OECD Economics Department Working Papers No. 396

The Impact of Exchange Rate Regimes on Real Exchange Rates in South America, 1990-2002

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https://dx.doi.org/10.1787/256327408747

OECD

Unclassified **ECO/WKP(2004)19**

Organisation de Coopération et de Développement Economiques
Organisation for Economic Co-operation and Development **30-Jun-2004**

English - Or. English

ECONOMICS DEPARTMENT

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Unclassified

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JT00167022

English - Or. English

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ABSTRACT/RÉSUMÉ

The impact of exchange rate regimes on real exchange rates in South America, 1990-2002

This paper analyses the impact of exchange rate regimes on real exchange rates, as defined by the relative price of nontradables to tradables in Argentina, Brazil, Chile (ABC) and Mexico from 1990 to 2002. The real exchange rate is determined in the long-run by the Balassa-Samuelson effect, but in the medium run also by government expenditure and terms of trade. Another determinant is fixed exchange rate regimes, which force exporters to adjust their local price of tradables. Moreover, fixed regimes attract portfolio inflows that increase demand and prices for nontradables. The econometric results of the paper confirm the impact of exchange rate regimes on relative prices in all countries except Chile, which maintained exchange rate flexibly and adopted capital controls.

Keywords: exchange rate policy, real exchange rates, Latin America
JEL classification: E52, N16

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L'impact des régimes de change sur le taux de change réel en Amérique latine, 1990-2002

Cet article analyse l'impact des régimes de change sur le taux de change réel- défini comme le prix relatif des biens du secteur abrité et des biens du secteur exposé- en Argentine, Brésil, Chili (ABC) et au Mexique de 1990 à 2002. Le taux de change réel est déterminé dans le long terme par l'effet Balassa-Samuelson et à moyen terme par les dépenses du gouvernement et les termes de l'échange. Les régimes de change fixes peuvent constituer un nouveau déterminant car ils forcent les exportateurs à geler le prix local des biens échangeables. Simultanément ils attirent des flux de portefeuille qui exercent une pression à la hausse sur la demande et donc les prix des biens abrités. Les résultats économétriques de l'article confirment l'impact des régimes de change sur les prix relatifs de tous les pays sauf le Chili qui a maintenu une flexibilité de change et imposé des contrôles de capitaux.

Mots clés: politique de change, taux de change réels, Amérique latine
Classifications JEL: E52, N16

THE IMPACT OF EXCHANGE RATE REGIMES ON REAL EXCHANGE RATES IN SOUTH AMERICA, 1990-2002

by Anne-Laure Baldi (University of Paris-X) and Nanno Mulder (OECD)[1,2]

1. Introduction

1. The real exchange rate, defined as the relative price of nontradables (P_n) to tradables (P_t),[3] is a key driver of domestic resource allocation and international competitiveness. A fall in this ratio indicates that production in tradables is likely to be more profitable that in nontradables, and provides as such an incentive for resources to move from the latter to the former sector. The real exchange rate is also a proxy of international competitiveness: given the relative prices in the rest of the world, an increase in the relative price means that a country now produces tradable goods in a relatively less efficient way (compared to the rest of the world) than before (supposing price indices fully capture quality changes). The interpretation of a fall in the relative price of tradables or real depreciation is symmetrical (Edwards, 1989).

2. Although the real exchange rate follows an equilibrium upward trend in the long run due to the Balassa-Samuelson (BS) effect,[4] it may deviate from this trend in the short and medium run due to other factors. These include government expenditure and terms of trade. For example, an increase in government expenditure on mostly nontradables will increase their price and correspondingly the (P_n/P_t) ratio will tend to increase more rapidly than due the BS effect only. A lasting 'misalignment' of relative prices may cause a non-sustainable reallocation of resources from the tradable to nontradable sector.

3. The novelty of this paper is that it adds another factor that causes deviations of the real exchange rate from its 'equilibrium trend', *i.e.* is fixed exchange rate regimes. These regimes have two effects. First, they force countries that are international price takers to adjust their local price of tradables to ensure price equalisation between them and their trading partners. Second, in countries with liberalised capital accounts, fixed regimes are often associated with high interest rates which attract large amounts of capital inflows

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2. We are grateful for comments from Joaquim Oliveira Martins, Romain Duval, Sabrina Lucatelli and Silvana Malle. We also thank the participants of seminars in Santiago (ECLAC, Banco Central), Buenos Aires (IADB-INTAL) and Rio de Janeiro (IPEA), and in particular Pablo Garcia, Daniel Heymann and Elcyon Caiado Rocha Lima. Thomas Chalaux provided an excellent contribution to the econometrics and Anne Legendre very competent research assistance. The views expressed are those of the authors and do not necessarily reflect those of the OECD or its member countries.

3. The common definition of real exchange rate is (in logarithms) $q = e + p - p^*$, with e, p and p^* being the exchange rate, and the domestic and foreign *total economy* price levels respectively. This equation can be decomposed in two parts: $q = q_e + \alpha[(p_t - p_n) - (p_t^* - p_n^*)]$ with α being the share of the nontradable sector in GDP. $q_e = e + p_t - p_t^*$ is the real exchange rate in the tradable sector, and $[(p_t - p_n) - (p_t^* - p_n^*)]$ the difference between the tradable and nontradable price differentials of two countries. Assuming the law of one price in the tradable sector, a constant share on nontradables in GDP, and a 'given' foreign price differential between tradables and nontradables, the real exchange rate becomes $q = p_t - p_n$.

4. Note that this result also depends on the wage equalisation across sectors and the fact that productivity increases in tradable sector are typically higher in the less developed countries.

that raise final consumption. As nontradables are less elastic in supply than tradables, the price of nontradables will rise relative to that of tradables.

4. The role of each of these real exchange rate determinants is assessed here for Argentina, Brazil and Chile (ABC) and Mexico from 1990 to 2002, during which very different exchange rate regimes prevailed. Argentina introduced a currency board in 1991, which lasted until the end of 2001. Brazil *de facto* fixed its currency to the dollar from 1994 to 1999 except for some mini-devaluations. Mexico and Chile constrained the depreciation of their currencies to a lesser extent, between 1990-94 and 1990-99 respectively. All countries changed to (almost) fully flexible regimes between 1999 and 2002. The fixed regimes strongly accelerated the increase in relative prices, in particular in Argentina and Brazil after these countries fixed their currencies, in 1991 and 1994 respectively. The increase in relative prices also accelerated during the 'less than flexible' regimes in Chile and Mexico. The 'overshooting' of relative prices was corrected in all countries following the switch to a flexible exchange rate regime.

5. In these countries, fixed regimes strongly affected the allocation of resources via their impact on relative prices. In particular, they caused a 'disproportionate' increase in the share of nontradables in employment and GDP. Moreover, during the fixed-regime period the share of manufacturing in the tradable sector fell.

6. The paper is organised as follows. We first present trends in the real exchange rate and the composition of employment and GDP in terms of tradables and nontradables in ABC and Mexico. Then the theoretical literature is reviewed on the main determinants of relative prices, focusing on Balassa-Samuelson, its extensions. Subsequently the role of fixed exchange rate regime is discussed. Finally, the relative impact of each determinant on the real exchange rate trends is assessed for ABC and Mexico for the period 1990-2002 using econometric analysis.[5]

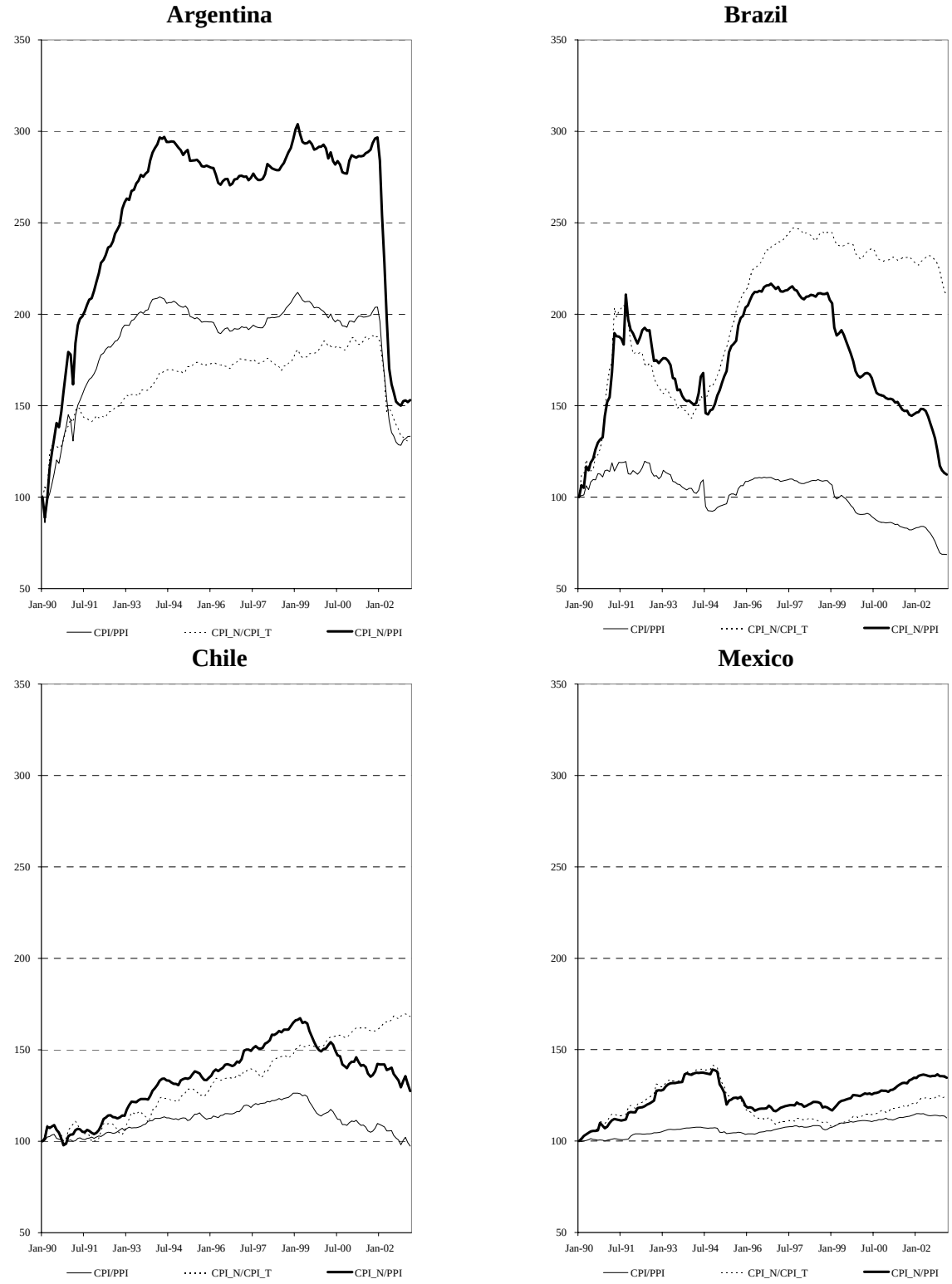
2. Large Swings in the real exchange rates in ABC and Mexico

