DEPARTMENT OF ECONOMICS

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RESEARCH PAPER 2010-025
NOVEMBER 2010

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D/2010/1169/025

DETERMINANTS OF THE STRUCTURAL REAL EXCHANGE RATES AND ECONOMIC STRUCTURES IN ARGENTINA, CHILE AND MEXICO*

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Abstract

A theoretical model, applied to Argentina, Chile and Mexico, shows how exogenous shocks impact on the structural real exchange rate (SRER, defined by the relative tradable to non-tradable price) and sectoral shares.

First, a simulation approach designed to test how rich the theoretical model is in providing predictions: a) captures the behaviour of the Argentinean series quite well but its ability to predict the Chilean and Mexican variables differs between variables and b) shows that the collapse of the Argentinean currency, at the end of 2001, was necessary to correct a 38.9% SRER misalignment.

In addition, a cointegration approach shows that: a) productivity improvements in the Mexican manufacturing sector reduce its share to GDP, b) labour endowments influence positively the Chilean SRER and both tradable sectors in Argentina and Mexico, while they reduce the Chilean primary sector, c) terms of trade improvements depreciate the SRER of all countries but reduce the size of the primary sector in Chile and Mexico, d) government spending reduces the Mexican SRER and the primary and manufacturing shares in Argentina while it increases the Mexican SRER and manufacturing shares, e) additional external debt reduces the Argentinean SRER and reduces (increases) the Argentinean and Mexican primary (manufacturing) shares and f) the collapse of the Argentinean currency depreciated its SRER by about 31.1% with an 18% overshooting.

The benchmarking of the simulated and cointegrated results for Argentina reveals that the cumulated Argentinean SRER misalignment before the collapse of its currency was due to fundamental factors.

JEL Classification Numbers: F11, F31, F35, F37, F41, F43, C22
Keywords: Structural real exchange rate, factor productivity, endowments, sectoral income distribution, Dutch disease, cointegration

* I would like to thank Professor Joseph Plasmans for his valuable comments, discussions and recommendations. I also thank Rodrigo Caputo from the Central Bank of Chile for helpful suggestions that substantially improved this paper.

INDEX

Pages

I. Introduction

Despite the importance of real exchange rates in determining the allocation of resources and expenditure within an economy, "there is surprisingly little agreement concerning both how to measure and interpret their movements" (Dwyer and Lowe, 1993, p.1). Largely, disagreements stem from the fact that the real exchange rate definition vary according to the context in which it is used. This paper uses the so-called structural real exchange rate (SRER), defined as the relative price of tradable to non-tradable goods.

This paper investigates the theoretical determinants of the SRER and sectoral shares for an small economy with two tradable goods (primary and manufacturing) and one non-tradable good. The postulated theoretical relationships are then tested when applied to Argentina, Chile and Mexico.

The SRER definition is "appropriate for assessing the real exchange rate within countries" because it measures the value of a unit of tradable goods in terms of non-tradable goods (Driver and Westaway, 2004, p.17).[1]

It is also a key determinant of domestic resource allocation and international competitiveness: a rise in the SRER indicates that the production of tradable goods becomes more profitable relative to the production of non-tradables, and thus provides an incentive for reallocating resources by shifting them from the latter to the former sector. Given the relative prices of the rest of the world, the SRER is also a proxy of international competitiveness, as an increase in the SRER indicates that a country produces tradable goods in a relatively more efficient way (compared to the rest of the world).

There is no single dominant approach to modeling the equilibrium SRER. Different authors have used methods ranging from the purely statistical to the purely theoretical ones. Nonetheless, all approaches consider the SRER as an endogenous variable determined in a complete macro-economic system where macroeconomic fundamentals are key driving variables underlying its movements.[2] Thus, SRER movements might depend on a variety of additional factors including productivity differentials, terms of trade, factor endowments and debt shocks.

Via their impact on SRER, these factors affect the size of the different sectors of an economy,[3] which this paper also explains, focusing on the primary, manufacturing and non-tradable sectors. In a first step, a small economy model sets out the theoretical impact of exogenous shocks on the SRER and the sectoral shares. In a second step, the postulated relationships are tested for the economies of Argentina, Chile and Mexico.

The paper is organized as follows. Section II describes some stylized facts. Section III presents relationships from the literature as well as a theoretical model that shows how exogenous shocks impact on the SRER and the sectoral shares of an economy. Section IV tests the theoretical relationships empirically applied to Argentina, Chile and Mexico. Two approaches have been used: a) a dynamic-stochastic approach and b) a standard regression approach. These two approaches are then benchmarked for the Argentinean economy. Section V suggests further extensions, while section VI provides some conclusions.

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[1] "Despite the domestic role afforded to domestic relative prices in theoretical models of open economies, practical difficulties associated with the estimation of such prices have resulted in widespread adoption of the PPP real exchange rate" (Dwyer and Lowe (1993, p.1)). The PPP definition (relative price between foreign and domestic goods) is based on deviations from purchasing power parities (PPP) between countries.

[2] Note also that different assumptions on preferences, technologies and the existence of differentiated products and market imperfections can potentially have different implications for the behaviour of the SRER.

[3] SRER movements in the process of economic development are a well-studied phenomenon since they encourage the reallocation of resources and, thus, affect the intra-sectoral composition of the economy.

II. Stylized facts

Latin America's economic prospects heralded new promises in the early 1990s, as ambitious stabilization and market-oriented reform programs were introduced. They reflected a broad shift away from the interventionist and inward looking policies followed in the past. To promote transparency and credibility, monetary policy was in most cases constrained by a commitment to a "fixed" or "quasi fixed" exchange rate. The region's economic performance and growing productivity in the first half of the 1990s appeared to validate initial expectations.

However, signs of fragility and contagious vulnerability became evident in the following of Mexico's "Tequila" and the Asian and Russian financial crisis. Thus, Argentina, Brazil and Mexico were unable to accommodate to the constraints of a fixed exchange rate (Baldi and Mulder, 2004).[4] Ultimately, they abandoned their exchange rate regimes, triggering severe economic and debt crises: Mexico in 1994, Brazil in 1999 and Argentina in 2002;[5] Chile did not face a crisis of similar magnitude since its exchange regime was more flexible; it, however, did suffer a slowdown in economic growth and investment in 1997/98. With the abolition of fixed exchange rate regimes, the currencies strongly depreciated and relative price trends reverted, at least for some time.

Before the Argentinean exchange regime collapse (1st quarter of 2002), its fixed exchange rate regime distorted the SRER behaviour and pushed the center of gravity of the economy away from the tradable sector. The Chilean and Mexican experiences with a more flexible exchange rate regime provide two different Latin-American counter examples to the Argentinean case.[6]

Figure 1 displays the evolution of the SRER and the economic structure of the countries under analysis. Sectoral shares to GDP partly describe the economic structure of a country because they measure the size of each sector. External restrictions also indicate the shape of an economy since they reveal the restrictions imposed by the international markets on that economy. The contribution of the tradable sector as a whole includes the contribution of both primary and manufacturing sectors.

The SRER is calculated as the ratio between the wholesale and consumer price indexes while Xshares, Mshares and Tshares are the primary, manufacturing and tradable (primary and manufacturing) sectors shares to GDP, respectively. Appendix I and II detail, respectively, the SRER measurement procedure and sectoral categorization.

The Argentinean SRER moderately trended downwards in the period before the fixed exchange regime collapse. Following the fixed exchange regime collapse, its SRER jumped by over 50%. The Chilean SRER declined until the 1st quarter of 1999 but increased afterwards. The Mexican SRER, does not exhibit a clear trend.

[4] Recall that when a fixed regime is adopted, it is difficult to create enough flexibility elsewhere in the economy in order to compensate for this source of rigidity.

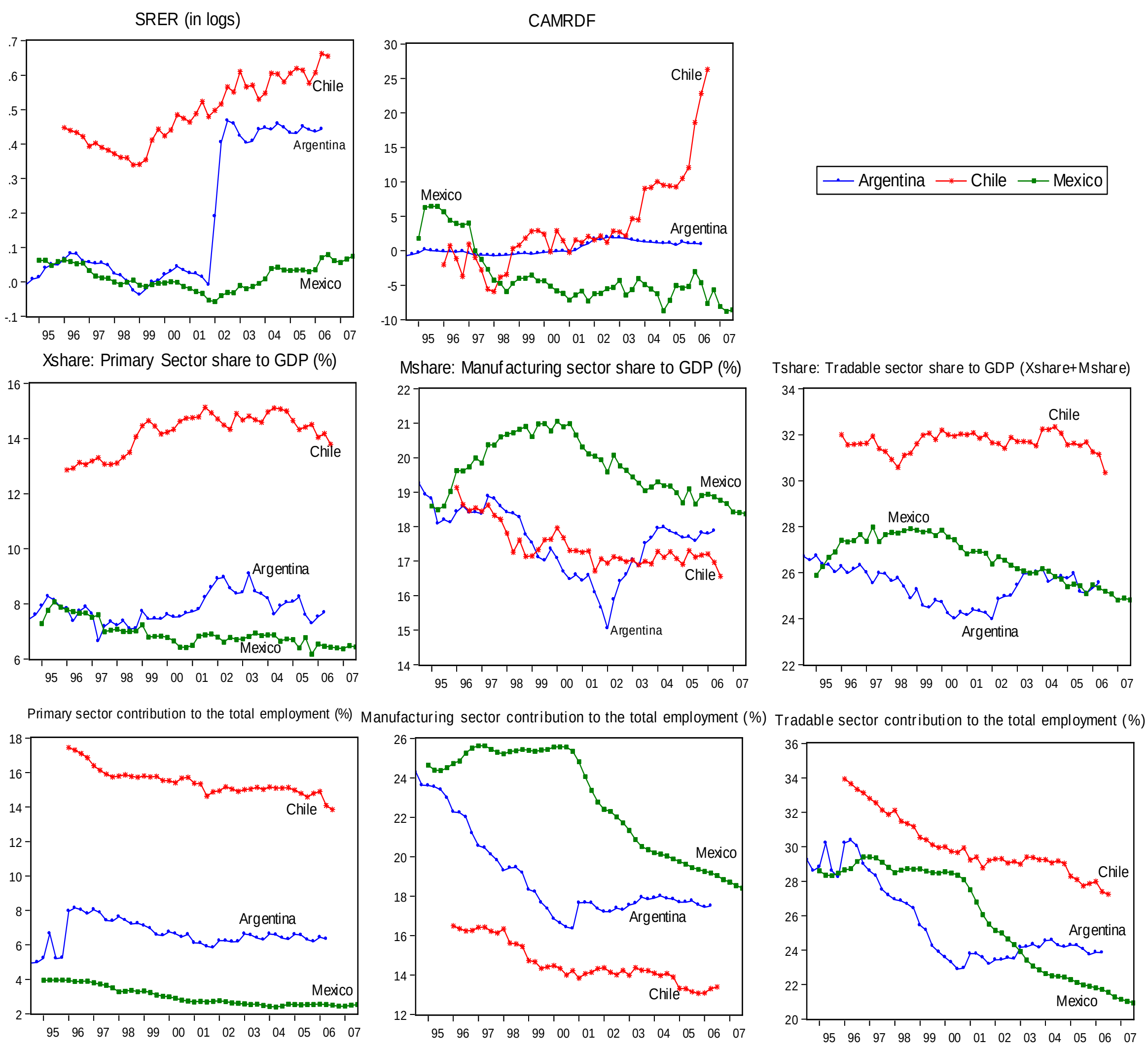
[5] Being mostly price-takers, producers of tradable goods were forced to restrain price increases of their products due to fixed exchange rates. In contrast, non-tradable producers, who faced no international competition, had fewer incentives to keep their output prices low. The combined result was a steep decline in the SRER. The entry of substantial short-term inflows of portfolio capital, which contributed to higher final demand, exacerbated the declination of the SRER; only in Chile, where restrictions on capital inflows were in place, this effect was mitigated.

