretical priors, as described in the previous section. The procedure is as follows. Suppose that there are a total of N nonstationary fundamentals. The first step is to test for cointegration using all N fundamentals in the test equation and each of the constant-trend specifications listed above. If at least one cointegrating relationship is found according to either the trace or maximum-eigenvalue tests for any of these three CEs, then the estimated CE is examined further. Otherwise it is dropped. Next, the surviving CEs are examined for the signs and statistical significance of the included fundamentals. If all N fundamentals enter a surviving CE with coefficients that bear the theoretically predicted signs and that are statistically significant, the CE is retained. Otherwise it is dropped. If there are multiple surviving CEs after this step, since they all share the same set of N nonstationary fundamentals, they must differ from each other only with respect to their constant-trend specifications. Constant and trends are retained in the cointegrating equation only if they are statistically significant or if their exclusion would imply an inability to reject the null of no cointegration. If this procedure yields a CE in which all N fundamentals have coefficients that are of the theoretically predicted sign and are statistically significant, then that CE is taken to describe the determination of the sustainable equilibrium real exchange rate and we move to step 4.

However, if the procedure does *not* yield a CE that meets the criteria set out above, then the same procedure is applied to each of the N possible subsets of N-1 fundamentals (one such subset can be derived by excluding each of the N nonstationary fundamentals in turn). Again, if this procedure yields a unique CE with N-1 fundamentals satisfying the criteria set out above, this CE is chosen for the application of step 4. If no CE from this step satisfies these criteria, however, then we reduce the dimensionality of the fundamentals once again, and repeat the procedure for each of the N(N-1)/2 subsets of combinations of N-2 fundamentals, and so on, with the set of potential fundamentals decreasing in dimensionality by one at each stage.

At each such stage featuring N-1 fundamentals or fewer, it is possible to find more than one combination of fundamentals that satisfies the conditions set out above. In that case, the following criteria are used to choose among them:

a) CEs in which a constant and/or time trend must be included to achieve cointegration, but in which these variables do not prove to be statistically significant, are dropped in favor of those in which they are.

b) If the surviving CEs do not differ in this respect – i.e., if none of the surviving CEs feature statistically insignificant constants and/or trends – then surviving CEs that do not require the inclusion of a statistically significant constant and/or trend to achieve cointegration are chosen in preference to those that do. This reflects a preference to adopt specifications that do not rely on unexplained patterns in the data.

c) If the surviving CEs do not differ in this respect either – i.e., if their constant/trend specifications are uniform -- then CEs for which the lagged error-correction term in the error-correction representation for the change in the real effective exchange rate carries a negatively-signed and statistically significant coefficient are adopted in preference to those that do not.

d) Finally, if the lagged error-correction term is significant and has a negative sign in the error-correction representation for the change in the real effective exchange rate in more than one surviving CE, then the CE for which the error-correction representation has the largest adjusted R^2 is adopted.

4. Once the specification of the CE is chosen, "permanent" values of the fundamentals are estimated by filtering the series to eliminate transitory components. Although there is a variety of possible ways to do this, the approach adopted here uses the Hodrick-Prescott filter with the conventional annual value for the smoothing parameter • (= 100).

5. Finally, the fitted values of the cointegrating equation for the REER in each country, using the estimated "permanent" components of the fundamentals, represent the estimates of the sustainable equilibrium real exchange rate for each year in the sample, and the difference between these fitted values and the observed REER series measures the gap between the actual and sustainable equilibrium real exchange rates (misalignment).

V. Estimating the LRER and interpreting misalignment in MERCOSUR

The methodology described in the previous section was implemented to estimate the SERER for all five MERCOSUR countries plus Chile, using annual data spanning the period from 1969 to 2005. Data sources and descriptions are contained in the appendix. Cointegrating equations were estimated for the log of the (CPI-based) trade-weighted real effective exchange rate for each country (RER) and the initial set of five potential fundamentals described in Section III: relative labor productivity in the domestic economy compared to that of the country's trading partners (PROD), the country's international investment position, expressed as a ratio to GDP (IIP), the log of the country's net barter terms of trade (LTOT), the ratio of public sector consumption expenditures to GDP (GOVCON), and the measure of commercial openness in the form of the ratio of exports plus imports to GDP (OPEN).[12] The results of the estimates of the cointegrating equations are reported in Table 1.

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[12] The share of international transfers in GDP was also considered initially as a potential fundamental. However, this variable was insignificant in magnitude for all countries but Paraguay, and proved to be stationary in the case of Paraguay, so it was dropped from the set of fundamentals.

Recall that the methodology applied to produce these estimates imposes results consistent with the conventional theoretical priors described in the previous section. Thus, these results in no way constitute a test of these priors. Nonetheless, it is reassuring to note that it proved possible to find cointegrating equations for the real exchange rate for all six countries in which the fundamentals possessed the theoretically-predicted signs. This outcome was certainly not preordained by the empirical approach described in the last section. Notice also that, while PROD plays an important role in five of the six countries considered, as expected, the set of fundamentals in the preferred cointegrating equations includes more than the Balassa-Samuelson productivity effect in every case except that of Chile, suggesting that the competitiveness of the traded goods sector in each of these economies has indeed been affected by a variety of other factors.[13] Another result that is similar across countries is that the government consumption variable does not enter any of the estimated cointegrating equations. A possible interpretation is that, at least for this particular group of countries, the traded-nontraded composition of public consumption does not differ substantially from that of private spending. Finally, despite these uniformities, results for the cointegrating equations imply that the factors driving the SERER tend to be country-specific. Among the set of six countries only Brazil and Uruguay share the same specification for the cointegrating vector, suggesting that the relevant set of fundamentals varies from one country to another even within MERCOSUR.

Table 1

COINTEGRATING EQUATIONS FOR THE REAL EXCHANGE RATE IN MERCOSUR COUNTRIES, 1969-2005[a]

	Argentina	**Bolivia**	**Brazil**	**Chile**	**Paraguay**	**Uruguay**
PROD		- 16.930	- 3.193	- 2.903	- 1.804	- 0.908
		(3.612)	(1.252)	(0.332)	(0.396)	(0.462)
IIP	- 0.010		- 0.014		- 0.018	
	(0.002)		(0.003)		(0.003)	
LTOT	- 1.689	- 0.582				- 0.588
	(0.204)	(0.253)				(0.294)
GOVCON						
OPEN	0.010				0.019	
	(0.005)				(0.001)	
TREND	- 0.028		0.002	0.048		

Source: Author's calculations.
[a] Numbers in parentheses are standard errors.