7. Trends in real exchange rates (*i.e.* the price ratio of nontradables to tradables, P_n/P_t), using three definitions, are shown in Figure 1 for ABC and Mexico for 1990-2002. These three definitions are (see also Box 1): (a) the consumer price index (CPI) for nontradables and the wholesale (producer) price index (WPI or PPI) for tradables; (b) the nontradable and tradable categories of the CPI (Barros and Barbosa, 2002a, 2002b); and (c) the nontradable items of the CPI for nontradables and the PPI for tradables.

8. The three definitions yield almost the same results, except for the ratio of the tradable components to the nontradable components of the CPI. This is because the numerator is a poor proxy of tradable prices (see Box 1). Our 'preferred' ratio is the third that resembles mostly closely the prices of the tradable and nontradable goods and services. For Chile and Mexico, a rise in relative prices can be observed during 1990-2002 corresponding to the BS effect. In Argentina and Brazil, this is not clear as there were large relative price swings.

5. In the paper, the real exchange rate and relative price of nontradables to tradables are used interchangeably, having the same meaning.

Figure 1: Ratio of Price Indices of Nontradables to Tradables (January 1990=100)



CPI_T = CPI index for tradables; CPI_N = CPI index for nontradables.

Sources: CPI and PPI indices from national statistical offices (INDEC, IBGE, INE and INEGI).

9. The 'overshooting' of relative prices seems to be associated with the introduction of fixed exchange rate regimes. The exchange rate regimes are classified here using a score ranging from 2 (fully flexible) to 5 (totally fixed), see Levy-Yeyati and Sturzenegger (2002).[6] Fixed regimes were introduced in the 1990s varying from a currency board in Argentina (1991-2001) to a crawling peg in Brazil (1990-98) and Mexico (1990-95) (see Table 1). Although Chile also had officially a crawling peg from 1990 to 1998, in practice it was an almost flexible regime as the central parity was regularly adjusted to market conditions. All countries switched to mostly free floats between 1995 (Mexico) and 2002 (Argentina).

Table 1: Exchange rate regimes in Argentina, Brazil, Chile and Mexico from 1990 – 2002

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Argentine	3	3	5	5	5	5	5	5	5	5	5	5	2
Brazil	3	4	4	4	5	5	4	4	5	2	2	2	2
Chile	2	4	2	2	2	2	2	2	2	2	2	2	2
Mexico	3	5	5	5	5	3	3	2	2	2	2	2	2

1 = inconclusive; 2 = float; 3 = dirty; 4 = dirty/crawling peg; 5 = fix

Source: Levy-Yeyati and Sturzenegger (2002), with minor adjustments and data completed for 2002.

10. The price ratio of tradables to nontradables determines in large part the allocation of resources between the two sectors. The rise of this price ratio in the course of economic development, due to the BS effect, increases the share of the nontradable sector (public utilities, construction and services) in the economy. This equilibrium trend is accentuated by the growing share of nontradables in final demand (Engel's law) as per capita income rises.

6. In contrast to the "official" exchange rate regime classification, Levy-Yeyati *et al*. (2002) propose a *de facto* classification that reflects the actual regimes in place. They record regimes according to the behaviour of three variables: changes in the nominal exchange rate, the volatility of these changes, and the volatility of international reserves. These are the key variables of the textbook definition of exchange rate regimes. Fixed exchange rate regimes are associated with substantial changes in international reserves aimed at reducing the volatility in the nominal exchange rate. Alternatively flexible regimes are characterised by substantial volatility in nominal rates with relatively stable reserves.

Box 1. The distinction between tradables and nontradables

Separating tradables from nontradables is of key importance in the literature on domestic price structures and real exchange rates. In principle, only few commodities can be classified as purely nontradable. Most commodities are traded between at least some countries, with transportation costs of goods, the service provider or consumer determining the degree of tradability. Nevertheless, the characteristics of some commodities make them inherently more or less tradable. Lacking a theoretical definition of tradability, many authors have looked instead to the extent to which commodities *are* actually traded. Most empirical studies, including the pioneering articles by Balassa (1964) and Samuelson (1964), used a shortcut and labelled manufactures as tradables and services as nontradables. Others (for example Canzoneri, *et al*. 1996, Ito *et al*. 1999) added mining products to tradables.

No consensus exists on whether to include agricultural products in tradables. Strauss (1999), focusing on OECD countries, explicitly excluded them as *de facto* they are largely non-traded due to high protection by these countries. Motonishi (2002) excluded agriculture for another reason, as it is land-intensive and does not conform the hypotheses of the Balassa-Samuelson model. Other studies, covering a wider group of countries, included agricultural products in tradables without justification.

Most authors defined nontradables as construction and services. Motonishi (2002) excluded finance and insurance and de Gregorio *et al*. (1994) transport from the nontradable category as data for OECD countries show they are internationally traded.

Other authors use as a shortcut for tradables and nontradables the items included in the wholesale (producer) and consumer price indices respectively. The former is a relatively good proxy for tradedables as it includes essentially traded goods from agriculture, forestry, and fishing, mining, manufacturing and public utilities.[1] The only drawback is that it excludes traded services. At present several countries are extending the coverage of the PPI to services. The CPI is not as good as a proxy for nontradables, as it includes both traded and nontraded items of final expenditure. Moreover, the CPI only covers implicitly the prices of intermediate (nontraded) services via their margins in mostly final expenditure prices of goods. The CPI is also affected by prices of imported goods and services and taxes and subsidies. Some authors excluded goods from the CPI to have a better proxy of nontradables.

Few authors have based the tradables-nontradables distinction on empirical data. One example is de Gregorio *et al.* (1994), who classified commodities as tradables if at least 10 per cent of domestic production was exported. Using this cut-off point for 14 OECD countries, all manufacturing branches were part of tradables, while all services except transport were part of nontradables.

1. See draft of Producer Price Manual developed under the auspices of the IMF (http://www.imf.org/external/np/sta/tegppi/ch12.pdf).

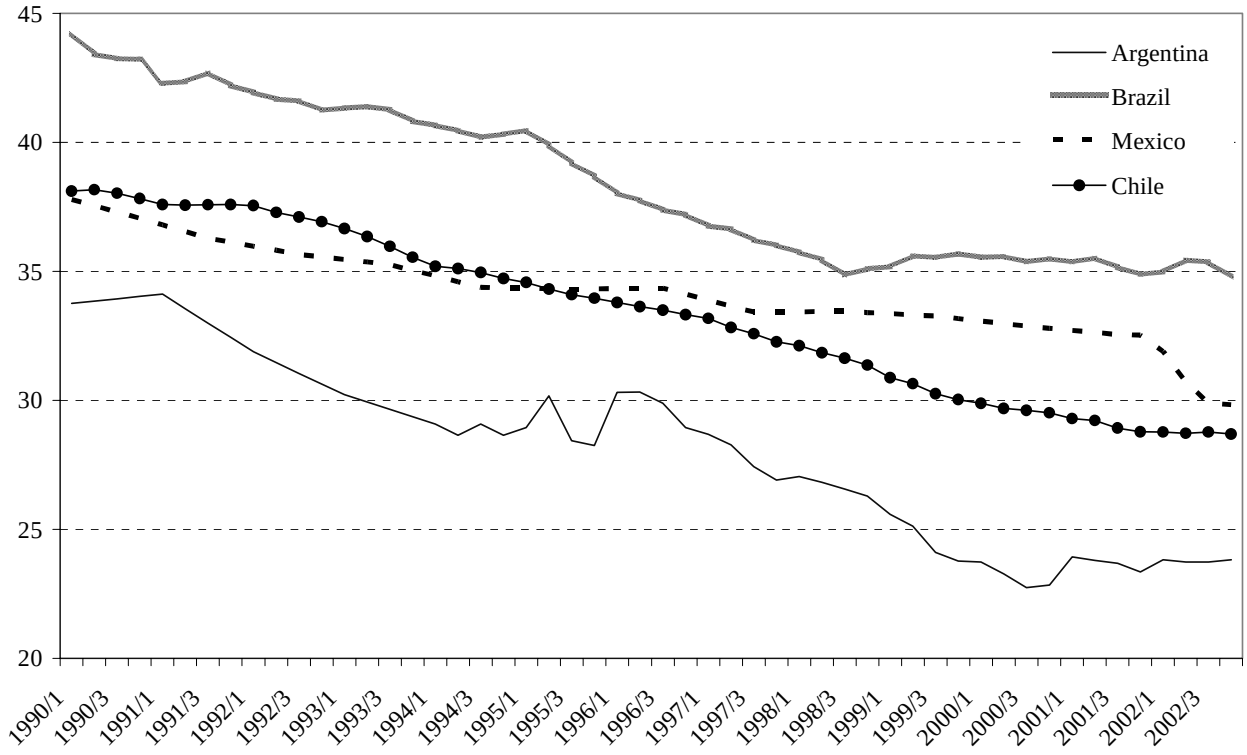
Table 2: Contribution of Tradables and Nontradables to Employment and GDP Growth, (annual average growth rates, 1990-2002)