[6] In the period of analysis of this paper: a) the Argentinean economy experienced two different economic outlooks: a fixed exchange rate (or convertibility) regime (1 peso = 1 dollar) until the 1st quarter of 2002 when – following a series of devaluations of the peso – it eventually collapsed and was replaced by a flexible exchange rate regime, b) Although Chile officially had a crawling peg exchange rate regime before 1998, in practice it was an almost flexible regime as the central parity was regularly adjusted to market conditions (Baldi & Mulder, 2004, p.22) and c) the exchange rate regime has been flexible in Mexico.

Figure 1 suggests also that Xshare: a) does not have a clear trend in Argentina, b) exhibits an increasing trend in Chile and c) exhibits a negative trend in Mexico. Also, Mshare a) declined before the end of the convertibility regime, increased until the 1st quarter of 2004 and decreased thereafter in Argentina, b) has had a negative trend during the period of analysis in Chile and c) increased until the 1st quarter of 2000 but decreased thereafter in Mexico. The contribution of both tradable sectors to the total employment have been declining through the period of analysis, see also figure 1.[7]

Following Table 1: a) the primary sector share to GDP (Xshare) is relatively small in Argentina and Mexico but not in Chile, b) the contribution of the manufacturing sector to the GDP (Mshare) is relatively large in all countries with an average contribution larger than 17% and c) the sectoral importance in employment generation have been similar to their GDP contribution.

Figure1: SRER and indicators of the economic structure of Argentina, Chile and Mexico



[7] Baldi and Mulder (2004) suggest also that the share of the tradable sector in employment and GDP fell more than proportionally during the 1990s in Argentina, Brazil, Chile and Mexico.

The Tshare-SRER correlation might differ between countries since it depends on the Xshare-SRER and Mshare-SRER correlation rates.[8] For instance, in Argentina, Chile and Mexico, Xshare is positively correlated to SRER while the Mshare-SRER correlation is negative.

Table 1: Sectoral shares and their correlation rates to SRER and CAMRDF

	Argentina (1994Q3-2006Q2)				Chile (1996Q1-2006Q3)				Mexico (1995Q1-2007Q3)			
	SRER	**Xshare**	**Mshare**	**Tshare**	**SRER**	**Xshare**	**Mshare**	**Tshare**	**SRER**	**Xshare**	**Mshare**	**Tshare**
Mean	1.22	7.83%	17.59%	25.42%	1.64	14.21%	17.45%	31.66%	1.02	6.92%	19.68%	26.59%
Employment		6.6%	17.59%	24.19%		15.45%	14.58%	30.03%		2.98%	22.79%	25.77%
ρ_{RER}		0.47***	-0.150	0.132		0.52***	-0.57***	0.057		0.21	-0.602***	-0.424***
		(3.62)	(-1.03)	(0.91)		(3.93)	(-4.42)	(0.37)		(1.52)	(-5.28)	(-3.27)
ρ_{CAMRDF}	0.87***	0.76***	-0.52***	-0.118	0.79***	0.36***	-0.516***	-0.14	0.39***	0.89***	-0.042	0.37***
	(12.0)	(7.99)	(-4.1)	(-0.81)	(8.26)	(2.46)	(-3.86)	(-0.91)	(2.96)	(13.69)	(-0.29)	(2.79)

Employment refers to the sectoral employment in relation to the total employed force
ρ_{SRER} and ρ_{CAMRDF} are the SRER and CAMRDF correlation to SRER, Xshare, Mshare and Tshare
Values in parenthesis refer to the t-statitics of the null-hypothesis of null correlation
(*), (**), (***) indicate the statistical significance of the correlation rates at the 10%, 5% and 1% , respectively

In this paper, external restrictions are measured by the ratio of the current account surplus (net of services and transfers) to GDP (CAMRDF, see appendix II). Strengthening international competitiveness is key to the Argentinean, Chilean and Mexican perennial challenge to generate a net export surplus sufficient to finance debt-service obligations without constraining domestic demand growth.

The second chart of figure 1 shows that the a) Argentinean CAMRDF was, except in the 2nd quarter of 1995, negative before the 1st quarter of 2001 but positive (with negative tendency) thereafter,[9] b) Chilean CAMRDF was mostly negative up to the 4th quarter of 1998, slightly positive until the 3rd quarter of 2003 and larger than 5% of the GDP afterwards, and c) Mexican CAMRDF has had a negative trend and has been negative since the 3rd quarter of 1997.

External restrictions do have different implications for the SRER and sectoral shares behaviour; e.g. the SRER-CAMRDF correlation is positive for all countries, see also Table 1.

III. SRER, sectoral shares and their fundamentals: Current literature and theoretical model

This section sets out the analysis of the relationship between the SRER and its fundamentals - sectoral productivities, factor endowments, terms of trade and debt-to-GDP ratios. To the best of our knowledge there are neither theoretical nor empirical papers that show how exogenous shocks to productivity, factor endowments, terms of trade or the debt-ratio determine the sectoral sizes.

1. Relationships from the literature

i) Sectoral productivities

The Balassa-Samuelson (BS) model was the first model that related sectoral productivity shocks to real exchange rate movements. In the BS framework, which assumes factor price equalization and exogenous tradable goods prices, sectoral productivity determines the non-

[8] Following Baldi and Mulder (2004), the size of the Argentinean, Brazilian, Chilean and Mexican tradable sectors may have changed in opposite direction to SRER in the 1990s.

[9] "External constraints" imposed by the close up of international markets on Argentina made a positive CAMRDF between 1998 and 2001 extremely necessary in order to cover debt obligations.

tradable goods prices.[10] This encompasses the well known 'internal equilibrium' theory of real exchange rate determination. Calderon (2000) and Gay & Pellegrini (2003) find evidence of BS effects in Argentina; while Baldi & Mulder (2004) have similar findings for Argentina, Chile, Brazil and Mexico.

Productivity gains in the primary (manufacturing) sector reduce the relative cost of producing primary (manufacturing) goods. It pushes factor prices up, attracting production factors from other sectors. Higher factor prices increase the income of the economy and the demand for all goods. In small open economies, with tradable prices determined in the world markets, the non-tradable goods price only increase. Productivity gains in any of the tradable sectors thus appreciate the SRER. Also, these productivity gains reallocate resources favorably to the primary (manufacturing) sector and increase (reduce) the size of the primary (manufacturing) sector.

ii) Factor endowments

Like sectoral productivity, factor endowments also determine the SRER from the supply side. Expansions in factor endowments increase the supply of all goods thus reducing factor prices and non-tradable prices. Despite the factor price reduction, the production and consumption of all goods increase. It is not clear, however, whether the primary or manufacturing shares increasese or not. The SRER, however, depreciates as a consequence of additional factor endowments.

iii) Terms of trade

Demand factors also play a role in determining the SRER. Several models stress the importance of terms of trade disturbances as a potential demand source of SRER fluctuations e.g. Baldi & Mulder (2004, Chile and Mexico), Gay & Pellegrini (2003, Argentina) and Carrera & Restout (2008, 19 Latin-American countries) find evidence of a negative PPP real exchange rate – terms of trade relationship.

If the terms of trade improve, the production of primary goods becomes more profitable relative to the production of manufacturing and non-tradable goods, and thus provides an incentive for reallocating resources from the latter to the primary sector. Such reallocation pushes all factor prices up, increases the supply of primary goods and, because of income effects, the demand of non-tradable goods. Thus, non-tradable goods prices increase. The impact of terms of trade improvement on the SRER is ambiguous because both tradable and non-tradable prices increase in the same direction.

Terms of trade are expected to increase the size of the primary sector but to reduce the size of the manufacturing sector. When they reduce the size of the primary sector because of huge income effects, these improvements perform a macroeconomic misalignment called the Dutch disease.[11]

iv) Additional external debt (current account deficits)

Capital inflows are associated with real exchange rate appreciations because, if there is no initial debt, they 'affect the economy by raising the domestic absorption' (Carrera & Restout 2008, p.6). Thus, via pure income effects, capital inflows increase the demand for all goods, push non-tradable prices up and increase the consumption of both tradable goods

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[10] Following Alberola ((2003), p.11) non-tradable goods market equilibrium and factor price equalization conditions imply that sectoral relative prices are related to the evolution of sectoral productivity.

[11] Originally, "the term Dutch disease refers to the adverse effects on Dutch manufacturing of the natural gas discoveries of the 1960s, essentially through the subsequent appreciation of the Dutch real exchange rate" (Corden, 1984, p.359). The de-industrialisation of the existing manufacturing was attributed to the upward pressure that the Dutch energy discovery placed on the Guilder and wages.

provided they aren't inferior goods. They, however, reduce both tradable output levels. Hence, capital inflows appreciate SRER and reduce the size of both tradable sectors.

v) Government expenditures

Other variables 'empirically explaining' relative price movements are government expenditures (Baldi and Mulder 2004, p.23-36). Government expenditures influence the SRER via the resource withdrawal effect, the effect of withdrawing resources from private consumption as a consequence of excess of demand for non-tradable goods generated by additional government spending.

Government expenditure raises the demand for tradable and non-tradable output. In small economies, only the additional non-tradable sector demand cannot be satisfied at the current non-tradable prices. Following Carrera & Restout (2008, p.5) an increase in government spending exercises an upward pressure on the relative price of non-tradable goods and thus appreciates the real exchange rate. The consequent SRER appreciation reallocates resources and reshapes the economic structure of a country.

2. Setting up a model suited for small economies, like Argentina, Chile and Mexico

Several theoretical models of real exchange rate determination have been implemented for developing countries. They are generally based on strong micro-economic foundations but differ in their underlying hypotheses, e.g. perfect competition and constant returns to scale in all sectors (Edwards, 1989), perfect competition but diminishing marginal returns in all sectors (Montiel, 1999, and Lane and Milesi-Ferreti, 2004), monopolistic competition in a non-tradable sector that faces diminishing returns to scale (Obstelfd and Rogoff, 1996), monopolistic competition in the non-tradable sector, linear technologies in the non-tradable sector and tradable goods exogenously given (Calderon, 2000), perfect competition, linear technology in the non-tradable sector and Cobb-Douglas in the tradable sectors (Zarzosa, 2008) and monopolistic non-tradable sector but perfect competition in the tradable sectors, linear (non-tradable) and Cobb-Douglas (tradable) technologies (Zarzosa, 2008).