To assess how much these results actually have to say about the determination of the sustainable equilibrium real exchange rate in these countries, we can turn to estimates of error-correction equations for changes in real exchange rates in each country based on the fundamentals identified as empirically important by the results in Table 1[14] These equations yield two types of information regarding the adequacy of the theory:

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[13] Interestingly, Argentina is the only country in which PROD did not figure as a fundamental. This is in contrast to the results of of Gay and Pellegrini (2003), as well as Alberola et. al. (2002). The former used PROD, IIP, and TOT as fundamentals, while the latter used IIP and TOT. In my case, using PROD, IIP, and TOT yielded coefficients on IIP and TOT with theoretically-inappropriate signs, while using PROD and IIP yielded statistically insignificant coefficients.

[14] Engel and Granger (1987) note that if n nonstationary series are cointegrated, their dynamics of adjustment can be given an error-correction representation. This observation forms the basis for the Johansen-Juselius test of cointegration implemented here.

a) If the notion of a an equilibrium real exchange rate is a meaningful one, and if the theory of Section III adequately describes an empirically-relevant set of fundamentals, then estimated misalignment based on the fundamentals identified by this theory should drive future real exchange rate changes in the direction of equilibrium. That is, the error-correction term in the estimated error-correction equation (which measures the degree of undervaluation conditioned on current values of the fundamentals) should systematically predict the direction of future real exchange rate movements – i.e., it should enter the equation with a coefficient that is negative and statistically significant.

b) A separate issue, however, concerns the predictability of real exchange rate changes based on these fundamentals. We can address this question by examining how large a share of actual real exchange rate changes can be explained by estimated misalignment and changes in the identified fundamentals. This information is provided by the adjusted R^2 in the error-correction equations.

Table 2 provides these data for each of our six countries. As is evident from the table, the theory generates estimates of misalignment that help predict future real exchange rate movements in every case. This suggests that meaningful empirical estimates of misalignment can indeed be generated with the relatively small set of fundamentals described in Section III. However, in all six of these countries real exchange rate movements during the sample period have not been driven primarily by the fundamentals. In Brazil, Chile, Paraguay, and Uruguay the fundamentals explain in the vicinity of 40 percent of the variation in real exchange rate changes, but in Argentina and Bolivia the proportion explained by the fundamentals is much lower, at about 15 percent. This reflects in part the fact that Argentina has had by far the most variable real exchange rate of the group.[15] Overall, however, the implication is that non-fundamental factors explain at least half of the variation in actual real exchange rates changes for all of these countries. Given the nominal instability that has characterized the countries in this region during the sample period, this is not surprising. Such instability would tend to be associated precisely with non-equilibrating movements in nominal exchange rates and domestic prices.

Having examined the properties of our estimates of the factors driving long-run equilibrium in each of our six countries, I next turn to a comparison of actual and estimated equilibrium real exchange rates for each country, based on steps 4-5 of Section IV.

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[15]   The standard deviation of the change in the log of the real exchange rate during 1969-2005 amounting to 31 percent for Argentina, 17 percent for Bolivia, 13 percent for Brazil, 17 percent for Chile, 15 percent for Paraguay, and 13 percent for Uruguay.

PROPERTIES OF ERROR-CORRECTION REGRESSIONS FOR MERCOSUR COUNTRIES

	Coefficient of the error-correction term	Adjusted R^2
Argentina	- 0.796	0.151
	(0.374)	
Bolivia	- 0.232	0.154
	(0.083)	
Brazil	- 0.632	0.404
	(0.142)	
Chile	- 0.873	0.405
	(0.184)	
Paraguay	- 0.623	0.481
	(0.134)	
Uruguay	- 0.318	0.362
	(0.130)	

Source: Author's calculations.

1.   Argentina

Figures 1 and 2 depict the results for Argentina. Figure 1 superimposes the actual real effective exchange rate (RER) on the plot of the SERER, while Figure 2 presents a decomposition of the determinants of the estimated SERER.

The extreme variability of the actual real exchange rate relative to the estimated SERER in Argentina is evident in Figure 1. The figure makes clear that the sharp appreciation of Argentina's real exchange rate during the early years of the Convertibility Plan was the result of more than inflation inertia, as the actual real exchange was significantly undervalued when the Convertibility Plan stabilization was undertaken. However, inflation inertia seems to have contributed to an overshooting of the sustainable equilibrium rate, and by 1993 the real exchange rate was overvalued by about 25 percent. Though Argentina's low inflation rate and the continued appreciation of the equilibrium rate had closed this gap appreciably by 1996, the stabilization of the equilibrium rate and the appreciation of the US dollar widened it again, and by the time of the end-2001 crisis, the Argentine peso was overvalued by approximately 22 percent.[16]   Indeed, the estimates suggest that the peso was consistently overvalued during the entire Convertibility Plan episode. The sharp depreciation of the Argentine real exchange rate associated with the 2001-02 crisis once again resulted in a significant overshooting, this time in the direction of undervaluation, and by 2005 the peso is estimated to remain strongly undervalued, with a gap of 78 percent between the actual and equilibrium rates.

Consider next the behavior of the SERER itself. In the Argentine case, the effects of the fundamentals that we can identify are superimposed on a long-run trend appreciation arising from sources that remain unidentified, but that are unlikely to represent trend productivity improvements in the Argentine economy since PROD, an estimate of relative labor productivity in Argentina, did not enter the cointegrating vector and in any case has not exhibited a secularly improving trend. Among the identified fundamentals, the largest impact on the equilibrium real exchange rate by far is registered by the terms of trade.   In combination, the trend plus the terms of trade

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[16]   This estimate of overvaluation is substantially smaller than those derived by Albarola, Lopez, and Serven 2002 (53 percent) or Gay and Pellegrini 2003 (44 percent).