		Exchange rate regime	Employment			GDP		
			Total	Tradables	Nontradables	Total	Tradables	Nontradables
Argentina	1991-2001	Fixed	1.4	-2.3	3.1	2.6	1.6	3.1
	2002	Flexible	-9.2	-8.9	-9.3	-10.9	-7.9	-10.6
Brazil	1990-93	Flexible	0.7	-1.1	2.0	2.0	3.8	0.7
	1994-98	Fixed	0.2	-3.1	2.3	2.6	3.2	1.9
	1999-2002	Flexible	2.0	1.7	2.2	2.4	1.9	2.4
Chile	1990-98	Fixed	2.4	0.1	3.7	7.6	4.5	7.1
	1999-2002	Flexible	0.5	-1.5	1.3	3.1	3.4	2.5
Mexico	1990-94	Fixed	2.1	0.1	3.2	3.5	2.6	4.2
	1995-2002	Flexible	2.1	0.4	2.9	3.9	3.8	3.2

Note: regimes are classified as "fixed" (scores 4-5) and "flexible" (scores 2-3) according to scores in Table 1.

Sources: national accounts, see Annex II.

Figure 2: Share (%) of tradable sector in employment, 1990-2002



11. However, in the short and medium run labour and investment incentives and in turn growth in each sector are also affected by the other factors outlined above, in particular the fixed trade regimes (Table 2 and Figure 2). For example, employment in the nontradable sector increased most rapidly during periods of fixed exchange rate regimes: Argentina (entire decade of 1990s), Brazil (1994-98) and Mexico (1990-95). The change to more flexible regimes seems to have levelled off the growth of the share of nontradables in employment, in particular for Brazil after 1998 and Mexico after 1995 (see Figure 2). The 'misalignment' of relative prices had a smaller impact on the composition of GDP. During the 'fixed' regime periods in Argentina (1991-2001), Chile (1990-99) and Mexico (1990-95), the nontradable share in GDP increased around one percentage point (Figure 3). During the periods with flexible regimes in Chile and in particular Mexico, the nontradable share fell. The exchange rate regimes, via their impact on relative prices, also altered the composition of the tradable sector (see Figure 4). Although the share of agriculture and mining seems mostly unaffected by exchange rate regimes, the size of manufacturing was negatively (positively) affected by fixed (flexible) regimes.

Figure 3: Share (%) of tradable sector in real GDP, 1990-2002

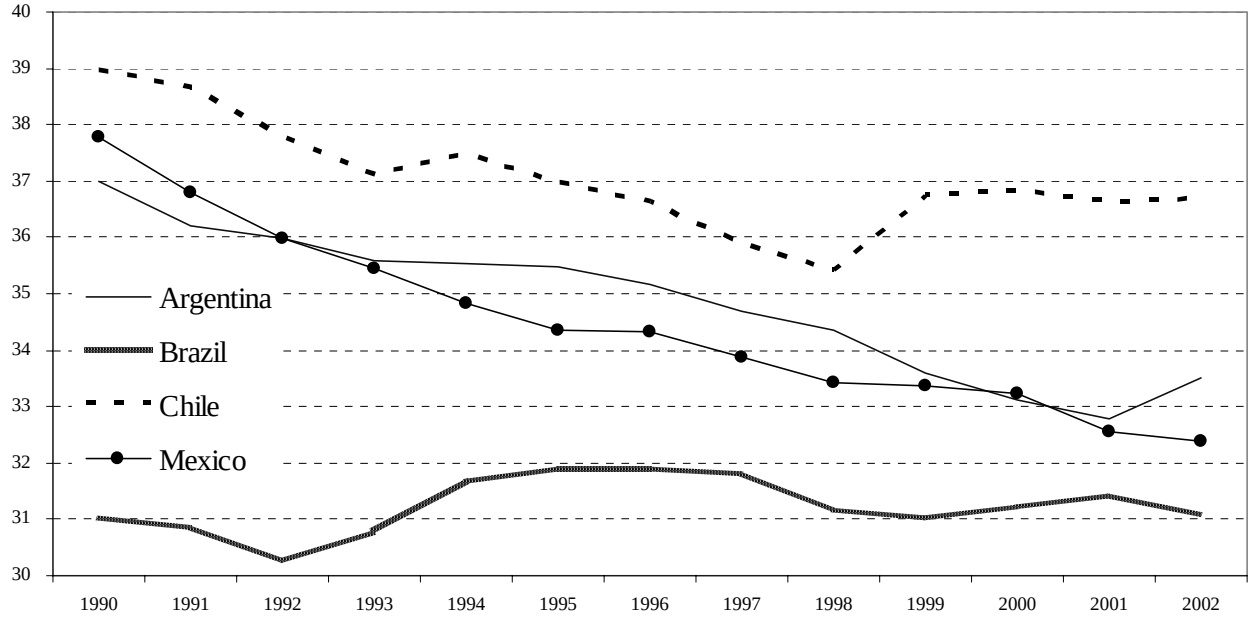
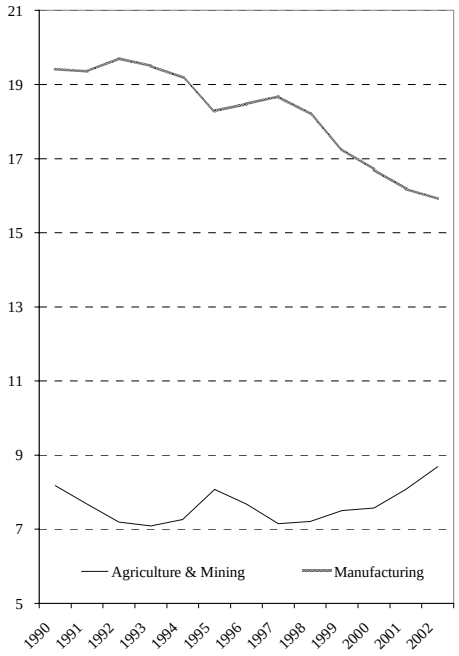
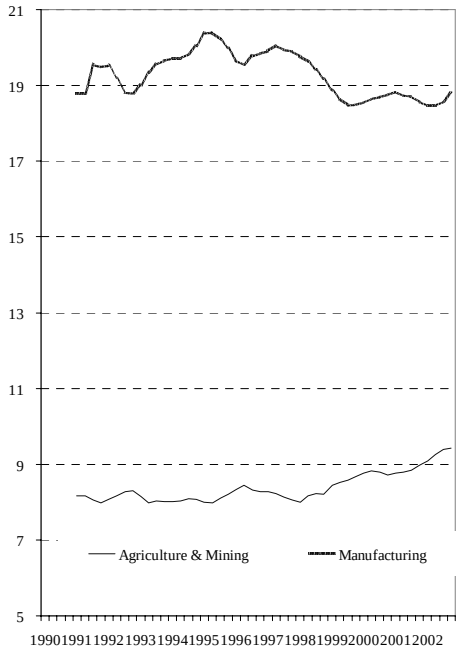