Despite their differences, all models converge in a single equation approach that allows deriving a reduced form for the equilibrium real exchange rate. Next a modified version of the micro-founded model for small economies developed by Zarzosa (2008) is presented.

Representative consumers and producers are assumed to be rational. We assume a world with three goods: two tradable goods and one non-tradable good (N). Like Salter-Swan's model (1959, p. 226), tradable goods consist of primary goods (X), of which the surplus over home consumption is exported; and *manufacturing goods* (M), of which the deficiency between consumption and home production is imported. The prices of the primary and the manufacturing good are determined on world markets and follow the law of one price (LOOP).[12] Hence, the relative primary to manufacturing price would be equal to the terms of trade ($TT = P_X / P_M$), relative price defined as the relationship between the prices of its exports (P_X) and the prices of its imports (P_M).

We assume a two-level constant elasticity of substitution (CES) utility function, where primary, manufacturing and non-tradables are considered to be imperfect substitutes in consumption. Formally:

[12] This law 'defines tradable goods as those goods whose prices are determined entirely by international border prices and the nominal exchange rate' (Hinkle and Montiel, (1999), p.117).

$$U = \left\{ \gamma^{1-\beta} \left[\left[\delta^{1-\rho} C_X^{\rho} + (1-\delta)^{1-\rho} C_M^{\rho} \right]^{\frac{1}{\rho}} \right]^{\beta} + (1-\gamma)^{1-\beta} C_N^{\beta} \right\}^{\frac{1}{\beta}} + g \quad (1)$$

where:
U is the consumption utility function (or total consumption CES index)
C_X, C_M and C_N are the primary, manufacturing and non-tradable goods consumption levels, respectively
γ is the preference weight for tradable goods w.r.t. non-tradable goods
δ is the preference weight for primary w.r.t. manufacturing
$0 < 1/(1-\beta) < \infty$ is the inter-class tradable to non-tradable elasticity of substitution ($\beta < 1$),
$0 < 1/(1-\rho) < \infty$ is the intra-class elasticity of substitution between tradable goods ($\rho < 1$),
g is the amount of government spending allocated to each consumer

In line with Balvers and Bergstrand (2002, p.4), government spending is incorporated in the utility function in a 'separable way'.[13] Thus, it is assumed that the representative consumer receives an exogenous amount *g* of government expenditure, where *g* is allowed to be spent on both tradable and non-tradable goods.

The representative consumer maximizes her utility subject to her budget constraint. In the consumers' optimum point, the relative tradable to non-tradable demand depends negatively on the SRER ($SRER = P_T / P_N$), suggesting a consumption trade-off between tradable and non-tradable goods. Further, the consumption trade-off between primary and manufacturing goods is reflected by the relative manufacturing to primary goods demand and depends negatively on the terms of trade.

The economy is divided into three internally homogenous sectors: primary (X), manufacturing (M) and non-tradable (N). These sectors use labour and capital in their production process. Following Rodrik (2006), the non-tradable sector technology is linear while the both tradable sectors technology are Cobb-Douglas. Formally:

$$X = X(L_X, K_X) = TFP_X L_X^{\phi_X} K_X^{\psi_X} \quad (2)$$

$$M = M(L_M, K_M) = TFP_M L_M^{\phi_M} K_M^{\psi_M} \quad (3)$$

$$N = N(L_N, K_N) = TFP_N \left\{ Z_{N_L} L_N + Z_{N_K} K_N \right\} \quad (4)$$

where:
X, *M* and *N* are the production of primary, manufacturing and non-tradable sectors, respectively,
ϕ_X and ψ_X, ϕ_M and ψ_M are the primary and manufacturing output elasticities, respectively, lying between zero and one,
TFP_X, TFP_M and TFP_N are the total factor productivities of the factors employed in the primary, manufacturing and non-tradable sectors, respectively
Z_{NL} and Z_{NK} are the specific productivities of the labour and capital employed in the non-tradable sector. They are assumed to be constant
L_i and K_i are the labour and capital employments for sector *i*

The representative producer of each sector maximizes profits taking the technology, prices and resource endowments as given. In the producers' optimum point, resource allocation between tradable and non-tradable goods depends on the SRER; while resource allocation within the tradable goods sector depends on the terms of trade. The supply of each tradable good is thus positively related to the SRER, while terms of trade improvements increase the supply of primary goods but decrease the supply of manufacturing goods.

The economy is assumed to be perfectly competitive with international price-taking behaviour. Prices can be thought of as perfectly flexible and the current account at a 'sustainable' level in the sense that it is consistent with eventual convergence to the stock-

[13] The introduction of g in a 'separate way' implies that the marginal rate of substitution between tradable and non-tradable goods does not depend on g.

flow equilibrium.[14] In addition, we assume full employment of a fixed supply of labour and capital as well as the perfect mobility of labour and capital between sectors. Formally:

$$L = L_X + L_M + L_N \tag{5}$$
$$K = K_X + K_M + K_N \tag{6}$$

where:
L and *K* are the labour force and capital endowments of this economy

The equilibrium of an economy with perfectly competitive markets and full employment of its production factors implies no extraordinary profits. Thus, the income generated by all sectors during a given period (Gross Domestic product, GDP) is equal to the factor rewards during that period. The zero profits condition is formally presented as follows:

$$P_X X + P_M M + P_N N = GDP = wL + rK \tag{7}$$

where:
w and *r* are the domestic wage and the interest rate, respectively,
P_X, P_M and P_N are the prices of the primary, manufacturing and non-tradable goods, respectively
GDP is the gross domestic product

Government expenditures along the total expenditure of tradable and non-tradable goods cannot be bigger than the GDP plus the additional debt (or loon) net of services. Also, non-tradable production must be equal to the public consumption of non-tradables ($a.G/P_N$) plus the private consumption of non-tradable goods (C_N). The current account definition and the non-tradable market condition are formally presented as follows:

$$P_X C_X + P_M C_M + P_N C_N + G = GDP(1 + \frac{CA}{GDP} - \frac{r*dF}{GDP}) = GDP(1 + CAMRDF) \tag{8}$$
$$s.t. \quad N = C_N + a.(G/P_N)$$

where:
r^*, *F*, *CA*, are the international interest rate, net foreign asset position, current account, respectively. CAMRDF measures the current account (or a country's debt reduction) net of debt services and transfers as a share of GDP
G and g are the total public expenditure and the total government expenditure / GDP ratio
a is the proportion of total government expenditure (G) that falls in non-tradable goods
d is the difference operator

Equilibrium Relationships

Production factors and consumer expenditures are allocated according to the signals of the SRER and terms of trade. In equilibrium, consumer and producer interaction fits the micro- and macroeconomic conditions. If the economic structure of a country is given at the beginning of the period of analysis, the static comparative analysis of this model implies that exogenous shocks will impact on SRER and the sectoral shares.

Table 2 shows schematically the *ex-ante* SRER and the sectoral shares equilibrium relationships; Equations (9)-(12) display the formal relationships. The 1st row of Table 2 displays the SRER response to exogenous productivity, factor endowments, terms of trade, government expenditure and debt shocks. Similar relationships are widely estimated by real exchange rate models, e.g. Balassa (1964), Devarajan et al (1991), Baldi and Muller (2004), Garcia (1999), MacDonald and Ricci (2002), Gay and Pellegrini (2003), Calderon (2003) and Obstfeld and Rogoff (2006).

[14] Following Alberola ((2003), p.11), the external balance is characterized by the achievement of the optimal or desired stock of net foreign assets.

Table 2: Structural Real Exchange Rates and Sectoral Income Distribution ratios*

Variables	TFP_X	TFP_M	TFP_N	L	K	TT	g	CAMRDF
SRER	-	-	+	+	+	$?_-$	-	+
X share	+	-	-	?	?	+	-	+
M share	-	+	-	?	?	-	-	+
T share	+	+	-	-	-	$?_+$	-	+

TFP_X, TFP_M and TFP_N are the total factor productivity of the primary, manufacturing and non-tradable sectors
L (labour force) and K (capital) are labour and capital endowments, respectively
TT, g and CAMRDF are the terms of trade, total government spending (as a share of GDP) and the current account surplus net of debt services and transfers, respectively
X, M and T shares are the primary, manufacturing and tradable sectors share to GDP, respectively

$$SR\hat{E}R = -\Phi_1 T\hat{F}P_X - \Phi_2 T\hat{F}P_M + \Phi_3 T\hat{F}P_N + \Phi_4 \hat{L} + \Phi_5 \hat{K} - \Phi_6 (\hat{TT}) - \Phi_7 d(g) + \Phi_8 d(CAMRDF) \quad (9)$$

$$d(\theta_X) = \Gamma_{1X} T\hat{F}P_X - \Gamma_{2X} T\hat{F}P_M - \Gamma_{3X} T\hat{F}P_N + \Gamma_{4X}\hat{L} + \Gamma_{5X}\hat{K} + \Gamma_{6X}(\hat{TT}) - \Gamma_{7X}.d(g) + \Gamma_{8X} d(CAMRDF) \quad (10)$$

$$d(\theta_M) = -\Gamma_{1M} T\hat{F}P_X + \Gamma_{2M} T\hat{F}P_M - \Gamma_{3M} T\hat{F}P_N + \Gamma_{4M}\hat{L} + \Gamma_{5M}\hat{K} - \Gamma_{6M}(\hat{TT}) - \Gamma_{7M} d(g) + \Gamma_{8M} d(CAMRDF) \quad (11)$$

$$d(\theta_T) = \Gamma_1 T\hat{F}P_X + \Gamma_2 T\hat{F}P_M - \Gamma_3 T\hat{F}P_N - \Gamma_4 \hat{L} - \Gamma_5 \hat{K} + \Gamma_6 (\hat{TT}) - \Gamma_7 d(g) + \Gamma_8 d(CAMRDF') \quad (12)$$

where
a hat over a variable indicates a rate of change while d refers to the difference operator
$Xshare(=\theta_X)$, $Mshare(=\theta_M)$, $Tshare(=\theta_T)$, θ_L and θ_K are the primary, manufacturing and non-tradable shares to GDP
θ_L, θ_K are the labour and capital shares to GDP

$$\Phi_0 = \frac{\frac{1-\beta}{\beta}\left(\frac{1}{\theta_T - CAMRDF - (1-a)g}\right)}{1-\gamma+\left[\frac{1-\beta}{\beta}\left(\frac{1}{\theta_T - CAMRDF - (1-a)g}\right)\times\left(\frac{\theta_X}{1-\phi_X-\psi_X}+\frac{\theta_M}{1-\phi_M-\psi_M}\right)\right]} \geq 0$$