(TREND+TOT) would have produced a steadily appreciating SERER in Argentina after the mid-1980s, as the country experienced a cumulative improvement in its terms of trade of over 20 percent from 1985 to 2005.   Two factors mitigated this appreciation after the early 1990s: the increased openness of the Argentine economy, and the deterioration in the country's international investment position.   The contribution of the former to the evolution of the SERER can be identified by the gap between the TREND+TOT and the TREND+TOT+OPEN curves in Figure 1, while that of the latter is given by the gaps between the TREND+TOT+OPEN and SERER curves. The combined effect of this behavior of the fundamentals was to arrest the appreciation of the equilibrium rate after about 1995 and stabilize the SERER over the rest of the sample period.
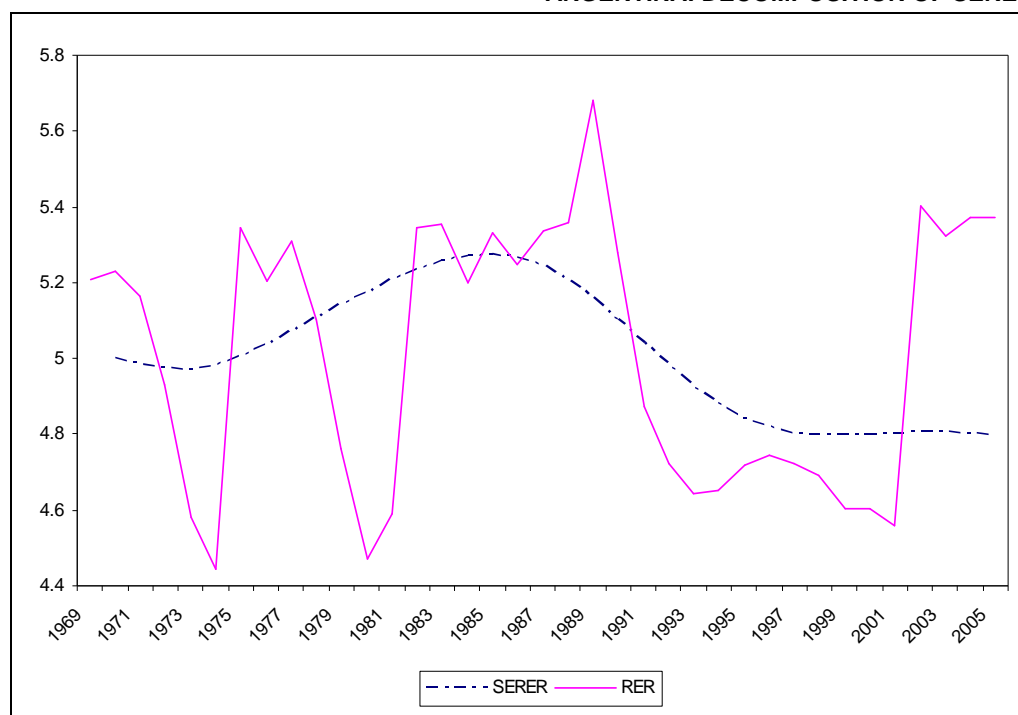
Movements in Argentina's terms of trade have been dominated by fluctuations in world prices of the country's traditional exports, including beef, wheat, and maize.   Consequently, it is likely that improvements in Argentina's terms of trade would have actually undermined the competitiveness of nontraditional tradable sectors through Dutch disease-type effects.   The competitiveness of these activities has consequently been pulled in different directions in recent years: undermined by improvements in the country's external terms of trade, but improved by its increased openness and its deteriorating net international investor position. Over the past decade or so these factors have effectively canceled each other out, suggesting no change in the competitiveness of nontraditional exports in Argentina since the mid-1990s, at least as indicated by the SERER.

Figure 1
ARGENTINA: ACTUAL AND EQUILIBRIUM REAL EXCHANGE RATE
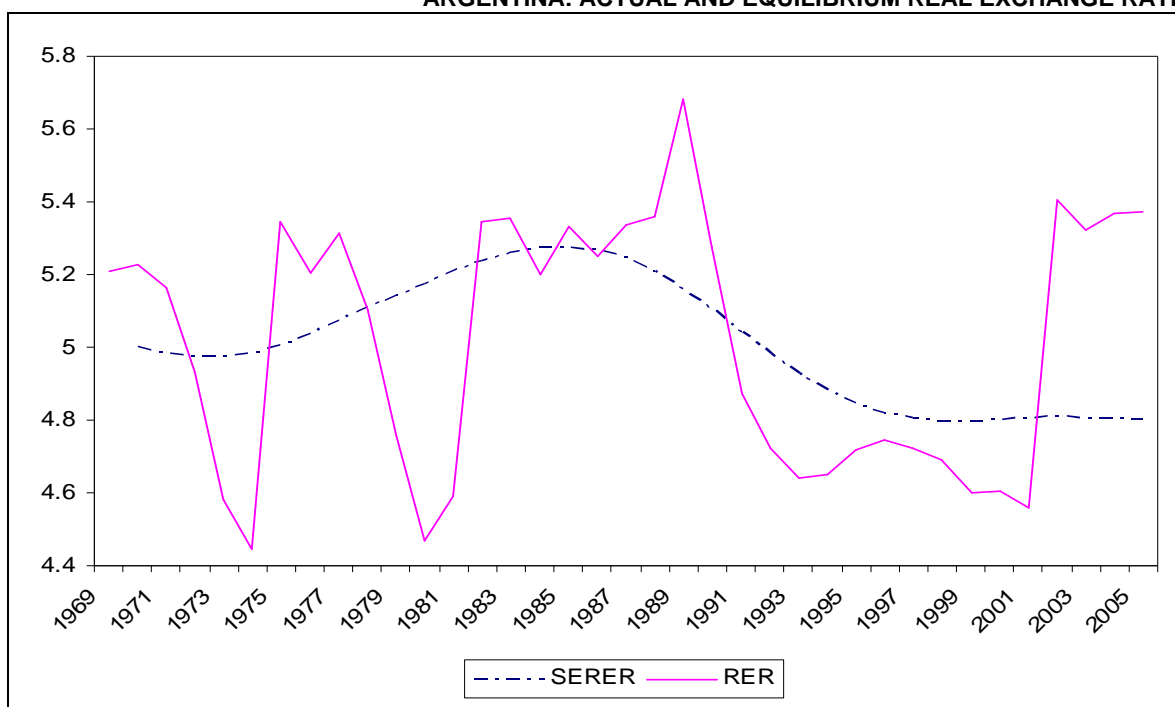
Source: Author.