Figure 4: Share of Tradable Sectors in Real GDP, 1990-2002

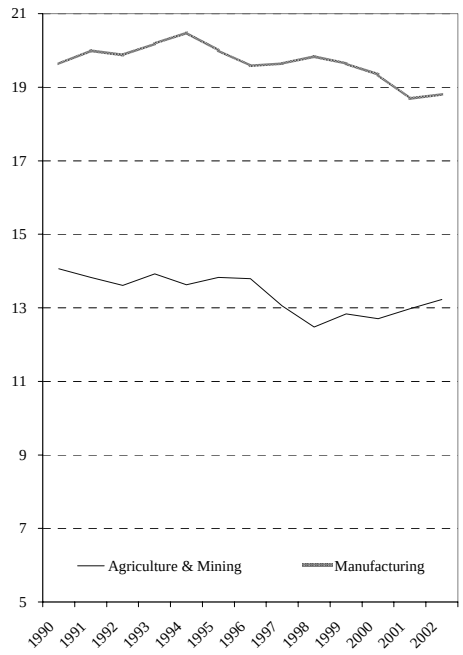
Argentina



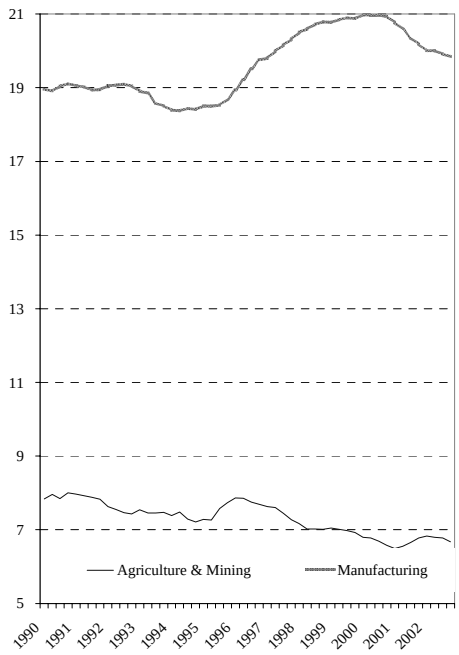
Brazil



Chile



Mexico



3. Explaining relative prices: Balassa-Samuelson and extensions

12. The continuous rise of the real exchange rate (P_n/P_t) in the process of economic development is a much studied phenomenon in the economic literature, starting in particular with two seminal articles by Balassa and Samuelson in 1964 (see Annex I for more details). The BS model is a traditional two-country, two-commodity Ricardian trade model amended to include nontradable goods. In the BS framework, productivity in the tradable sector, given factor price equalisation, determines the price of nontradables. Economies with higher productivity levels in tradables will have higher wages and thus higher prices of nontradables. The BS model can be summarised by the following equation (in log-terms):

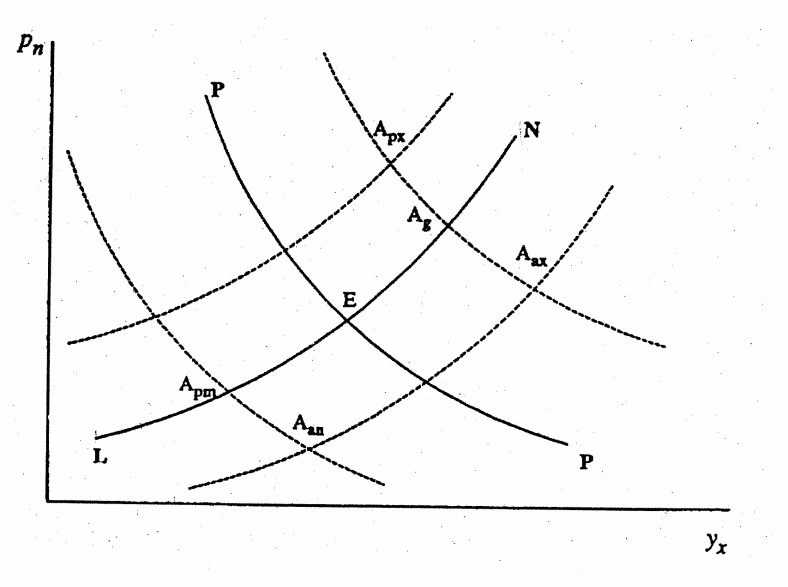
$$p_n - p_t = p_n = (\frac{\theta_n}{\theta_t})a_t - a_n \qquad (1)$$

with p denoting prices, a multifactor productivity, θ capital intensity or capital share in value added, and the subscripts t and n the tradable and nontradable sectors. In the standard BS model, P_n/P_t is determined only by the supply side. If both sectors have equal capital intensities ($\theta_t = \theta_n$), then P_n is determined by the productivity differential between the tradable and nontradable sectors only. The relative price of the nontradables even rises when productivity increases at the same rate in both sectors (referred to as *balanced productivity growth*) if the nontradable sector is more labour intensive than the tradable sector ($\theta_n \rangle \theta_t$).

13. Demand factors also play a role in determining the relative price if not all of the three basic assumptions of the standard BS model are fulfilled: perfect domestic inter-sectoral mobility of production factors, perfect competition and perfect international capital mobility.

14. The BS model can be extended with demand variables, see Annex I (based on Gregorio and Wolf, 1994). This model can be used to illustrate how the relative price of tradables to nontradables affects the size of the tradable sector in the economy, see Figure 5. The allocation of resources between tradables and nontradables is determined by relative prices (equation A.7) and illustrated by the *PP* curve. It is downward sloping for the following reason. As capital is assumed internationally immobile, the production of the exportable good is subject to decreasing returns to scale. In this case wages depend not only on p_x but also on the scale of production of exportables. A fixed capital stock implies that the marginal productivity of labour falls with the level of production. In order to equalise marginal costs and the given world price, wages – and the price of nontradables – decline with the quantity of produced exportables. An increase in a_x or p_x causes an increase in wages for a given level of production of exportables, which in turn raises the price of nontradables, leading to an upward shift of the curve. In contrast, an increase in a_n reduces p_n for a given quantity of produced nontradables and wages and causes a downward shift of the *PP* curve.

Figure 5: Comparative Statics between the Goods Sector and Labour Market



Source: de Gregorio and Wolf (1994).

15. The equilibrium in the nontradables and labour market (see equation A.3) is illustrated by the NL (nontradable and labour market equilibria) curve. The upward slope represents the need for a higher price of nontradables to reduce the demand for nontradables in order to shift labour to exportables (see equation 8). This curve shifts downwards when:

a. a_x increases, as for a given level of y_x, p_n must fall to raise demand and shift the released labour to nontradables;
b. a_n increases, which also requires p_n to fall in order to increase demand;
c. the price of the imported good (p_m) rises, assuming a low elasticity of substitution, which lowers disposable income; and
d. an increase in a_n requires a reduction in p_n to increase demand.

This curve shifts upwards when:

a. p_x increases, which raises income and hence the demand for nontradables In order to clean the market supply must rise. In the situation of capital immobility supply will rise thanks to a resources shift which is possible if p_n rises; and
b. government spending g increases raising the demand for nontradable goods. It requires an increase in p_n to shift labour from exportables to nontradables.

To summarise, the price of nontradables is affected by changes in productivities, prices of exports and imports and government spending:

$$\begin{array}{lccccc} P_n = & F(a_x & a_n & p_x & P_m & g) \\ & ? & - & + & - & + \end{array}$$

A rise in p_x increases p_n and the production of tradables (y_x). A rise in a_n decreases p_n but has an ambiguous effect on the production of tradables (y_x). In contrast, an increase in a_x has an ambiguous effect on p_n but increases y_x. When p_m increases and the income effect is dominant, p_m falls.

3.3. The impact of fixed exchange rate regimes

16. This paper adds fixed exchange rate regimes to the above model. Fixed regimes affect the real exchange rate in at least two ways. Firstly, they put a downward pressure on the price of tradables. The model above assumes that the law of one price applies to the tradable sector: $p_t = p^*_t e$. This assumption is confirmed for the countries of our sample being price takers. Given the prices of a country's trading partners, international price equalisation occurs either through the nominal exchange rate or the domestic price of tradables. Under a flexible regime, the nominal exchange rate (e) ensures international price equalisation. However, with a fixed regime, the adjustment is through the domestic price of tradables (p_t). In the model, a fixed exchange rate regime puts a downward pressure on p_t, and real wages for a given level of exports, which in turn lowers the price of nontradables; that is the PP curve shifts downwards.

17. Secondly, fixed regimes put an upward pressure on the price of nontradables, in particular in countries with free entry and exit of portfolio capital. To maintain fixed regimes, countries are obliged to adopt high nominal interest rates which in turn attract large capital inflows. These often translate into an expansion of domestic credit, increasing domestic demand for tradables and nontradables. To increase the supply of nontradables, a rise of p_n is needed to shift labour from exportables to nontradables. This is represented in Figure 5 by and upward shift of the LN curve. In the new equilibrium the size of the export sector has diminished.

18. The impact of international transfers of resources linked to capital inflows in emerging countries is much analysed (Edwards 1989; Elbadawi, 1994). Following various studies, summarised in Athukorala and Rajapatirana (2003), we focus on portfolio flows and ignore other types of flows such as foreign direct investment (FDI). This is because mainly the former have an impact on prices of nontradables. FDI tends to concentrate in the traded sector. Moreover, it is less volatile than portfolio flows and therefore any possible lingering effect on the real exchange rate from surges of inflows is likely to be less important. Econometric results from Athukorala and Rajapatirana (2003), analysing the impact of capital inflows on the real exchange rate in Latin America and Asia from 1985 to 2000, also confirm the predominant impact of portfolio inflows relative to FDI.