$\Phi_1 = \Phi_0 \frac{\theta_X}{1-\phi_X-\psi_X} \quad 0 \leq \Phi_1 \leq 1$ $\quad \Gamma_1 = \theta_T \frac{\Phi_1}{\Phi_0}(1-\Phi_3)$ $\quad \Gamma_{1X} = \theta_X \frac{1-\Phi_1}{1-\phi_X-\psi_X}$ $\quad \Gamma_{1M} = \theta_M \frac{\Phi_1}{1-\phi_M-\psi_M}$

$\Phi_2 = \Phi_0 \frac{\theta_M}{1-\phi_M-\psi_M} \quad 0 \leq \Phi_2 \leq 1$ $\quad \Gamma_2 = \theta_T \frac{\Phi_2}{\Phi_0}.(1-\Phi_3)$ $\quad \Gamma_{2X} = \theta_X \frac{\Phi_2}{1-\phi_X-\psi_X}$ $\quad \Gamma_{2M} = \theta_M \frac{1-\Phi_2}{1-\phi_M-\psi_M}$

$\Phi_3 = \Phi_1 + \Phi_2 \quad 0 \leq \Phi_3 \leq 1$ $\quad \Gamma_3 = \Gamma_2 + \Gamma_2$ $\quad \Gamma_{3X} = \theta_X \frac{1-\Phi_3}{1-\phi_X-\psi_X}$ $\quad \Gamma_{3M} = \theta_X \frac{1-\Phi_3}{1-\phi_M-\psi_M}$

$\Phi_4 = \Phi_0 \theta_T \theta_L$ $\quad \Gamma_4 = \theta_T \frac{\Phi_4}{\Phi_0}(1-\Phi_3)$ $\quad \Gamma_{4X} = \theta_X \frac{\Phi_4}{1-\phi_X-\psi_X} - \theta_L$ $\quad \Gamma_{4M} = \theta_M (\frac{\Phi_4}{1-\phi_M-\psi_M} - \theta_L)$

$\Phi_5 = \Phi_0 \theta_T \theta_K$ $\quad \Gamma_5 = \theta_T \frac{\Phi_5}{\Phi_0}(1-\Phi_3)$ $\quad \Gamma_{5X} = \theta_X \frac{\Phi_5}{1-\phi_X-\psi_X} - \theta_K$ $\quad \Gamma_{5M} = \theta_M (\frac{\Phi_5}{1-\phi_M-\psi_M} - \theta_K)$

$\Phi_6 = (1-\delta)\Phi_1 - \delta\Phi_2 \underset{\leq}{\geq} 0$ $\quad \Gamma_6 = \theta_T \frac{\Phi_6}{\Phi_0}(1-\Phi_3)$ $\quad \Gamma_{6X} = \theta_X \frac{\Phi_{6M}}{1-\phi_X-\psi_X}$ $\quad \Gamma_{6M} = \theta_M \frac{\Phi_{6X}}{1-\phi_M-\psi_M}$

$\Phi_7 = \Phi_0 \frac{(1-\theta_T) - a(1-CAMRDF)}{1+CAMRDF} \geq 0$ $\quad \Gamma_7 = \theta_T \frac{\Phi_7}{\Phi_0}\Phi_3$ $\quad \Gamma_{7X} = \theta_X \frac{\Phi_7}{1-\phi_X-\psi_X}$ $\quad \Gamma_{7M} = \theta_M \frac{\Phi_7}{1-\phi_M-\psi_M}$

$\Phi_8 = \Phi_0 \frac{(1-\theta_T) - ag}{1+CAMRDF} \geq 0$ $\quad \Gamma_8 = \theta_T \frac{\Phi_8}{\Phi_0}\Phi_3$ $\quad \Gamma_{8X} = \theta_X \frac{\Phi_{8M}}{1-\phi_X-\psi_X}$ $\quad \Gamma_{8M} = \theta_M \frac{\Phi_{8X}}{1-\phi_M-\psi_M}$

$$\Phi_{8X} = \Phi_8 + \delta = (1-\delta)\Phi_1 + \delta(1-\Phi_2) \qquad \Phi_{8M} = 1-\delta-\Phi_8 = (1-\delta)(1-\Phi_1) + \delta(\Phi_2)$$

The 2nd, 3rd and 4th rows of table 3 describe the ex-ante sectoral income distribution effects of exogenous shocks. It is through changes in the relative cost of producing a particular good, that any exogenous shock has two effects: the resource movement effect and the spending effect. The first one refers to the reallocation of resources as a result of changing factor prices induced by a given shock. If there is full employment, the GDP and demand for all products would change. Again a reallocation process will take place (spending effect). Zarzosa (2008) explains in detail the intuition behind these relationships.

The set up of this theoretical model is perfectly suited for small economies like Argentina, Chile and Mexico. Next, Table 2 relationships are tested when applied to these economies.

IV. Empirical estimation and results: The Argentinean, Chilean and Mexican cases

In this section the theoretical model is applied based on the guidelines of two approaches: The Fundamental Equilibrium Exchange Rate (FEER) and the Behavioral Equilibrium Exchange Rate (BEER).

Whereas the FEER is a special-purpose modeling approach that is specifically designed to test how rich the theoretical model is in providing predictions about the future evolution of the SRER and sectoral shares,[15] the BEER denotes a modeling strategy that attempts to explain the actual behaviour of the SRER and sectoral shares in terms of relevant economic variables. The BEER in this paper, however, is not based on ad-hoc conditions but rather on the schematic relationships that the theoretical model proposes.

The FEER is, thus, a normative approach that would be consistent with the "ideal economic conditions: the theoretical model holds". These conditions are, however, not necessarily projected to occur in the future, but rather are desirable outcomes that may never be realized (Clark and MacDonald, 1998, p.6). This normative aspect by itself is not a criticism of the approach, as it simply reflects the objective of calibrating the theoretical model. The BEER involves the direct econometric analysis of SRER and the sectoral shares. Thus, the BEER is adapted so as to provide meaningful assessment of the SRER and sectoral shares along the lines of the FEER approach.

The FEER and BEER approaches are mainly focused on the determinants of the real exchange rate.[16] Thus, a subsection of this section will compare the SRER misalignments, deviations of the actual SRER to the FEER and BEER for the Argentinean case. Next, the dataset is presented, the theoretical model is calibrated as well as directly estimated and a benchmarking for the Argentinean SRER is developed.

1. Data: Definition and evolution

The dataset includes observations from 1994Q3 to 2006Q2 for Argentina (48 observations), 1996Q1 to 2006Q3 for Chile (43 observations) and 1995Q1 to 2007Q3 for Mexico (51 observations). The XII-ARIMA model has been applied to their original data, see appendix II.

The seasonally adjusted data have been used to construct the following variables: a) TFP measures, which have been built based on conditions imposed by the theoretical model,[17] see appendix III, b) sectoral labour productivities (LP) refer to the sectoral product to its sectoral employment ratio,[18] c) terms of trade (TT) are the relative export to import prices, d) labour force (L or labour endowment) series include the labour employed by the primary, manufacturing and non-tradable sectors, e) capital endowments (K) for Argentina en Chile and f) capital endowments in Mexico have been proxied by the gross fixed investment series

[15] Following Clark and MacDonald (1998, p.4), the FEER equilibrium exchange rate is defined as the real exchange rate that is consistent with macroeconomic balance, which is generally interpreted as when the economy is operating at full employment and low inflation (internal balance) and a current account that is sustainable (external balance).

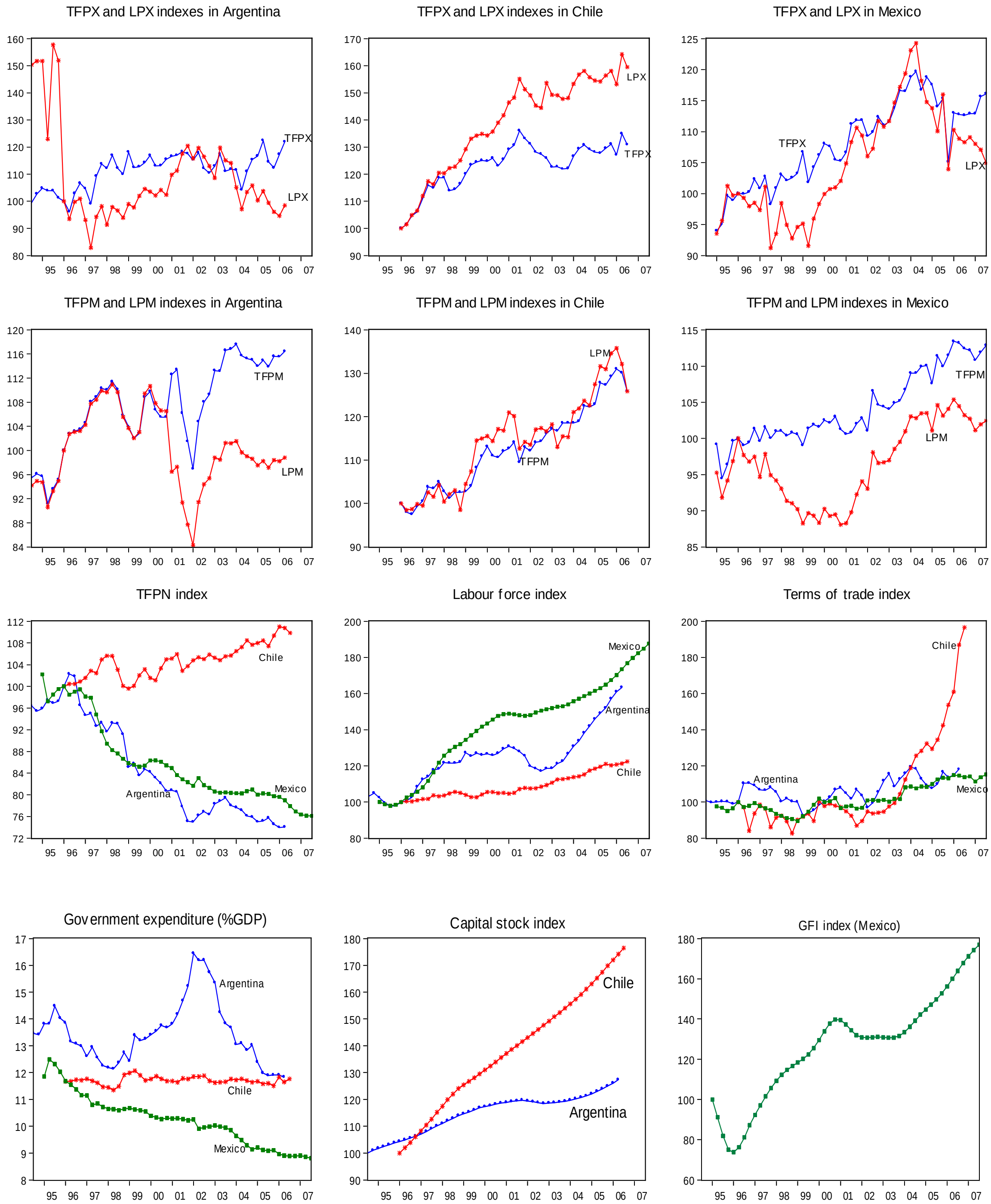
[16] The FEER and BEER in the current literature are focused on the Purchasing power parity real exchange rate rather than in the SRER.