Figure 2
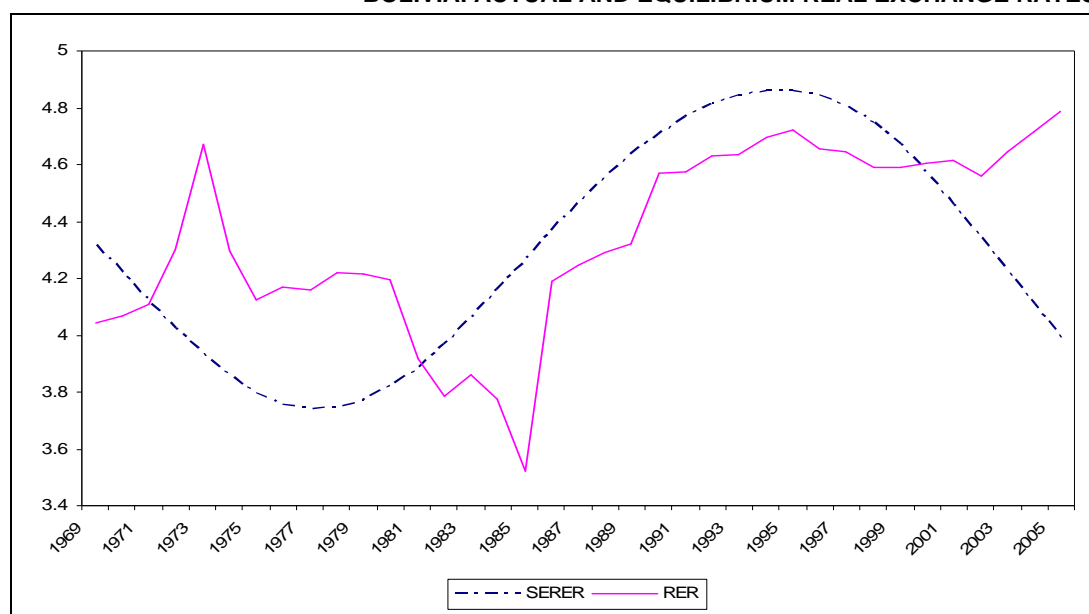**ARGENTINA: DECOMPOSITION OF SERER**

2.   Bolivia

A comparison of Bolivia's actual and estimated equilibrium real exchange rates, presented in Figure 3, reveals that the sample period is characterized by three episodes: substantial undervaluation during the decade of the 1970s, a sustained overvaluation from 1981 to 2000, and renewed undervaluation since then. The 1984-85 hyperinflation episode resulted in a severe overvaluation of the peso, which was only partially rectified through the adoption of a floating exchange rate that accompanied the 1985 stabilization. The upshot is that the real exchange rate has spent prolonged periods away from its sustainable value in Bolivia.

Figure 4 provides a decomposition of Bolivia's long-run equilibrium real exchange rate. As indicated in Table 1, the cointegrating equation for Bolivia includes both relative productivity levels as well as the terms of trade. However, most of the variation in Bolivia's LRER can be attributed to changes in productivity. Bolivia's relative productivity performance deteriorated sharply from 1975 to about 1992, fluctuated around a constant value until 1999, and then improved strongly subsequently. This results in a steady depreciation of the long-run equilibrium real exchange rate from 1975 until the mid-1990s, followed by a gradual appreciation subsequently. This temporal pattern is not greatly altered by fluctuations in the terms of trade. Though the country's terms of trade deteriorated continuously from 1978 to about 1997, and then recovered subsequently, the estimated impact of terms of trade changes on Bolivia's equilibrium real exchange rate is rather small, so the effects of the terms of trade on the evolution of competitiveness in Bolivia during the sample period has been small as well.

Notice that the SERER has been appreciating in Bolivia over the course of the past decade. However, since the results above suggest that this appreciation has been driven primarily by
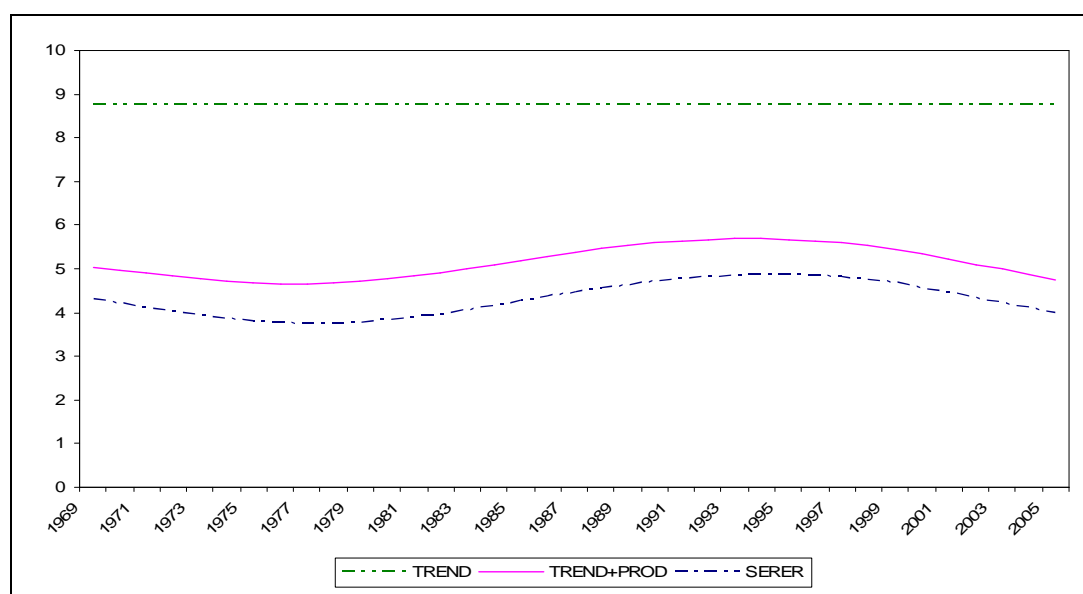
improvements in relative productivity performance, they indicate that the competitiveness of nontraditional export activities has been improving in Bolivia during recent years.

Figures 3
BOLIVIA: ACTUAL AND EQUILIBRIUM REAL EXCHANGE RATES

Source: Author.