4. Determinants of the real exchange rate in ABC and Mexico

4.1. The model

19. This section assesses the importance of the determinants of relative price of nontradables to tradables outlined above: the labour productivity differential between both sectors (*BS*), government expenditure (*GE*), terms of trade (*TOT*), and exchange rate regime dummy (*Du*)[7] and lagged portfolio inflows (*PI*).[8]

20. Stationarity tests (Augmented Dickey-Fuller, ADF, 1979) show that all series except portfolio inflows are nonstationary, *i.e.* their stochastic properties are not invariant with respect to time (see Annex II). As a consequence we test the model in a cointegrated form. An univariate test is used, according

7. The exchange rate dummy is 0 for flexible regimes (score 2-3, see Table 1) and 1 for fixed regimes (score 4-5).

8. Following Edwards (1989).

to which an equation is estimated with the ordinary least squares (OLS) procedure. Subsequently the stationarity of the residual is tested using ADF. The Engle-Yoo statistics used to interpret the ADF values confirm cointegration between the variables for all countries at the 1 per cent threshold level for Argentina and Brazil and at the 5 per cent level for Chile and Mexico.

A log-linear specification of the model is used in order to interpret the coefficients as elasticities:

$$\ln(Pn \ / P_t) = \alpha_0 \ln(BS) + \alpha_1 \ln(GE) + \alpha_2 \ln(TOT) + \alpha_3 (PI_{t-1}) + \alpha_4 Du \qquad (9)$$

As the variables are nonstationary, the possible endogeneity of the explanatory variables does not allow us to carry out standard significance tests of. Instead the Stock and Watson (1993) method[9] is used according to which three leads and three lags of the explanatory variables in difference terms are added to the OLS regression. The same method was used by Allard-Prigent *et al.* (2000) and Duval (2001). Adding the leads and lags, the following equation is tested for Argentina, Brazil, Chile and Mexico separately using quarterly data for 1990-2002 (see Table 3 for results):

$$\ln(Pn / Pt) = \alpha_0 \ln(BS) + \alpha_1 \ln(GE) + \alpha_2 \ln(TOT) + \alpha_3 PI_{t-1} + \alpha_4 Du + \sum_{i=-3}^{+3} \Phi_i \Delta BS_{t-i} + \sum_{i=-3}^{+3} \Psi_i \Delta GE_{t-i}$$
$$+ \sum_{i=-3}^{+3} \Theta_i \Delta TOT_{t-i} + \sum_{i=-3}^{+3} \Omega_i \Delta PI_{t-i} \qquad (10)$$

where $\Delta X_t = X_t - X_{t-1}$.

9. The Stock and Watson method is a robust single equation approach that corrects for regressor endogeneity by the inclusion of leads and lags of first differences of the regressors.

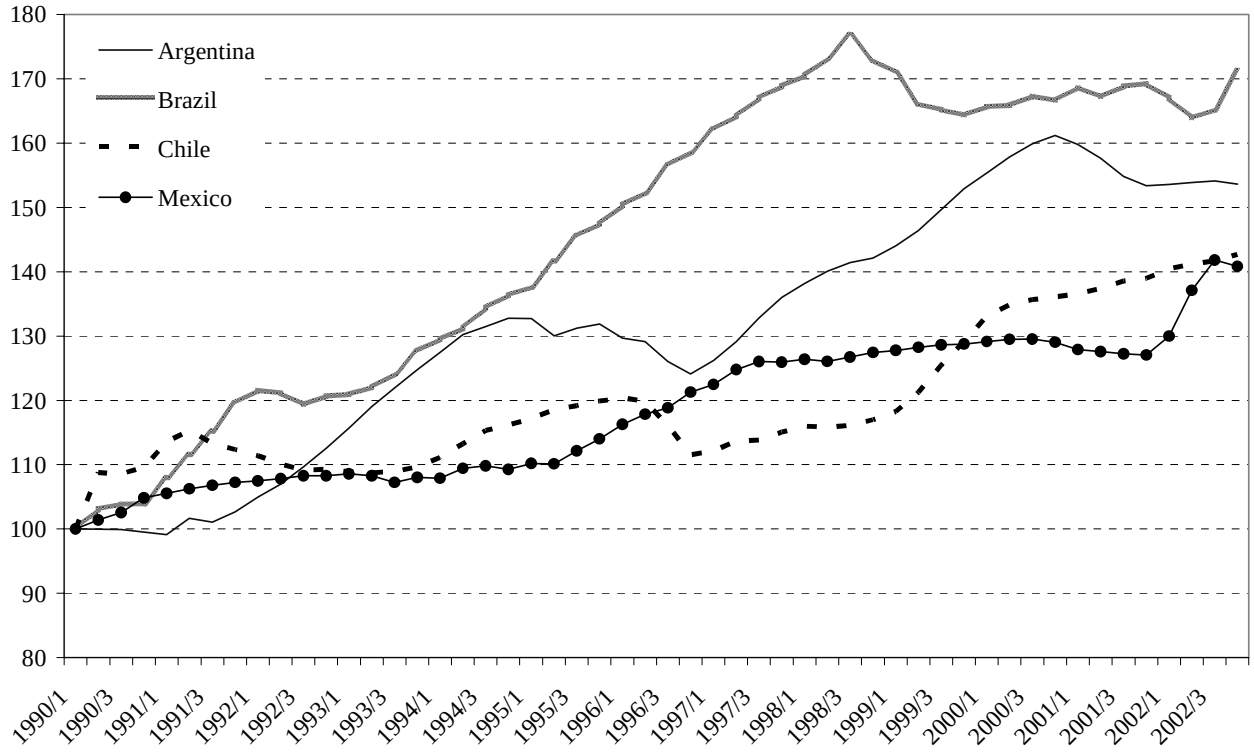
Table 3: Determinants of price of nontradables to tradables, quarterly data, 1990Q1 – 2002Q4

	Argentina	Brazil	Chile	Mexico
Period	1990:1-2002:4	1994:1-2002:4	1990:1-2002:4	1990:1-2002:4
Explanatory variables				
Ln prod (Balassa-	**0.72**	**0.74**	**0.36**	**0.74**
Samuelson)	*7.60*	*4.11*	*3.30*	*6.56*
Ln gov (government	**NS**	**0.04**	**NS**	**-0.04**
Expenditure)	*NS*	*0.86*	*NS*	*-5.71*
Ln tot (terms of trade)	**NS**	**NS**	**1.97**	**0.41**
	NS	*NS*	*10.36*	*3.85*
Ln fp (exchange rate	**0.44**	**0.21**	**NS**	**0.16**
Regime)	*9.23*	*5.65*	*NS*	*7.48*
Ln pi (portfolio	**5.19**	**8.98**	**NS**	**NS**
Inflows)	*3.81*	*7.85*	*NS*	*NS*
Dwstat	1.13	1.69	0.99	0.78
ADF statistic (lag)	-4.156 (0)	-2.596 (1)	-2.596 (4)	-2.100 (3)
10 % critical value	-1.61	-1.61	-1.61	-1.61
Nbr of obs (with leads and lags accounted)	48 obs	34 obs	45 obs	45 obs

The Balassa Samuelson Effect

21. In the long run the relative price of nontradables to tradables is mainly driven by the differential in multi-factor productivity (MFP) growth between the nontradable and tradable sector. Wages in the tradable sector wages are set by the productivity level, whereas wages in the nontradable sector adapt to those in the tradable sector. As productivity growth in nontradables is lower than tradables, the price of the former increases relative to the latter. As MFP could not be calculated for the four countries due to the absence of data on capital stocks by sector, we used labour productivity as a proxy (see Figure 6). The increasing trends for all four countries confirm the more rapid productivity growth in the tradable compared to the nontradable sector. Although a relatively steady trend was observed for the entire period, it seems that fixed regimes exacerbated this differential, as illustrated in Argentina and Brazil. This acceleration mainly originates from the productivity gains in the tradable sector which were aimed at compensating the loss in price competitiveness due to the fixing of the exchange rate. In Brazil, the large depreciation following the switch to the flexible regime in 1999 caused productivity growth in tradables to stagnate and as a consequence the differential with productivity growth in nontradables disappeared.

Figure 6: Ratio of indices of labour productivity in tradables to nontradables (1990Q1=100)