[17] Following Carrera & Restout (2008, p. 12), recent real exchange rate literature has been focused on proxy variables for TFP data (i.e. Solow residual). They stress that a) data on sectoral TFP is unavailable for developing countries because its calculation involves data on sectoral labour and capital stocks and estimates of sectoral labour shares in production which are almost unavailable for most developing countries and b) TFP measures based on the Solow residual tend to be correlated to aggregate demand variations and are often associated with Cobb-Douglas production functions.

[18] The evolution of TFP and LP are related. Thus, the TFP-LP correlations in the primary and manufacturing sectors are: a) 0.4554 and 0.0710 in Argentina, b) 0.92806, 0.96645 in Chile and c) 0.935 and 0.8123 in Mexico.

(GFI). Figure 2 displays the evolution of the Argentinean, Chilean and Mexican sectoral TFP and LP productivities, TT, and L, K and GFI series.

Figure 2: Determinants of SRER and sectoral shares



The relationships of Table 2 are not interdependent; thus, individual equations for SRER and the sectoral shares could be separately estimated. Next, two empirical applications are presented and analyzed: a) the theoretical model is simulated and b) the theoretical relationships are jointly estimated by the SUR model.

2. Calibration of the theoretical Model based on the E-views simulation approach

The theoretical relationships postulated by Equations (9)-(12) could be combined to create a stochastic joint simulation for all of the variables in the model. This simulation process: a) takes into account the features of the theoretical model and b) incorporates uncertainty into the model by adding a random element to the equation residuals.

To begin, the unknown coefficients Φ_i, Γ_{iX} and Γ_{iM} are estimated. Thus, Equations (9), (10) and (11) are separately estimated by ordinary least squares (OLS); Equation (10) for Argentina includes a crash dummy variable (variable with ones in the first and second quarter of 2002 and zero elsewhere). Then, we add the estimated Equations (9), (10) and (11) and the identity (Tshare=Xshare+Mshare) as a joint model.

The subsequent model is solved by a dynamic forecast approach. It examines how the model performs when used to forecast many periods into the future. To do this, it uses the forecast from previous periods, not actual historical data, when assigning values to the lagged endogenous terms in our model. Our results illustrate, thus, how our model would have performed if we have used it back in the beginning of the analyzed period to make a forecast over the period of analysis. Also, we are implicitly assuming that we had used the correct paths for the exogenous variables (in reality, we would not have know these values at the time the forecast were generated).[19]

The presented model is also solved by an stochastic simultaneous approach. Under this approach, the estimated Equations (9), (10) and (11) do not hold exactly over the forecast period but estimation errors are expected in the future as we have seen in history. Adding uncertainty to the model implies predicting a whole distribution of outcomes for each variable at each observation.

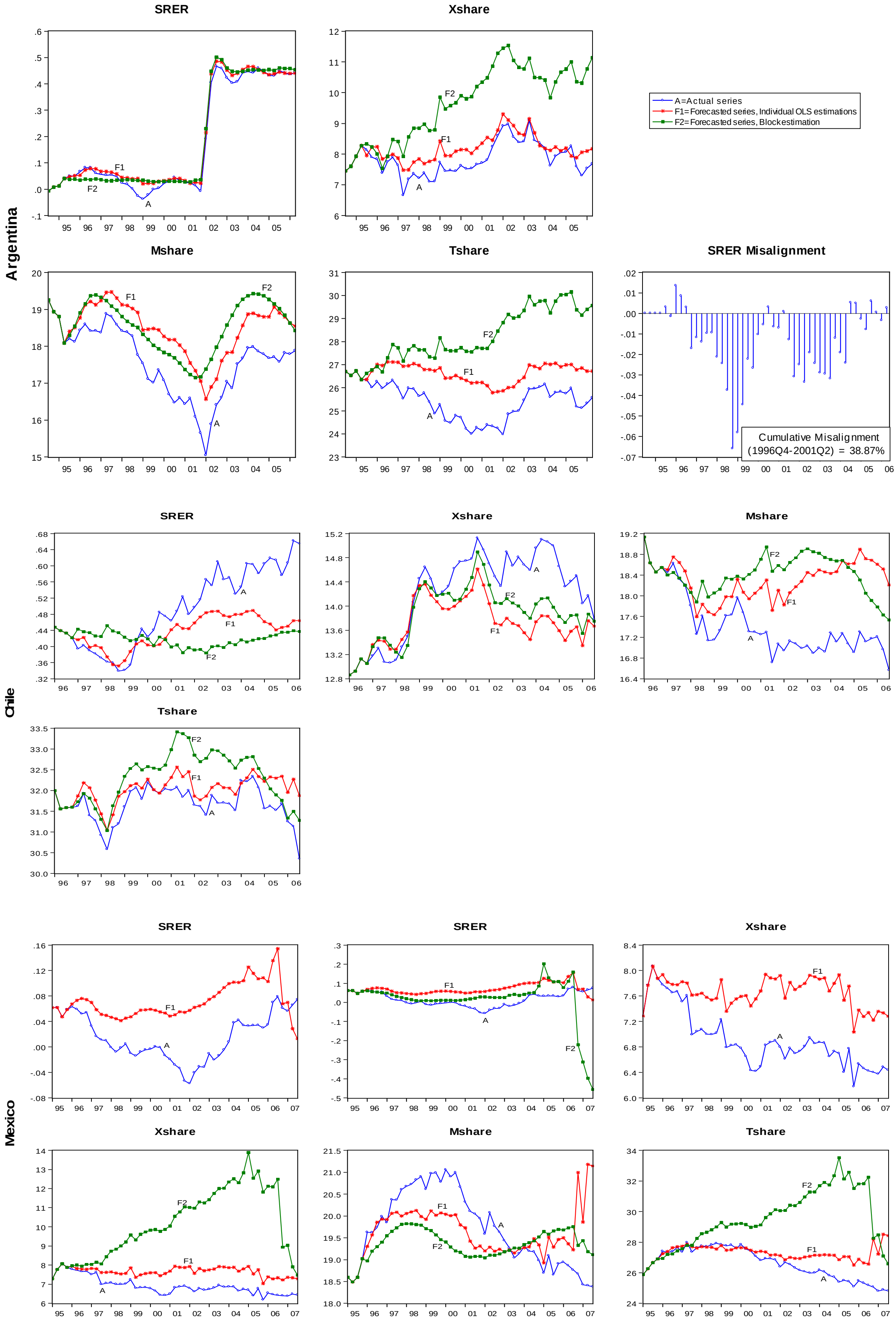
E-views makes it easy to calculate statistics to describe the distributions of SRER, Xshare and Mshare in an uncertain environment. Their distributions are simulated based on the Monte Carlo approach: the model is solved many times with pseudo-random numbers substituted for the unknown errors at each repetition. This method provides only approximate results. However, as the number of repetitions is increased, we would expect the results to approach to their true values.

A drawback of the presented model is that Equations (9), (10) and (11) does not take into account the Φ_i, Γ_{iX} and Γ_{iM} inter-relationships. An alternative model considers these relationships estimating Equations (9), (10) and (11) as a block and by the SUR method. This alternative model is then solved by a dynamic and stochastic forecast approach.

Figure 3 shows the actual and forecasted series for Argentina, Chile and Mexico; graphs with the error bounds are available upon request. Each chart displays the a) actual series (A), b) forecasted series (F1) of the single equations approach and c) forecasted series (F2) of the block estimation approach. It should be pointed out that we expect the F1 forecasted series to fit better the actual series behaviour. Whereas the F1 model is estimated based on the restrictions placed on their corresponding equation, the F2 must fulfil all of the inter-equations restrictions.

[19] This conditional forecast approach is likely to show substantial deviations from one-step ahead estimations (static forecast approach) but they test better the performance of the theoretical model.

Figure 3: Simulation results



The results for Argentina shows that a) both models perform quite well the SRER behaviour, b) the single equation approach performs better the Xshare and Mshare behaviour than the block estimation approach and c) the F2 series of SRER and Mshare are flattened respect the F1 series. Also, SRER and Mshare actual series are inside the error bounds up to 2 standard deviations of both models. The observed series of Xshare and Tshare do not lie always in the 2 standard deviation bound of the block estimation approach.

The theoretical model suggests that any deviation of the real exchange rate real exchange rate should be corrected via changes in the non-tradable prices or the nominal exchange rates. SRER deviations from its equilibrium value are known as SRER misalignments and they are measured as the difference between the actual and forecasted (*ex-ante* equilibrium) SRER.

The last chart of the Argentinean block in Figure 3 displays the SRER misalignment based on the forecast of the single equation approach. The SRER misalignment was negative between the last quarter of 1996 and the second quarter of 2001; the accumulated SRER misalignments in this period were by about 38.9%. The Argentinean macroeconomic conditions imposed, thus, a depreciation of its currency. The consequent collapse of the Argentinean exchange regime, at the end of 2001, generated an overshooting of the SRER; SRER depreciated by about 47.5% in the first three quarters of 2002.

The simulation results for Chile suggests that a) the single equation forecast approach performs better the SRER behaviour than the block estimation approach, b) the single and block estimation approach forecast well the deviations but not the level of Xshare, c) the single and block estimation approach forecast well the Mshare behaviour up to the last quarter of 1999 only and d) observed SRER, Xshare, Mshare and Tshare series are inside the two standard deviation error bounds of the forecasted series of both approaches.

The results for Mexico suggest that: a) both the single and block estimation approach yield poor estimations for the SRER behaviour, though the single approach predicts better the SRER deviations than the block estimation approach, b) the ability of the single approach to predict the Xshare behaviour is also better than the block estimation approach, c) the single estimation approach performs well the Mshare behaviour until the third quarter of 2006 only and d) the block estimation forecast is also good but the forecasted series are flattened. In addition, all observed series lay in the two standard deviation error bound of the forecasted series of the single estimation approach; only the Mshare series are inside the two errors bound of the forecast simulation results of the block estimation approach.

3. Standard regression analysis: Seemingly Unrelated Regression (SUR) model

A shortcoming of the calibration approach is that theoretical restrictions placed on Equations (9), (10) and (11) make difficult the interpretation of the contribution of each exogenous variable in explaining SRER and the sectoral shares.