Figure 4
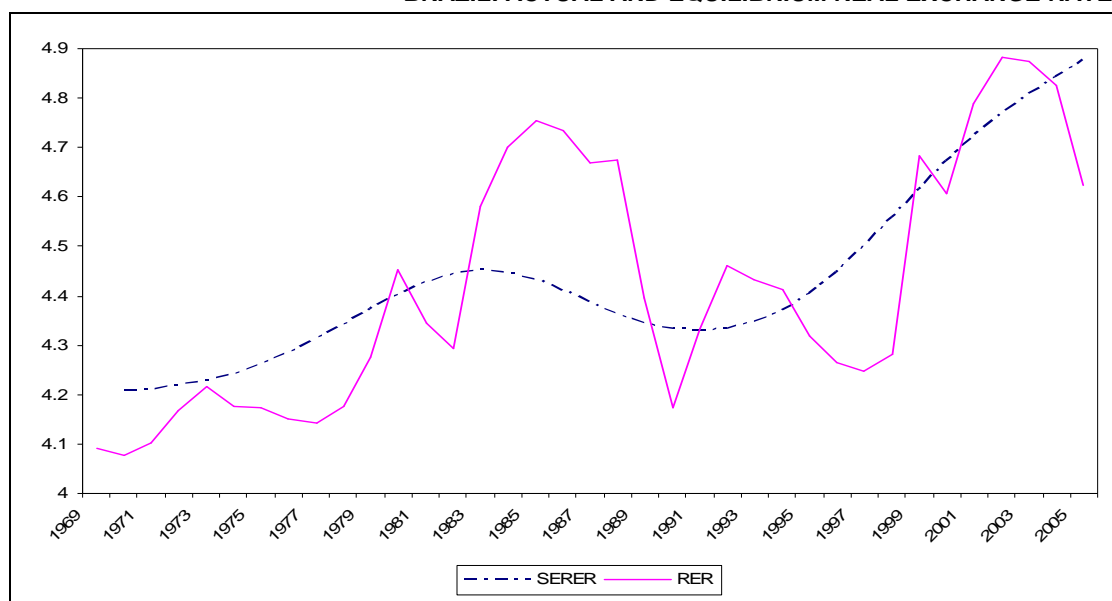**BOLIVIA: DECOMPOSITION OF SERER**

Source: Author.

3. Brazil

Brazil's SERER has been on a strongly depreciating trend over the past 15 years. Its actual real exchange rate has followed this trend, albeit with strong fluctuations around it (Figure 5). An

episode of severe undervaluation is evident during the mid-1980s, and of severe overvaluation in 1998. The estimated overvaluation on the eve of Brazil's January 1999 crisis is 24 percent, a magnitude that is surprisingly close to that of estimated overvaluation in Argentina three years later. In contrast with Argentina, however, the depreciation that followed the crisis in Brazil did not substantially overshoot the equilibrium rate. Mild undervaluation (in the vicinity of 10 percent) emerged in Brazil only three years after the crisis, and again in contrast with Argentina, this situation has been reversed rather dramatically since then. The 23 percent appreciation that Brazil's real exchange rate underwent from 2002 to 2005 has not been matched by a similar movement in the SERER, implying that by 2005 the *real* has become overvalued by an estimated 24 percent, similar to the degree of overvaluation estimated for 1998.

To what extent does the depreciation of Brazil's SERER during recent years indicate an improvement in competitiveness in its traded goods sector? Unfortunately, the answer is that it would be easy to be overly optimistic on this score. The evolution over time of the long-run equilibrium real exchange rate in Brazil has been influenced by the country's relative productivity performance *vis a vis* its trading partners, as well as by its net international investment position, the effects of which have been superimposed on a mild (unexplained) depreciating trend. Figure 6 decomposes the evolution of the SERER into the contributions of each of these factors. Brazil's relative productivity performance has experienced a trend deterioration since 1980, with productivity per worker falling from about 46 percent to about 32 percent of that of its trading partners over that time. As is evident from Figure 6, this has contributed a strong depreciating trend to the SERER over that time. However, this component of the depreciation, because it has arisen in response to a decline in relative productivity, has not contributed to an improvement in competitiveness. Indeed, we would expect exactly the opposite. On the other hand, the evolution of the country's international investment position has also contributed to a depreciating trend in the SERER, though this effect emerged more recently (only since about 1993), since Brazil's net external position actually improved from 1983 to 1992. Combining these factors leaves us unable to determine the net effect on the country's nontraditional traded goods sector's competitiveness.

Figure 5
BRAZIL: ACTUAL AND EQUILIBRIUM REAL EXCHANGE RATE

Source: Author.

4.   Chile

As shown in Figure 7, Chile's actual real exchange rate experience over the past two decades differs markedly from that of the other countries examined so far. In particular:

The period shows no episodes of serious overvaluation. The largest single such episode identified over the period, in 1997, was associated with an estimated overvaluation of a little over 7 percent.

The country also sustained an extended period of mild undervaluation from 1985 to 1995, a decade that saw rapid expansion in the Chilean economy and, as already indicated, significant productivity gains relative to the country's trading partners.

Overall, from 1985 to 2004, there were only four years in which the Chilean peso is estimated to have been overvalued (1996 to 1999), and during this time the estimated average degree of overvaluation amounted to less than 4 percent. The picture that emerges is that over two decades, the Chilean peso has remained very close to, but generally slightly more depreciated than, its long-run equilibrium level. However, as in the case of Brazil, there is no sign that the recent real appreciation of the peso during 2004-05 represents an equilibrium phenomenon. By the end of the sample period, the peso is estimated to be overvalued by a little under 5 percent.

Chile's sustainable equilibrium real exchange rate appears to have been driven primarily by productivity developments during the sample period.   These developments have been rather dramatic. From 1985 to 2003, labor productivity in Chile increased from 44 percent of the trade-weighted average of that of its trading partners to 74 percent. The equilibrium real appreciation associated with these productivity gains tempered the effects of a trend depreciation of unidentified source (Figure 7), causing the SERER to remain relatively stable from the late 1980s to 2005.