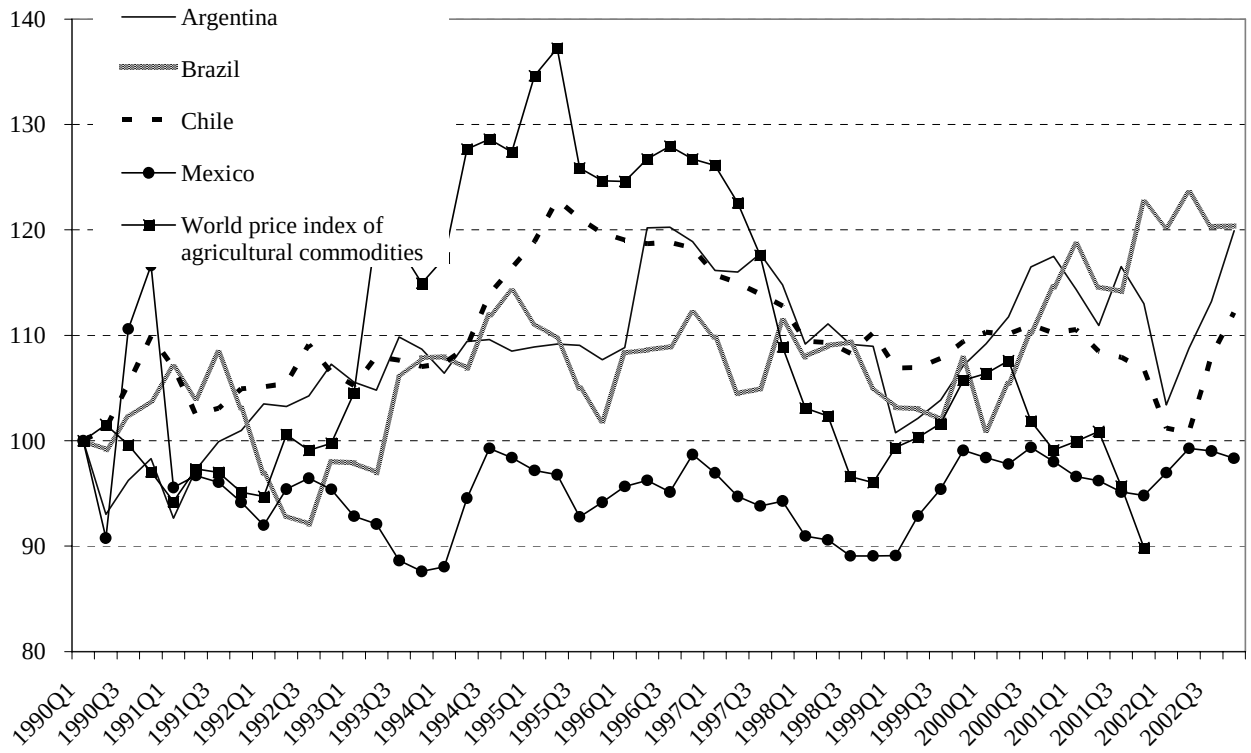
22. The econometric results confirm the BS effect for all countries. The coefficient has roughly the same value except for Chile. The low elasticity for Chile was also found by Delano and Valdes (1999).

The terms of trade effect

23. In addition to the supply-side effect, three demand effects are distinguished of which the first is the terms of trade (*i.e*. ratio of export to import prices). Improved **terms of trade** are expected to have a positive impact on the relative price of nontradables because they increase disposable income, which in turn raises final demand. With supply being inflexible in nontradables and the law of one price governing in tradables, the price of nontradables increases relative to that of tradables.

24. Terms of trade show relatively large fluctuations for all countries except Mexico and Argentina (see Figure 7). The flat trend for Argentina is surprising, as (agricultural) commodities account for a substantial share of its exports which world prices showed relatively large fluctuations. The world price for agricultural commodities increased between 1991 and 1994, but fell afterwards. The terms of trade of Brazil and to a lesser extent that of Chile paralleled this index. The small fluctuations in Mexico's terms of trade largely stem from the large share of differentiated goods in its exports, whose prices vary less than those of commodities. Terms of trade turns out to be significant determinant of relative prices only in Chile and Mexico. In Chile, the terms of trade is the most important determinant of relative prices.

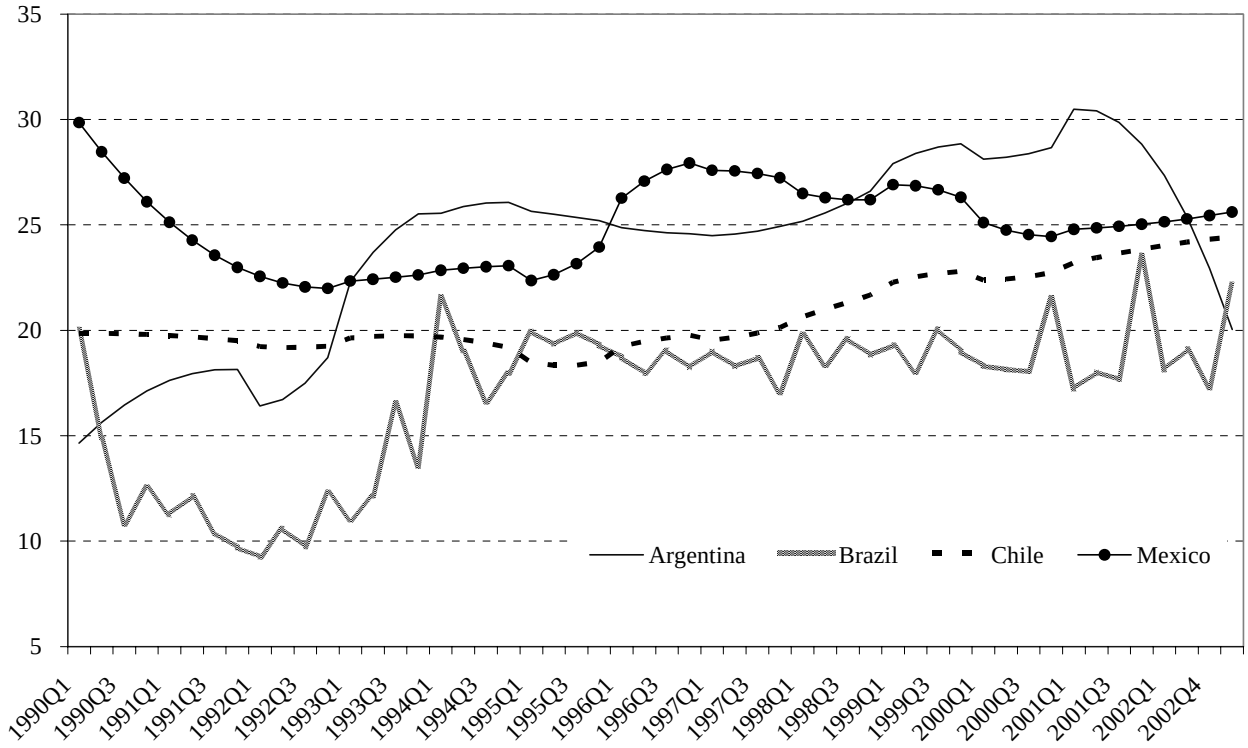
Figure 7: Terms of trade (1990Q1=100) (ratio of export price to import price)



Government expenditure

25. An increase in **government expenditure** as a share of GDP raises the price of nontradables as the largest part of this spending falls on nontradables whose supply is relatively inflexible. Government spending as percentage of GDP increased in Argentina and Chile and fell in Mexico (see Figure 8). This variable turns out significant in Brazil and Mexico, although it has an unexpected sign in the case of Mexico. A negative sign is also found in other studies, and is usually interpreted as an indication that most government spending is on tradables instead of nontradables (Duval, 2001).

Figure 8: Government expenditure as Percentage of GDP at current prices



Exchange rate regime

26. The **exchange rate regime dummy** is highly significant in all countries except Chile, which confirms that in the other three countries the exchange rate regime had an impact on relative prices. In Chile, the bands around the crawling pegs were repeatedly broadened to adjust to market conditions between 1990 and 1998 and as such the country had a relatively flexible regime in practice. Chile experienced a smooth transfer form a crawling band to a fully flexible regime in 1999.

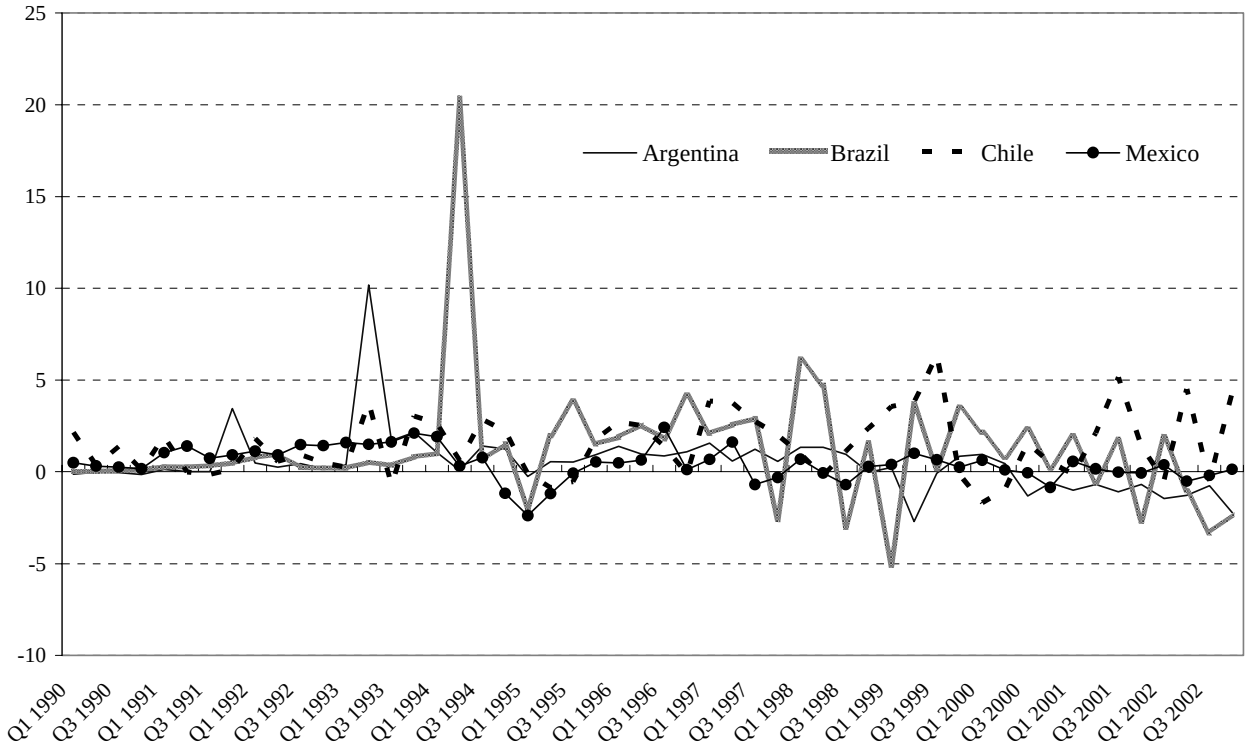
27. The demand effect of fixed exchange regimes is captured by **portfolio inflows**.[10] They are significant in Argentina and Brazil; inflows were highest during the a large part of the fixed exchange rate regimes (in Argentina 1992-98 and Brazil 1994-97), see Figure 9. The Chilean case is very interesting because it was the only country with controls on short-term capital inflows.[11] As a consequence it had a

10. At the end of the 1980s, Latin American countries opened their capital account as part of a larger liberalisation programme. The financial liberalisation involved the removal of interest-rate ceilings, the privatisation of the financial system and the elimination of exchange risk. This led to a major increase in international lending. The pegged exchange rate and high nominal domestic interest rates were the main factors behind the increase in short-term capital inflows, *i.e*. portfolio inflows (Mishkin, 2001).