Hence, standard regression methods are also applied to test Table 2 relationships. These postulated relationships are not interdependent; thus, individual equations for SRER and the sectoral shares could be separately estimated. If these equations are, however, simultaneously estimated, the estimations could be more efficient since their errors could be correlated. As a result, the following block has been estimated for each country by the SUR model corrected by intercept and crash dummy variables:[20]

[20] A SUR model is a multiple equation model with seemingly unrelated regression equations; equations explaining identical variables, but for different samples. The SUR model applies OLS to each individual equation based on the assumptions that each disturbance term is NID (normally and independently distributed) with identical contemporaneous correlation and that non-zero correlation between the different disturbance terms is expected. If the equations are 'really unrelated', the SUR estimates will be identical to the individual OLS

Table 3: SRER and sectoral shares long-run relationships (cointegration vectors)

$$SRER = a_{10} - a_{11}TFP_X - a_{12}TFP_M + (a_{11} + a_{12})TFP_N + a_{13}d(L) + a_{14}d(K) + a_{15}TT - a_{16}g + a_{17}CAMRDF + a_{18}DMI + a_{19}DMC \quad (10)$$

$$X_{share} = a_{20} + a_{21}TFP_X - a_{22}TFP_M - (a_{21} - a_{22})TFP_N + a_{23}d(L) + a_{24}d(K) + a_{25}TT - a_{26}g + a_{27}CAMRDF + a_{28}DMI_X + a_{29}DMC_X \quad (11)$$

$$M_{share} = a_{30} - a_{31}TFP_X + a_{32}TFP_M - (a_{32} - a_{31})TFP_N + a_{33}d(L) + a_{34}d(K) - a_{35}TT - a_{36}g + a_{37}CAMRDF + a_{38}DMI_M + a_{39}DMC_M \quad (12)$$

SRER, TFP_X, TFP_M, TFP_N, L, TT and K, except the Mexican K, are expressed in logarithms
DMI, DMI_X and DMI_M are the intercept dummy variables for SRER, Xshare and Mshare
DMC refers to the crash dummy variables (variables with one in a certain period and zero elsewhere), which were included in the estimations with residuals twice higher than their standard deviations
The first difference of the log of L has been included as a proxy variable of labour endowment
In the case of Chile: CAMRDF is included in first difference
d refers to the first difference operator

The variables involved in this empirical application show unit root behavior. Consequently, Engle and Granger '87s formal two-step approach for cointegration analysis is also applied to test each of the long-run relationships. The error correction model (ECM) corresponding to each long-run relationship are estimated as well.[21] Appendix V details this cointegration method.

The evolution of the tradable sector depends on the evolution of the primary and manufacturing sector. Thus, the addition of the Xshare and Mshare parameters, through the Wald-test, yields the Tshare long-run parameters.

Table 4 and 5 report the cointegration relationships and their corresponding error corrections models (ECM), respectively. Note that 'the long and short-run model can be different with respect to the number of specified variables. Variables that are not included in the long-run equation can be included in the short-run model, or the other way around' (Vogelvang, (2004), p.298).

i) Sectoral productivities

The impact of sectoral TFP on the SRER and sectoral shares provides some insights into the BS framework and their effects on the development of tradable sectors. As expected, TFP_X improvements appreciate SRER, increase Xshare and reduce Mshare in Argentina, Chile and Mexico.

We found also that a) the SRER-TFP_M elasticity of all countries is positive but it is statistically significant in Mexico only, b) TFP_M improvements, as expected, reduce Xshare and increase Mshare in Argentina; though they do not increase its Tshare, c) TFP_M impacts on Mshare as expected but it is not statistically significant in Chile, d) TFP_M improvements reduce the size of both tradable sectors in Mexico and e) they generate in Mexico a macroeconomic misalignments, called the Dutch disease, since they are not expected to reduce the size of its corresponding sector.[22]

estimates. Following (Vogelvang, (2004), p.174), the equations of the SUR model are assumed to be independent but not the correlation between their disturbance terms. These correlations do not influence the OLS-estimation result by equation, though the use of all information gives more efficient results.

[21] Recall that each cointegration approach incorporates both a long-run and an error correction mechanism (short-run solution). An ECM model is an equation specified with variables in first differences and with an error correction term. The parameters of this model can consistently be estimated with OLS, when residual autocorrelation is absent (Vogelvang (2004), p.269). If it is not absent, general least squares (GLS) corrected by White heteroskedasticity-consistent standard errors is performed.

[22] Estimations based on the SUR model per variable shows also Dutch disease performed by TFP_M in Mexico.

TFP improvements in the non-tradable sector a) depreciate SRER in Argentina and Chile only, b) increase the size of both tradable sectors in Argentina and Mexico[23] and c) reduce the size of the Chilean primary and tradable sector as a whole.

Table 5 shows that in the short-run: a) TFP_X influences positively Xshare and negatively Mshare in Argentina and Mexico, b) TFP_X increases both tradable sectors in Chile, c) TFP_M reduces Xshare and increase Mshare in Argentina and Mexico, d) TFP_M reduces the Chilean Mshare e) TFP_N depreciates the Argentinean and Chilean SRER and f) TFP_N increases the Argentinean and Mexican Xshare while reduces the Chilean Xshare.

ii) Factor endowments

International trade theory is mainly focused on the relationship between factor endowments and the relative price between tradable goods. The SRER-factor endowments relationships have been, however, much less explored.

A rise in the growth rate of capital: a) appreciate the Argentinean and Chilean SRERs and b) reduce Xshare but increase Mshare in Argentina and Chile. GFI increments depreciates SRER, reduce Xshare and increase Mshare in Mexico. In the short-run, the capital stock growth rate a) appreciates the Argentinean and Chilean SRERs, b) reduce Xshare but increase Mshare in Argentina, and c) reduces the size of the manufacturing sector in Chile. Mexican GFI increments increase Mshare in the short-run.

A rise in the growth rate of the labour force would: a) depreciate (in line with the theory) SRER in Chile only,[24] b) influence positively both tradable sectors in Argentina and Mexico and c) reduce the size of the primary sector in Chile. In the short-run, the labour force growth rate increases the size of the Argentinean manufacturing sector while reduce Mshare and depreciates SRER in Chile.

iii) Terms of trade

There is evidence that terms of trade improvements depreciate the Argentinean, Chilean and Mexican SRER; their non-tradable prices are, therefore, not huge enough to offset the income effects of terms of trade improvements. As a result, TT improvements contribute in the long-run to the de-industrialisation of both tradable sectors in Chile and Mexico (Dutch disease evidence).

iv) Government expenditure as a ratio of the GDP (g)

As expected, g influences negatively the Argentinean SRER and reduces the sizes of its both tradable sectors. In Chile, g impacts on Mshare only but it is not statistically significant. In Mexico, g increments depreciate the SRER and increase the size of the manufacturing sector. In the short-term, g reduces the Argentinean and Chilean Xshare while raises the Mexican Mshare.

[23] These results could be due to the fact that TFP_N improvements during the nineties were focused to improve the economic infrastructure of these countries.

[24] In line with our theoretical model, Dornbusch (1985, p.14) argued that higher real exchange rates in labour abundant countries are expected since labour-using non-traded services can be produced at a relatively low cost compared to the rich capital abundant country. Also, Frenkel (2004) find negative relationship between unemployment and real exchange rate for Argentina, Chile, Brazil and Mexico. SRER-unemployment relationship fits in our model if and only if there are no exogenous shocks in the total labour force; 'labour force increments' would, thus, correspond to lower unemployment rates.

Table 4: SRER, Xshare, Mshare and Tshare: Long-run relationships

Blocks	Variables	C	TFP_X	TFP_M	TFP_N	d(L)	d(K)	TT	g	CAMRDF	DMI	DMI_X	DMI_M	Statistics	ECF
Argentina	SRER	-0.569	-0.195	0.069	0.127	-0.010	-1.499	0.213	-1.916	0.060	0.31			**R^2** 0.986	-0.387
		0.574	0.095	0.115	0.046	0.257	3.234	0.110	1.011	0.017	0.024			**$AdjR^2$** 0.983	0.065
			**		***			*	*	***	***			**ADF** -6.28	***
	Xshare	6.417	3.608	-4.997	1.389	3.168	-58.733		-6.173	0.544				**R^2** 0.873	-0.298
		1.208	0.559	0.697	0.354	2.011	24.721		8.179	0.060				**$AdjR^2$** 0.853	0.088
		***	***	***	***		**			***				**ADF** -4.70	***
	Mshare	18.325	-4.794	0.805	3.989	1.982	119.767	0.368	-3.137	-0.302			1.152	**R^2** 0.940	-0.265
		5.100	0.879	1.074	0.439	2.452	30.897	0.970	9.732	0.151			0.215	**$AdjR^2$** 0.927	0.111
		***	***		***		***			**			***	**ADF** -5.26	**
	Tshare	24.742	-1.186	-4.192	5.378	5.150	61.034	0.368	-9.310	0.241			1.152	**R^2** 0.978	
		5.371	1.174	1.448	0.662	3.724	46.310	0.970	14.994	0.172			0.215	**$AdjR^2$** 0.973	
		***		***	***								***	**ADF** -4.41	
Chile	SRER	-0.477	-0.542	0.236	0.307	2.283	-5.963	0.182		-0.004	0.097			**R^2** 0.931	-0.819
		0.143	0.122	0.198	0.221	0.516	2.396	0.041		0.002	0.013			**$AdjR^2$** 0.917	0.153
		***	***			***	**	***		*	***			**ADF** -5.47	***
	Xshare	21.965	6.038		-6.038	-8.999	-72.236	-1.297		0.022		0.749		**R^2** 0.945	-0.216
		0.924	0.877		0.877	3.426	13.237	0.207		0.013		0.096		**$AdjR^2$** 0.931	0.176
		***	***		***	***	***	***		*		***		**ADF** 4.39	
	Mshare	14.842	-1.831	0.984	0.847		23.419	-0.547	0.428				-0.94	**R^2** 0.837	-0.426
		3.564	1.015	1.593	1.744		25.763	0.313	0.290				0.160	**$AdjR^2$** 0.804	0.122
		***	*					*					***	**ADF** -4.59	***
	Tshare	36.807	4.207	0.984	-5.191	-8.999	-48.817	-1.844	0.428	0.022		0.749	-0.94	**R^2** 0.976	
		3.737	1.446	1.593	2.044	3.426	30.213	0.393	0.290	0.013		0.096	0.160	**$AdjR^2$** 0.969	
		***	***		**	***		***		*		***	***	**ADF** -3.99	
Mexico	SRER	-1.809	-0.261	0.380	-0.119		0.263	0.320	5.761		0.067			**R^2** 0.877	-0.281
		0.281	0.063	0.116	0.094		0.096	0.050	1.433		0.009			**$AdjR^2$** 0.853	0.117
		***	***	***			***	***	***		***			**ADF** 4.73	**
	Xshare	5.891	4.965	-5.929	0.964	8.390	-1.479	-0.811		0.086		0.181		**R^2** 0.926	-0.109
		3.117	0.805	1.067	0.606	2.782	0.825	0.634		0.012		0.082		**$AdjR^2$** 0.914	0.087
		*	***	***		***	*			***		**		**ADF** -4.70	
	Mshare	28.572	-0.901	-3.436	4.338	22.217	7.205	-3.244	48.974	-0.092			1.327	**R^2** 0.888	-0.174
		9.672	1538	2.909	2.253	7.295	2.432	1.640	31.657	0.032			0.231	**$AdjR^2$** 0.867	0.069
		***			*	***	***	**		***			***	**ADF** -5.37	**
	Tshare	34.462	4.063	-9.365	5.302	30.606	5.726	-4.055	48.974	-0.006		0.181	1.327	**R^2** 0.981	
		9.484	1.547	2.904	2.219	7.146	2.373	1.597	31.657	0.031		0.082	0.231	**$AdjR^2$** 0.976	
		***	***	***	**	***	**	**				**	***	**ADF** -7.54	