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Overall, then, the effects of the identified fundamentals in Chile's case are consistent with an improvement in competitiveness in the production of nontraditional traded goods. Coupled with the relative absence of episodes of misalignment in the last part of the period, this suggests that the country has created a propitious environment for investment in tradables production.[17]

Figure 7
CHILE: ACTUAL AND EQUILIBRIUM REAL EXCHANGE RATES
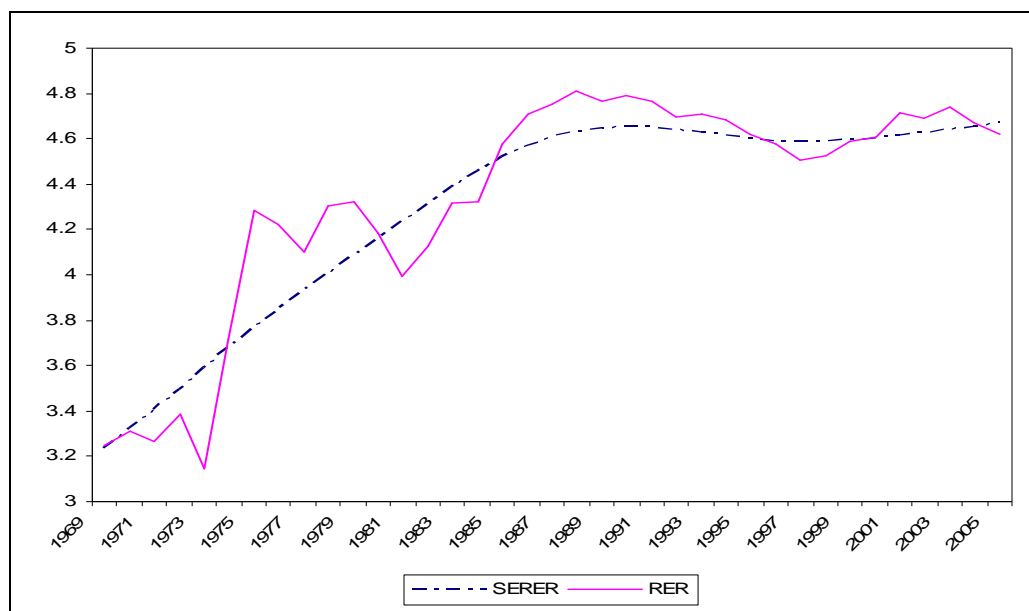
Source: Author.

Figure 8
CHILE: DECOMPOSITION OF SERER
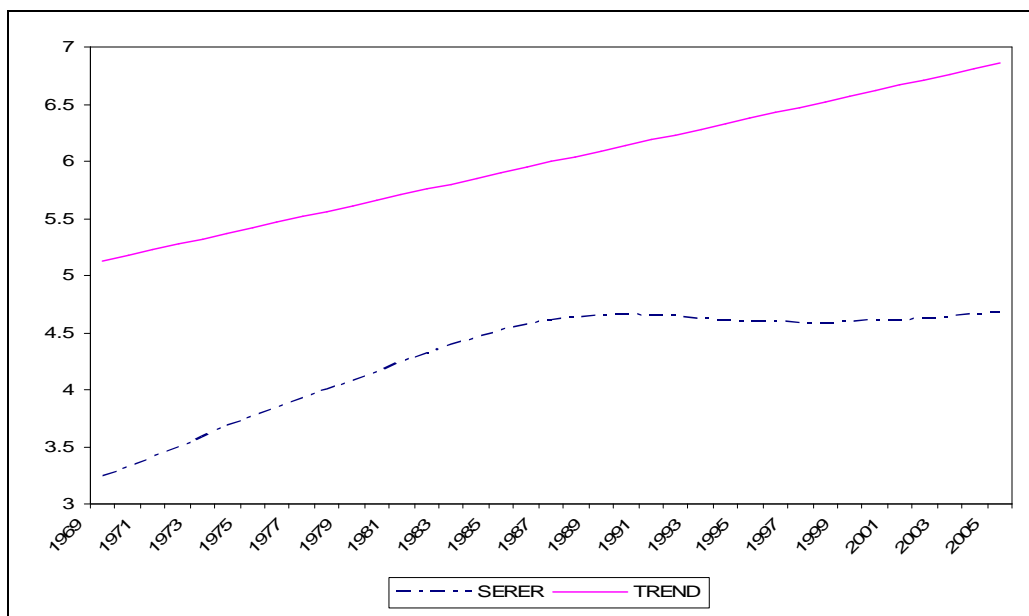
Source: Author.

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[17] This conclusion is consistent with the detailed analysis of Chilean competitiveness in Guerguil and Kaufman (1998).

5. Paraguay

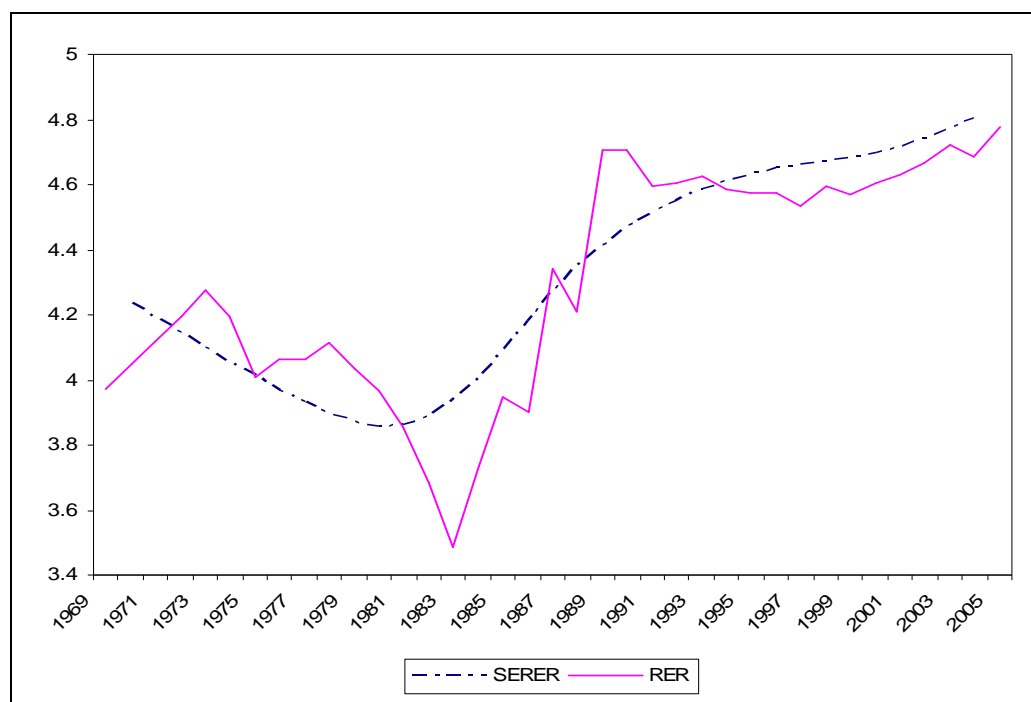Paraguay's actual and sustainable equilibrium real exchange rates are plotted together in Figure 9. Overall, as in Chile, the actual rate has tracked the equilibrium rate fairly closely over most of the sample period, at least over the past two decades. There was a substantial episode of overvaluation in 1983, when the currency was overvalued by an estimated 36 percent, resulting both from a continuation of the appreciation of the actual real exchange rate that had begun five years earlier and the initiation of a period of depreciation of the equilibrium rate (described below). Like Chile, Paraguay has seen its actual real exchange rate track the equilibrium rate fairly closely for an extended period of time in the recent past. Indeed, the maximum deviation of the actual from the equilibrium rate over the 1993-2004 period is estimated to be around 11 percent. However, unlike Chile, this period has been characterized by continuous overvaluation, rather than undervaluation.]