11. In Chile, capital inflows were regulated between 1991 and 1999. The least restrictions were on foreign direct investment as it was supposed to have positive externalities on the economy. The only requirement was a minimum stay of one year. In contrast, capital inflows for foreign indebtedness, in particular those of a short-term nature, were much more restricted, *i.e*. a minimum (non-remunerated) reserve requirements of 30 per cent. Reserve requirement increased the cost of external financing and as such stemmed inflows (Budnevich and Lefort, 1997).

stable level of portfolio inflows which were unaffected by the move to a more flexible exchange rate regime in 1999. Elbadawi and Soto (1997)[12] also found that short run capital inflows did not affect the real exchange rate in Chile.

Figure 9: Net Portfolio Inflows as a Percentage of GDP



Box 2. Capital controls in Chile

In Chile, capital inflows were regulated depending on their character between 1991 and 1999. The least restrictions were on foreign direct investment as it was supposed to have positive externalities on the economy. The only requirement was a minimum stay of one year. In contrast, capital inflows for foreign indebtedness, in particular those of a short-term nature, were much more restricted, as a minimum (non remunerated) reserve requirements of 30 per cent was applied to them. Reserve requirement increased the cost of external financing and as such stemmed inflows.

12. They tested the long-run impact of capital flows on the Chilean RER in the period 1960-92. With cointegration and an error-correction model they confirm that short-term capital flows and portfolio investment have no influence on the equilibrium real exchange rate (ERER). Instead the ERER turn out to be determined by the long-term capital flows and direct foreign investment.

5. Concluding remarks

28. This study deals with the determinants of the real exchange rate defined by the relative price of nontradables to tradables in ABC and Mexico during the period 1990-2002. The literature predicts a long-run upward trend of this relative price linked to the Balassa-Samuelson effect, as well as short and medium terms fluctuations due to demand factors such as government expenditure and terms of trade. Another factor considered in this paper is fixed exchange rate regimes, which explain why relative prices followed a bell-shaped form during 1990-2002. All these countries experienced hyper- or double-digit inflation in the late-1980s early-1990s. Fixing the exchange rate forced tradable good producers in these "small" countries to stem price increases as they are subject to the law of one price. As nontradable producers face no international competition, the inflation of nontradables decelerated at a slower pace. As a result, the relative price of nontradables to tradables sharply increased. In addition, countries with fixed exchange rate regimes, except Chile, attracted large capital inflows. These significantly raised final demand, which in turn raised the price of nontradables relative to tradables, mostly so in Argentina and Brazil. When fixed regimes come to an end, the currencies depreciated and capital fled out of these countries, reversing the relative price trends**.**

29. The econometric results confirm the impact of exchange rate regimes on relative prices in all countries except Chile. In Argentina and Brazil, fixed exchange regimes affected relative prices also indirectly via portfolio inflows, in the context of liberalised capital accounts, which increased final demand. The other variables 'explaining' relative price movements are Balassa-Samuelson (all countries), government expenditure (Brazil and Mexico) and terms of trade (Chile and Mexico).

30. The paper also illustrates the effect of constrained exchange rates, via their impact on relative prices, on the allocation of resources. During the fixed regime periods, the share of the nontradable sector increased disproportionally at the expense of the tradable sector. This reallocation is most accentuated in employment, but can also be seen in GDP.

31. In addition to relative prices, resource allocation can also be explained in terms of access to finance. Tornell and Westermann (2002) show a positive correlation between the ratio of nontradables to tradables output and credit growth for a sample of 39 middle-income countries between 1980 and 1999. They explain the bell-shaped ratio of nontradables to tradables output by asymmetries of financing opportunities across nontradable and tradable sectors. Although the tradable sector has access to both domestic and foreign finance, the nontradable sector depends almost completely on bank credit. The authors show that banks over-expose themselves to the nontradable sector during lending booms, but disproportionally cut credit to this sector during a credit crunch. These trends mostly parallels the fixed and subsequent flexible regime periods and reinforces the factor reallocation underlined in this paper.

32. Several (policy) conclusions can be drawn. Firstly, in setting macro-economic (exchange rate) policy, countries should be aware of the impact on the domestic price structure and the linked factor allocation across the tradable and nontradable sectors. Secondly, countries should carefully consider the pros and cons of free entry of (short term) capital. The fixation of the exchange rate may cause large portfolio inflows which raise demand and the relative price of nontradables to tradables. Thirdly, it seems important to increase competition in the nontradable sector as a lack of it in countries such as Argentina contributed to the large increase in the price of nontradables relatively to tradables.

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ANNEX I. EXPLAINING RELATIVE PRICES: BALASSA-SAMUELSON AND EXTENSIONS

33. The continuous rise of the real exchange rate (P_n/P_t) in the process of economic development is a much studied phenomenon in the economic literature, starting in particular with two seminal articles by Balassa and Samuelson in 1964. Later on their model was extended with other determinants of relative prices.

Annex I.1. The Balassa-Samuelson model[13]

34. Balassa (1964) and Samuelson (1964) (BS) independently explained systematic trends in relative prices of nontradables to tradables across countries. The BS model is a traditional two-country, two-commodity Ricardian trade model amended to include nontradable goods. There are two commodities (tradable (t) and nontradable (n)) and two production factors (Labour (L) and capital (K)). The price of tradables follows the law of one price equated – under perfect competition - with marginal costs. K and L are perfectly mobile across sectors domestically, but only K is perfectly mobile internationally. Hence a small open economy takes the world interest rate (r) as given. Wages (w) are determined by marginal costs and the world price of tradables. In the BS framework, productivity in the tradable sector, given factor price equalisation, determines the price of nontradables. Economies with higher productivity levels in tradables will have higher wages and thus higher prices of nontradables.

35. The BS model can be summarised by the following equations. The tradable and nontradable sectors are characterised by Cobb-Douglas production functions:

$$\begin{aligned} Y_t &= A_t L_t^{\theta_t} K_t^{1-\theta_t} \\ Y_n &= A_n L_n^{\theta_n} K_n^{1-\theta_n} \end{aligned} \tag{A.1}$$

Under perfect competition, the following conditions for profit maximisation of firms hold. In the tradable sector:

$$\begin{aligned} w &= \theta_t A_t L_t^{\theta_t - 1} K_t^{1-\theta_t} = \theta_t A_t k_t^{1-\theta_t} \\ r &= (1-\theta_t) A_t L_t^{\theta_t} K_t^{-\theta_t} = (1-\theta_t) A_t k_t^{-\theta_t} \end{aligned} \tag{A.2}$$

and in the nontradable sector:

$$\begin{aligned} w &= P_n \theta_n A_n L_n^{\theta_n - 1} K_n^{1-\theta_n} = P_n \theta_n A_n k_n^{1-\theta_n} \\ r &= P_n (1-\theta_n) A_n L_n^{\theta_n} K_n^{-\theta_n} = P_n (1-\theta_n) A_n k_n^{-\theta_n} \end{aligned} \tag{A.3}$$

13. The presentation here of BS is based on Froot and Rogoff (1994). For other presentations, see Balassa (1964), Samuelson (1964), Asea and Corden (1994), Halspern and Wisplosz (2001), and Duval (2001b).

with *k* being the capital-labour ratio and *P* being prices.

36. By log-differentiating the three previous equations, the BS effect can be generalised as follows:

$$p_n - p_t = p_n = (\frac{\theta_n}{\theta_t})a_t - a_n \qquad \text{(A.4)}$$

with the small letters denoting the logarithm of variables. In the standard BS model, P_n/P_t is determined only by the supply side. If both sectors have equal capital intensities ($\theta_t = \theta_n$), then P_n is determined by the productivity differential between the tradable and nontradable sectors only. The relative price of the nontradables even rises when productivity increases at the same rate in both sectors (referred to as *balanced productivity growth*) if the nontradable sector is more labour intensive than the tradable sector ($\theta_n \rangle \theta_t$).