All variables, except CAMRDF and the Mexican d(k), are expressed in logarithms. d(k) in Mexico refers to the GFI series
DMI, DMI_X and DMI_M are the intercept dummy variables,
ECF is the error correction factors; residuals of the cointegrated relationships lagged one period,
The first row in each cell refers to the estimated parameters while the second row to its standard deviation
(*), (**) and (***) indicate, that the estimate is significant different from zero at the 10%, 5% and 1% significance levels
ADF is the observed Dickey-Fuller statistic applied to the estimated residuals; all residuals are stationary at 10% levels; critical ADF values are restricted to the number of coefficients estimates in the long-run relationships, see Charemza and Deadman (1997, p. 284)

Table 4.1: Crash Dummy variables (CDV)

CDV included in the equation of:	DM12Q02	DM4Q04	DM4Q00	DM1Q00	DM1Q02	DM4Q05
Argentinean SRER	0.090*** (0.019)					
Chilean Xshare		0.549*** (0.162)	0.598*** (0.157)			
Chilean Mshare				0.769*** (0.204)		
Mexican SRER					-0.047*** (0.011)	-0.044*** (0.013)

DmiQ0j refers to the crash dummy variable corresponding to the quarter i of the year 200j
DM12Q02 is the CDV (variable with ones in the first and second quarter of 2002 and zero elsewhere)

Table 5: SRER, Xshare, Mshare and Tshare: Short-run relationships

Blocks	Variables	d(TFPX)	d(TFPM)	d(TFPN)	d(d(L))	d(d(K))	d(TT)	d(g)	d(CAMRDF)	ECF	DMC	Lag(-1)	Lag(-2)	Lag(-3)	Statistics	
Argentina	d(SRER)			0.256		-4.556	0.215			-0.387	0.174	0.249	-0.099		R^2	0.949
				0.084		1.391	0.053			0.065	0.009	0.046	0.039		$AdjR^2$	0.941
				***		***	***			***	***	***	**			
	d(Xshare)	7.771	-4.808	2.958		-46.612	-0.858	-15.164	0.241	-0.298		0.151	0.155	0.073	R^2	0.919
		0.482	0.717	0.890		13.873	0.500	4302	0.091	0.088		0.047	0.046	0.045	$AdjR^2$	0.895
		***	***	***		***	*	***	***	***		***	***		ADF	
	d(Mshare)	-2.266	7.111		2.766	84.745				-0.265	0.265		0.159		R^2	0.782
		0.621	0.874		1243	20.954				0.111	0.121		0.072		$AdjR^2$	0.748
		***	***		**	***				**	**		**			
Chile	d(SRER)	-0.248		0.655	1.672	-5.211	0.146		-0.004	-0.819					R^2	0.428
		0.160		0.292	0.388	2.636	0.062		0.001	0.153					$AdjR^2$	0.327
				**	***	*	**		***	***						
	d(Xshare)	6.318		-10.096	-4.853			-0.610	0.034	-0.216		0.264		-0.229	R^2	0.535
		1.217		2.765	3.031			0.277	0.010	0.176		0.116		0.120	$AdjR^2$	0.430
		***		***				**	***			**		*		
	d(Mshare)	12.062	-4.118			-0.896				-0.426		0.170	0.288	0.252	R^2	0.639
		1.515	2.382			0.474				0.122		0.114	0.105	0.097	$AdjR^2$	0.572
		***	*			*				***			***	**	ADF	
Mexico	d(SRER)		0.181							-0.281		0.373	-0.221	0.213	R^2	0.276
			0.100							0.117		0.128	0.132	0.129	$AdjR^2$	0.207
			*							**		***	*	*		
	d(Xshare)	6.964	-2.049	3.740				39.217		-0.109					R^2	0.866
		0.432	0.991	0.991				11.182		0.087					$AdjR^2$	0.853
		***	**	***				***								
	d(Mshare)	-1.562	12.779			2.889	-1.661			-0.174		0.249	0.201		R^2	0.766
		0.725	1383			1.501	0.916			0.069		0.094	0.079		$AdjR^2$	0.731
		**	***			*	*			**		***	**			

All variables, except CAMRDF and the mexican d(k)), are expressed in logharithms. DM_C is the Argentinean crash dummy variable. ECF is the error correction factors; residuals of the cointegrated relationships lagged one period. Lag (i) refers to the first difference of the dependant variable lagged i-periods.
The first row in each cell refers to the estimated parameters while the second row its standard deviation
(*), (**) and (***) indicate that the estimate is significant different from zero at the 10%, 5% and 1% significance levels

v) Additional external debt (current account deficits)

The external equilibrium theory of real exchange rate determination suggests a negative relationship between SRER and the net foreign asset position of a country (Alberola, (2003), p.11). Our model postulates similar relationships to this external equilibrium theory if and only if the current account is balanced and there are no transfers.[25]

[25] Recall that CAMRDF is equal to the current account surplus plus transfers minus the debt services (the net foreign asset of a country times the interest or services it generates.

We find evidence that a net debt reduction (CAMRDF increment) depreciate the Argentinean SRER but has no effects on the Mexican SRER. Add, a rise on the speed of additional CAMRDF impact negatively on the Chilean SRER; it maybe because of the Chilean capital controls.

If "external constraints" imposed by the international markets imply CAMRDF increments, both tradable sectors output must increase. CAMRDF is positively related to Xshare but negatively to Mshare in Argentina and Mexico;[26] Argentina and Mexico took debt during the nineties to reform their industrial sector. CAMRDF increments favor the increase of the Chilean Xshare only. In the short-run, CAMRDF a) reduces the size of the primary sector in Argentina and Chile and b) appreciates the Chilean SRER.

vi) Dummy variables

The Argentinean intercept and crash dummy parameters of Tables 4 and 4.1 suggest that the exchange rate regime switch from a fixed to a flexible one caused a 31.1% upward shift in the long-run SRER with an overshooting by about 18%. The exchange rate regime switch caused also an upward shift in the size of the manufacturing sector.

In Chile and Mexico, the SRER break-point are unconnected to the shifts in their sectoral shares e.g. a) in Chile: Mshare shifted downwards in the 2nd quarter of 1998, SRER shifted upwards after the 2nd quarter of 2002 and Xshare shifted slightly upwards after the 4th quarter of 2002, and b) in Mexico, SRER, Mshare and Xshare shifted upwards in the following of the 2nd quarter of 1998, 2nd quarter of 2001 and 3rd quarter of 2005, respectively.

Table 4.1 displays, in addition, the crash dummy variables incorporated in the Chilean Xshare and Mshares and the Mexican SRER series. All crash dummy are statistically significant at the 10% significance level.

vii) Adjustment process and learning process

Each long-run model has its corresponding short-run model since the estimated error correction factor (ECF) of each long-run relationship is negative and, except in the case of the Chilean Xshare, statistically significant at the 10% level.

Further, all ECM models incorporate the first difference of the dependent variable, lagged up to three periods, as explanatory variables. The statistical significance of some of the lagged variables shows that the adjustment process to the equilibrium after a shock has hit the economy is not immediate but implies a learning process.

4. SRER misalignment in Argentina

The Argentinean currency crisis at the end of 2001 provides a suited scenario to compare the FEER and BEER approaches since bad economic conditions impose necessary corrections of its currency.

The SRER misalignments refer to the difference between the observed and the FEER or BEER SRERs: the fundamental (F) misalignment is defined as the difference between the BEER and FEER SRERs while the current misalignment (C) as the difference between the observed and BEER SRERs. The total misalignment is equal to the sum of both misalignments, or the difference between the observed and FEER SRERs.

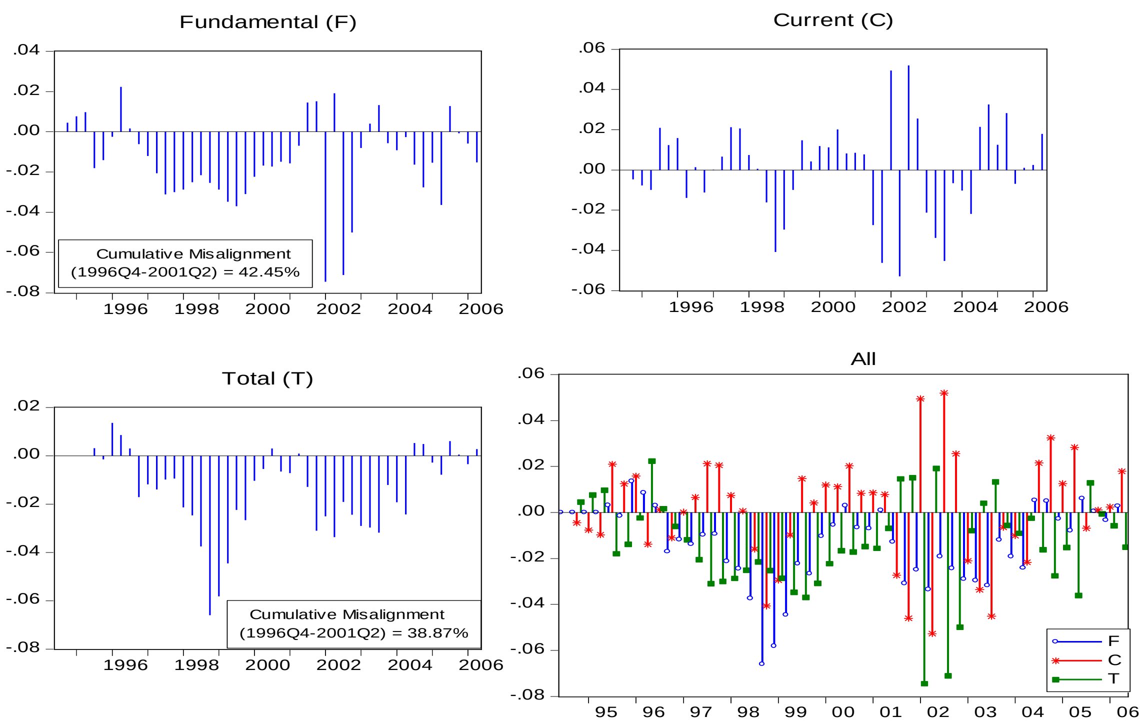
The fundamental misalignment reflects the difference between an empirical modeling strategy and a special-purpose modeling approach because the former refers to the equilibrium of an economy based on a theoretical model; the latter displays the best

[26] Similar results would be found if the estimations would be based on a SUR model by variables.

adjusting path of the SRER following only the theoretical relationships guidelines. Also, the BEER residuals are per-se not suited for detecting long-lasting misalignments since these residuals are not expected (and do not) to have unit root behavior.