Figure 9
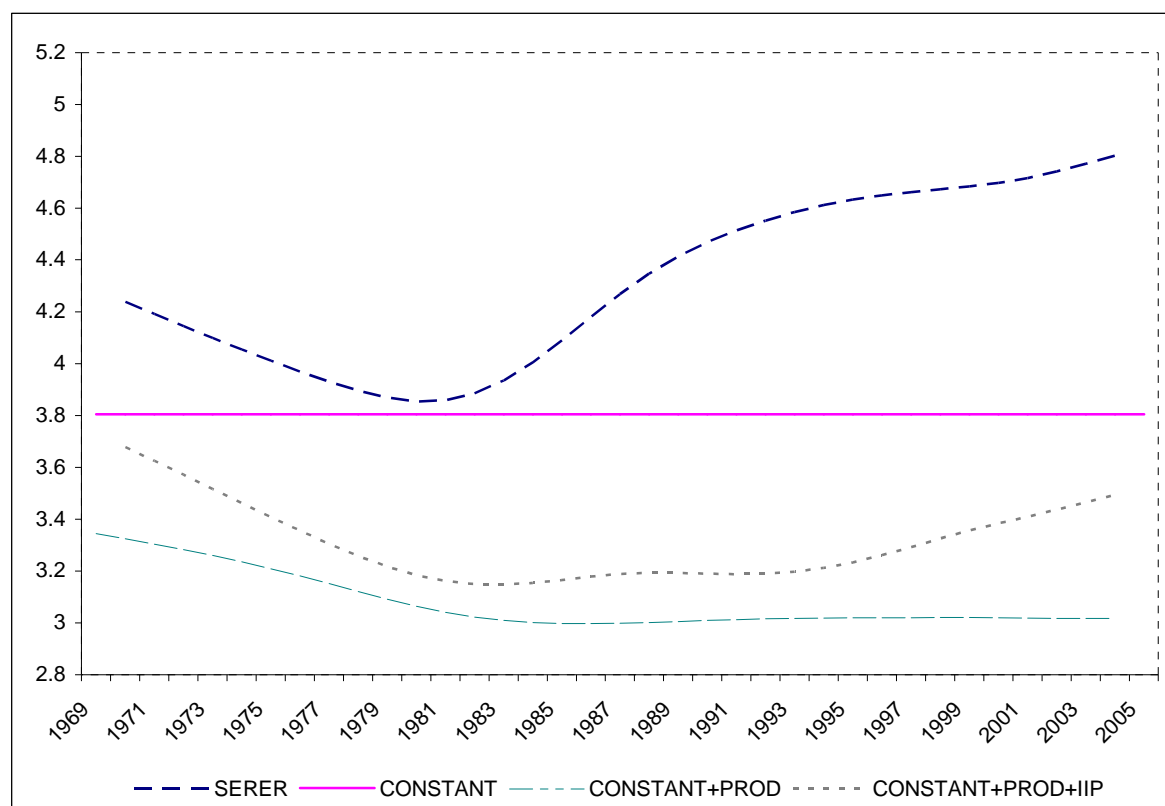**PARAGUAY: ACTUAL AND EQUILIBRIUM REAL EXCHANGE RATES**

Source: Author.

Paraguay's sustainable equilibrium real exchange rate has been depreciating continuously since 1980 (Figure 10). The key fundamentals accounting for this pattern have been the evolution of relative labor productivity, of the country's international investment position, and of its commercial openness (Table 1). Paraguay's relative labor productivity increased dramatically from the beginning of the sample until 1980. Since that time, it has been fluctuating around a very mildly decreasing trend. Consequently, as shown in Figure 10 (where the contribution of PROD to the evolution of the SERER is measured by the gap between CONSTANT and CONSTANT + PROD), this factor contributed to an appreciation of the SERER until the early 1980s, and since that time has essentially had no effect on variations in the SERER. The country's international investment position was on a gradually improving trend until roughly 1980, and since that time has gradually deteriorated, accounting for part of the depreciation of the SERER, especially since 1992 (shown by the gap between CONSTANT + PROD and CONSTANT + PROD + IIP). But by far

the most important factor accounting for the strong depreciation in Paraguay's SERER has been a very substantial increase in the country's degree of commercial openness, measured as the ratio of exports plus imports to GDP. This ratio more than doubled (from slightly over 30 percent of GDP to over 70 percent of GDP) from 1969-83 to 1988-2004. The combination of the roles of the international position and commercial openness with a neutral role for productivity developments in recent years indicates improved competitiveness in the traded goods sector over that time.