Annex I.2. Extensions of the BS model

37. Demand factors also play a role in determining the relative price if not all of the three basic assumptions of the standard BS model are fulfilled: perfect domestic inter-sectoral mobility of production factors, perfect competition and perfect international capital mobility. With imperfect competition in the non-tradable sector, an increase in the demand for tradables and nontradables will increase only the price of the latter as for the former the "law of one price" holds. In contrast, in the nontradable sector, monopolistic competition allows producers to increase their prices (Allard-Prigent *et al.*, 2000). In the case of imperfect international capital mobility, the supply of tradables relative to nontradables is no longer infinitely elastic to relative prices.[14] In this context, the relative price also becomes dependent on demand variables (Bergstrand, 1991; Froot and Rogoff, 1991, 1994; Rogoff, 1992; De Gregorio *et al.*, 1994).

38. Demand factors are partly related to economic development. Firstly, primary and manufactured goods are substituted for nontradables with increases in per capita income, also referred to as Engel's law. An increase in the relative demand for nontradables raises their relative price. Secondly, government spending as a percentage of GDP also tends to increase with economic development. As most government spending is on nontradables, it increases their price. Other demand variables are terms of trade, trade barriers, and capital inflows.

39. The BS model can be extended with demand variables (Gregorio and Wolf, 1994).[15] Exports are produced but not consumed domestically. Hence, individuals consume a quantity of an importable good

14. An increase in the demand for nontradables raises their price and shifts production from tradables to non-tradables. Since the production of tradables is supposed to be more capital intensive, their relative price decrease causes the rental price of capital to fall. With perfect capital mobility, capital will flow out of the country and the domestic capital stock falls. This reduces the production of tradable goods, *i.e.* an increase in the relative production of non-tradable goods. With higher relative supply, the non-tradable sector will reduce the relative price of its products. This is turn will increase the rental rate of capital and restore equilibrium. In this framework, the relative supply of the non-tradable sector is infinitely elastic to its price (Duval 2001).

15. Another explanation of the rise in the relative price of nontradables during economic development is given by Kravis and Lipsey (1983) and Bhagwati (1984). They assume that capital accumulation allows the tradable sector (mostly manufacturing) to adopt more capital-intensive techniques. This increases the price of labour relative to capital, which in turn raises the relative price of nontradables due to wage equalisation across sectors. This result holds only when capital is *not* perfectly mobile internationally, which implies that the rental rate of capital is endogenous. The domestic rental rate of capital does not adjust to international markets but varies as a result of capital accumulation.

c_m available at the given world price p_m and the nontradable good c_n at the price p_n. Consumers maximise their utility[16] subject to the budget constraint:

$$p_n c_n + p_m c_m = I \tag{A.5}$$

where *I* denotes after tax incomes. The demand function[17] for each good is deduced from the utility function and budget constraint. The model assumes that government spending is entirely on nontradables. The government uses tax revenues, *r*, to finance spending on nontradables (of volume *g*): $r = p_n g$. Then the after tax income is:

$$I = p_x y_x + p_n (y_n - g) \tag{A.6}$$

40. The equilibrium price of nontradables[18] depends on the equilibria in the markets for tradables and labour. The price of nontradables that ensures equilibrium (prices and marginal costs) in the tradable sector is:

$$p_n = \frac{p_x \alpha}{a_n} \left(\frac{y_x^{1-\alpha}}{a_x}\right)^{\frac{-1}{\alpha}} \tag{A.7}$$

The equilibrium in the labour market is given by $L = L_x + L_n$. Equilibrium in the nontradable market implies: $c_n + g = a_n L_n$. The combination of these equilibrium conditions with the demand function yields the joint equilibrium in the markets for labour and nontradables:

$$\bar{\phi} \frac{p_x}{p_n} y_x + (1-\bar{\phi}) \left(\frac{y_x}{a_x}\right)^{1/\alpha} = (1-\bar{\phi})\left[a_n L - g\right], \text{ where}$$

$$\bar{\phi} = \phi^\gamma \frac{p_n^{1-\gamma}}{\phi^\gamma p_n^{1-\gamma} + (1-\phi)^\gamma p_m^{1-\gamma}} \tag{A.8}$$

---

16. The CES utility function is as follows: $U = \left\{ \phi c_n^{\frac{\gamma-1}{\gamma}} + (1-\phi) c_m^{\frac{\gamma-1}{\gamma}} \right\}^{\frac{\gamma}{\gamma-1}}$.

17. $$c_n = \phi^\gamma \frac{I}{p} \left(\frac{p_n}{p}\right)^{-\gamma}$$
$$c_m = (1-\phi)^\gamma \frac{I}{p} \left(\frac{p_m}{p}\right)^{-\gamma}$$

18. Here the relative price of nontradables (p_n / p_t) is reduced to p_n because p_t equals the exogenous world price.

ANNEX II: DATA SOURCES

Price indices:
Argentina: monthly consumer price index of the metropolitan area of Buenos Aires (*Índice de Precios al Consumidor*, IPC): for 1990-95 by nine expenditure groups from INDEC and from 1996 onwards by 50 expenditure categories from FIDE and INDEC. Wholesale price index (*indice de precios mayoristas*) from INDEC.
Brazil: consumer price index: from 1991 onwards *Indice de Preços ao Consumidor Amplo* (IPCA) from IBGE, *Banco de Dados Agregados – Sistema IBGE de Recuperação Automática* (SIDRA) (http://www.sidra.ibge.gov.br/bda/); linked to *Indice Nacional de Preços ao Consumidor* for 1990 from IPEA, *IPEADATA - Base de dados macroeconômicos* (http://www.ipeadata.gov.br/). Wholesale price index (Indice de preço por atacado-disponibilidade interna (IPA-DI) from IPEADATA.
Chile: consumer price index (*indice de precios al consumidor*) broken down by 30 expenditure categories and producer price index (*indice de precios al por mayor*) from INE.
Mexico: consumer price index (*indice de precios al consumidor*) and producer price index (*indice de precios productor*) from Banco de México, *información financiera y económica, indicadores económicos y financieros* (http://www.banxico.org.mx/eInfoFinanciera/FSinfoFinanciera.html).

Value Added:
Argentina: quarterly value added at constant and current prices from Dirección Nacional de Cuentas Nacionales, Ministerio de Economia, (see: http://www.mecon.gov.ar/peconomica/basehome/infoeco.html).
Chile: quarterly value added at current and constant prices (breakdown into 13 sectors) from Banco Central, *Base de Datos Economicos* (http://si2.bcentral.cl/basededatoseconomicos/900base.asp?usuidioma=e). Quarterly employment from 2001 onwards from ECLAC
Brazil: quarterly value added at current and constant prices (breakdown into agriculture, industry and services only) from IBGE, *SIDRA*.
Mexico: quarterly value added at current and constant prices (breakdown into 9 sectors) from INEGI, *Banco de Información Económica* (BIE) (http://www.inegi.gob.mx/difusion/espanol/fbie.html).

Employment:
Argentina: Minstry of the Economy, Dirección de Ocupación e Ingresos, Secretaría de Política Económica, on the basis of data from Sistema Integrado de Jubilaciones y Pensiones, provisto por AFIP.
Chile: Quarterly employment from INE, *Encuesta nacional del empleo*.
Brazil: IPEA, *Base de dados macroeconômicos* (http://www.ipeadata.gov.br/).
Mexico: same source as value added.

Net capital inflows: national sources and IMF, *International Financial Statistics*, Washington DC.

Government expenditure: Brazil: IBGE, *contas nacionais trimestriais.* Other countries: IMF (various issues), *World Economic Outlook*, Washington DC.

Terms of trade: Chile, Central bank, *Base de Datos Económicos*
(http://si2.bcentral.cl/basededatoseconomicos/900base.asp?usuIdioma=E)

ANNEX TABLE II.1 - THE RESULTS OF ADF ROOT TEST

	Test stat	lags	10 % critical value	Degree of Integration
		Argentina		
PN	-3.12	1	-2.6	0
TOT	-1.91	0	-2.6	1
GOVEXP	-1.90	4	-2.6	1
PROD	-2.24	4	-2.6	1
PI	-5.20	0	-2.6	0
D (GOVEXP)	-2.65	3	-2.6	**0**
D(PROD)	-3.08	3	-2.6	**0**
D(TOT)	-6.10	1	-2.6	**0**
		Brazil		
PN	-1.18	2	-2.6	1
TOT	-1.76	0	-2.6	1
GOVEXP	-1.35	1	-2.6	1
PROD	-1.83	1	-2.6	1
PI	-7.24	0	-2.6	0
D (PN)	-4.25	1	-2.6	**0**
D (TOT)	-7.38	0	-2.6	**0**
D (GOVEXP)	-11.32	0	-2.6	**0**
D (PROD)	-4.01	0	-2.6	**0**
		Chile		
PN	-2.37	4	-2.6	1
TOT	-1.77	2	-2.6	1
GOVEXP	1.33	4	-2.6	1
PROD	0.27	4	-2.6	1
PI	-6.14	0	-2.6	0
D (PN)	-6.18	1	-2.6	**0**
D (TOT)	-5.46	1	-2.6	**0**
D (GOVEXP)	-4.28	3	-2.6	**0**
D (PROD)	-3.39	3	-2.6	**0**
		Mexico		
PN	-2.95	4	-2.6	0
TOT	-5.23	3	-2.6	0
GOVEXP	-1.64	4	-2.6	1
PROD	-0.54	1	-2.6	1
PI	-3.16	3	-2.6	0
D (PROD)	-4.01	0	-2.6	**0**
D (GOVEXP)	-2.73	4	-2.6	**0**

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