Figure 10
PARAGUAY: DECOMPOSITION OF SERER

6.   Uruguay

Uruguay's sustainable equilibrium real exchange rate has exhibited the least variation of that of any of the countries examined (Figure 11). It depreciated slightly during the first half of the 1980s, appreciated mildly over the decade 1985-95, and has depreciated more strongly ever since. As in the case of the other countries, however, the actual real exchange rate has fluctuated sharply around the SERER, with major episodes of overvaluation in 1980-82 and 1999-2001, peaking at 36 percent and 28 percent respectively. Both periods, of course, were associated with serious exchange rate crises. Undervaluation was prevalent during the 1970s, and during the decade after 1982. it is worth noting that, though the evolution of Uruguay's actual real exchange rate since the early 1990s has closely mirrored that of its major trading partner Argentina, its SERER has not. In particular, the relatively strong depreciation of Uruguay's SERER since 1995 does not have a counterpart in Argentina. Thus, though the real exchange rate depreciation associated with the 2001-02 crisis resulted in overshooting in Argentina, it did not do so in Uruguay. Instead, the crisis moved the Uruguayan real exchange rate to the vicinity of the SERER, and by 2005 it remained there.

The fundamentals driving the time path of the SERER in Uruguay are the country's relative productivity performance and its terms of trade, with the latter playing by far the larger role over the 1969-2005 sample period. The relative stability of the SERER reflects the fact that neither of these variables underwent large changes over the sample period. Uruguay's relative productivity was about half that of its trading partners in 1969, and was still at about 54 percent of that of its trading partners by 2003, giving up the substantial gains achieved during the early 1990s. The country's terms of trade were fairly stable after 1980, but have deteriorated by some 13 percent since 1998.

Given the stable relative productivity performance, effects on the competitiveness of the nontraditional traded goods sector during recent years have been driven by the terms of trade. As in Argentina, the terms of trade in Uruguay respond primarily to fluctuations in the prices of traditional commodity exports. Thus, the recent deterioration in the country's terms of trade suggests an improvement in competitiveness for nontraditional tradable activity during recent years (1998-2005).

Figures 11
URUGUAY: ACTUAL AND EQUILIBRIUM REAL EXCHANGE RATES

Source: Author.

Figure 12
URUGUAY: DECOMPOSITION OF SERER
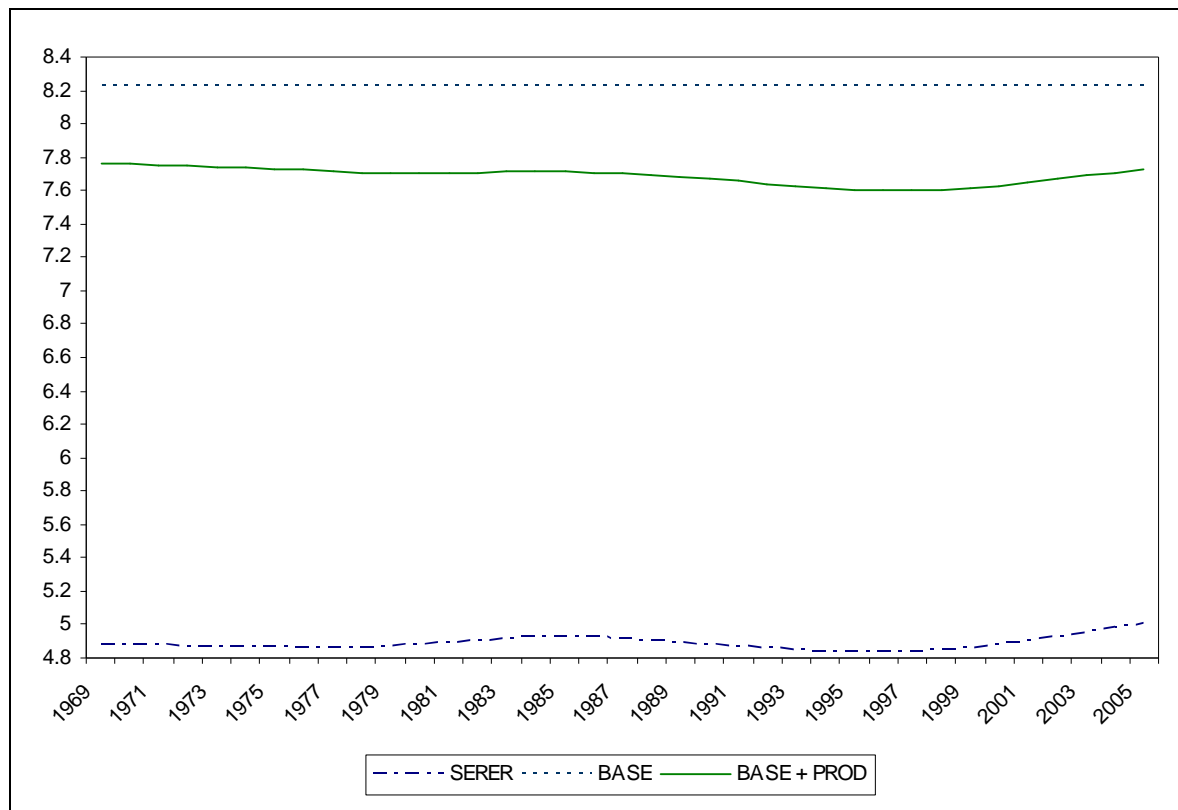
Source: Author.

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Appendix: Data Definitions and Sources

RER: Real effective exchange rate. Annualized value of monthly trade-weighted, CPI-based real exchange rate. Values from 1969 to 2005 provided by the United Nations Economic Commission for Latin America and the Caribbean (ECLAC).

PROD: Relative average labor productivity. Ratio of trade-weighted chained real (PPP converted) GDP (in 1996 prices) per worker to domestic chained real GDP per worker. The raw data are from the Penn World Tables, version 6.1 (Heston, Summers, and Aten 2006). The trade weights are the same as those used for the RER calculation, and were provided by ECLAC.

LTOT: Log of the terms of trade. Terms of trade calculated as ratio of export unit values to import unit values, using 2000 as base year. Data for Brazil, Chile, Paraguay, and Uruguay are from the IMF's International Financial Statistics, lines 74 and 75. Data for Argentina were provided by ECLAC.

IIP: International investment position (ratio to GDP). All data taken from Lane and Milessi-Ferretti (2006).

GOVCON: Ratio of government consumption to GDP. For all countries but Argentina, the government consumption data are from *IFS*, line 91, while the GDP data are from *IFS*, line 99b. Data for Argentina were taken from the Penn World Tables, version 6.1(Heston, Summers, and Aten 2006).

OPEN: Ratio of exports of goods and services plus imports of goods and services to GDP. Data are from *IFS*, lines 90c, 98c, and 99b.

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