The Argentinean FEER and BEER SRERs series refer, respectively, to the single equation forecast results of section 2 and forecast results of Table 4. Figure 4 displays the Argentinean SRER misalignments. The current misalignment as expected does not show a clear trend, not even in the last quarters of 2001 while the fundamental misalignment was negative between the last quarter of 1996 and the first quarter of 2001. The correction of the fundamental misalignment via non-tradable prices in the last quarters of 2001 was not enough to impede an abrupt correction via the nominal exchange rate. Note that the accumulated fundamental misalignment was around 42.45% while the accumulated SRER depreciation in the first three quarters of 2002 was by about 47.5%.

Figure 4: Argentinean Fundamental, Current and Total Misalignments



IV. Further extensions

Some of the shortcomings of this paper come from two sides. From the empirical point of view, the inclusion of a variable (L, labour force) with a deterministic trend could generate spurious regression.[27] We could include the unemployment rate instead of L as explanatory variable for SRER and the sectoral shares. The unemployment rate can be included in the theoretical model assuming that the total labour force does not change; e.g., Frenkel (2004) finds evidence of a negative SRER-Unemployment relationship.

On the theoretical side, there are no diminishing returns to scale in the non-tradable sector modeled in this paper. A CES production function in this sector would make the model more realistic. It could additionally explain the feedback SRER-relative factor prices or the

[27] Though, our regressions include the first difference of L as explanatory variable.

feedback SRER-Unemployment (if relative prices were hold constant). Further, the relationships of theoretical extensions can be empirically tested.[28]

V. Conclusions

A version of the theoretical model developed by Zarzosa (2008) shows how exogenous productivity, labour and capital endowments, terms of trade and debt shocks impact on the structural real exchange rate and sectoral shares of a small economy. The model set up is perfectly suited for small economies, like Argentina, Chile and Mexico. Thus, the SRER and sectoral shares equilibrium relationships have been tested when applied to these economies.

Two estimation approaches have been applied: a) a dynamic-stochastic simulation approach specifically designed to test how rich the theoretical model is in providing predictions about the future SRER and sectoral shares values and b) the Engle and Granger's cointegration approach; which attempts to explain the actual behavior of the economy.

The first approach: a) captures the behaviour of the Argentinean series quite well, b) shows that the collapse of the Argentinean currency at the end of 2001 was necessary to correct a cumulated misalignment of 38.9% and c) ability to predict the Chilean and Mexican variables differs between variables.

The second approach shows that: a) economic policies, which affect relative factor productivity change the SRER (in line with the Balassa-Samuelson framework) and sectoral shares, b) total factor productivity shocks in the Mexican manufacturing sector reduce the size of its corresponding sector, c) the SRER-labour endowments relationship, which has been much less explored in the literature, is positive as expected in Chile only, d) labour endowments influence positively both tradable sectors in Argentina and Mexico but reduce only the Chilean primary sector, e) policies oriented to attract investment have different effects on the SRER and sectoral shares, f) there is evidence of a positive SRER-terms of trade relationship, which implies that the increments in the non-tradable prices in Argentina, Chile and Mexico are not huge enough to offset the income effects of terms of trade improvements, g) terms of trade perform the Dutch disease in Chile and Mexico (reduce the size of their primary sector), h) government expenditure appreciates the SRER and reduces the size of both tradable sectors (as expected) in Argentina, i) Mexican government expenditure depreciates its SRER and increase the size of the manufacturing sector, j) additional external debt will appreciate the Argentinean SRER but has no effects on the Mexican SRER, k) additional external debt in Argentina and Mexico reduces the size of their primary sector but increase their manufacturing sector and l) the collapse of the Argentinean fixed exchange rate, at the end of 2001, depreciated its SRER by about 31.1% in the long-run with an overshooting by about 18%.

In addition, the simulated and cointegrated approachs are benchmarked for the Argentinean SRER. It suggests that the cumulated Argentinean SRER misalignment (38.87%) between the last quarter of 1996 and the second quarter of 2001 was due to fundamental factors determined by the structure of the theoretical model.

This paper can be extended by introducing the unemployment rate as an explanatory variable of SRER and the sectoral shares. Add, diminishing returns to scale in the non-tradable sector can be introduced in the theoretical model.

[28] There is some empirical evidence about the SRER-relative factor prices relationship. Assuming the price of capital as constant, Lee and Tang (2003) find a significant positive SRER-aggregate wage relationships for 12 OECD countries (Belgium, Canada, West Germany, Denmark, Finland, France, Italy, Japan, The Nederlands, Sweden, The United Kingdom and the United States).

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APPENDICES

Appendix I: SRER definition and measurement

The nominal exchange rates (E), purchasing power parity real exchange rate (RER_{PPP}) and SRER are proxy variables of a country's degree of competitiveness in international markets. Whereas E measures the relative prices of two moneys and RER_{PPP} measures the relative price of the similar bundle of goods between two economies,[29] SRER measures, as the name indicates, the relative price of two different goods.

Although the definition of SRER is analytically well defined, it is difficult to calculate in practice. A more operational definition of it is as following: SRER= $v.EP_T^*/P_N$, where P_T^* is the world price of tradable goods, P_N is the price of non-tradable goods and v (= P_T /EP_T^*) is the tradable goods real exchange. Following Monacelli and Perotti (2009, p.440) variations in v are still feasible due to the possible presence of home bias in consumption; note that v is equal to one when the LOOP holds but higher than one when there is home bias trade. If the LOOP holds the adjustment of SRER should come through changes either in E or P_N. The implications would be similar if LOOP does not hold but v is constant.

Different proxies have been used for $E.P_T^*$ and P_N. Assuming that the LOOP holds, "these proxies are usually some foreign price level (a wholesale price index, WPI, for example) and the domestic consumer price index (CPI)" (Edwards, 1988, p.4). CPI and WPI indices are assumed to be the geometric average of the price of tradable and non-tradable goods with the tradable weight of the WPI index (ℓ) larger than the tradable weight of the CPI index (γ).[30] Equations (A.1) and (A.2) define these price indices as follows:

$$CPI = P_T^{\gamma} P_N^{(1-\gamma)} \qquad \text{(A.1)}$$

$$WPI = P_T^{\ell} P_N^{(1-\ell)} \qquad \text{(A.2)}$$

The ratio WPI to CPI serves as a proxy of the relative price structure of an economy. Equation (A.3) shows that this ratio does not measure precisely SRER, but does quite clearly move up and down in sympathy with it.

$$\left.\frac{WPI}{CPI}\right|_{\ell>\gamma} = (SRER)^{(\ell-\gamma)} \qquad \frac{\partial(WPI/CPI)}{\partial SRER} > 0 \qquad \text{(A.3)}$$

Faruque (1995, p.90) states a similar relationship to equation (A.3). It would be more valuable to have true tradable and non-tradable price indices but, the non-tradable price index is by its nature not directly observable and a common world tradable price index would not weight properly the tradable goods of a certain small open economy. MacDonald and Stein (1999, 10) suggest that the ratio WPI to CPI is not a direct measure of the relative tradable to non-tradable price, although its use may be justified by arguing it captures both demand and supply side influences.

Harberger (2004, p.15) quotes its "very hard to understand why so much literature continues to focus on symmetric measures, like the RER_{PPP}, when the theory of the subject gives such central role of the distinction between tradable and non-tradable goods". In this paper, the ratio WPI/CPI is used as a proxy of SRER when applying our theoretical model.

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[29] The RER_{PPP} is defined as the relative price between foreign and domestic goods and it measures the necessary units of domestic goods to buy a unit of foreign goods. This PPP real exchange rate is positively related to the domestic SRER but negatively related to the foreign SRER.

[30] Faruque (1995, p.90) argues that WPI predominantly measures traded goods prices, while CPI has a significant component of services, which are generally not traded. Hinkle and Montiel (1999, p.75) recall that, compared with the CPI, WPI is usually more heavily weighted with traded goods and underweighted with non-traded goods. Harberger (2004, p.10) also suggests that WPI is heavily weighted with tradable goods.

Appendix II: Data sources and seasonal adjustment procedure

Quarterly data on consumer price index (CPI), wholesale price index (WPI), sectoral GDPs (X, M and N), sectoral labour employment (LX, LM and LN), terms of trade (TT), labour endowment (L), foreign direct investment (FDI) and capital stock series (K), gross fixed investment (GFI), current account surplus (CA) and debt services including transfer levels (rDF) were used for the estimations.[31]

a) Data sources

Primary, manufacturing and non-tradable sectors have been classified based on the International Standard Industrial Classification revision 3.1 (ISIC Rev.3.1) of the United Nations. The first one includes agriculture, hunting, forestry, fishing and mining and quarrying sectors (codes A, B and C of the ISIC Rev.3.1). The second one incorporates all the manufacturing sectors (code D of the ISIC Rev. 3.1). Like Gay & Pellegrini (2003), the non-tradable sector includes: Electricity-gas & water, construction, wholesale & retail, Hotel & restaurants, transport-storage & communication, financial intermediation, real estate & business services, public administration & defense, Education, health & social work, other community, social & personal service activities and Private households with employed persons (codes E, F, G, H, I J, K, L, M, N, O and P of the ISIC Rev.3.1).

Sectoral value added (sectoral GDPs) and labour employed have been calculated taking into account the sectoral classification criteria mentioned in the last paragraph.[32] Aggregate GDP series were calculated as the sum of primary, manufacturing and non-tradable production values. Total labour force series also include the labour employed by these three sectors. Sectoral GDPs are expressed in constant prices of the base years 1993 (Argentina), 1996 (Chile) and 1993 (Mexico).

Annual Argentinean capital series are obtained from the Institute of statistics and Census (INDEC). Pérez Toledo (2003) papers provide annual series of the capital stock of Chile. The quarterly data was obtained from the extrapolation of these series with the quarterly GFI series. In Mexico, the annual series of GFI were used as a proxy of first difference of its capital series; its frequency was converted by the Cubic frequency conversion method available in the E-Views programme.[33]

Also, we have tested for and dealt with aberrant Argentinean, Chilean and Mexican FDI observations following the guidelines of Plasmans (2007, pp. 98-104);[34] detailed analysis available upon request.

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[31] Consumer, export and import price indices and sectoral value added were obtained from Argentinean INDEC (Instituto Nacional de Estadísticas y Censos), Chilean Central Bank (Statistics Data Base series) and Mexican INEGI (Instituto Nacional de Estadísticas, Geografía e Informática). Sectoral labour data were obtained from Argentinean Ministry of the Economy (Dirección de Ocupación e Ingresos, Secretaría de Política Económica), Chilean INE (Instituto Nacional de estadísticas, Encuesta Nacional de Empleo) and Mexican INEGI.

[32] Sectoral GDPs include taxes and financial intermediation. Also, a non-classified category has been included in the labour employed in the Argentinean non-tradable sector. Such a category has had declining relative importance in the total non-tradable employment. Except between the 3rd quarter of 1997 and the 2nd quarter of 1999 (it was around the 10% level), it went from 4% to 1% in the last years.

[33] This method assigns each value in the low frequency series to the last high frequency observation associated with the low frequency period, and then places all intermediate points on the natural cubic spiline connecting all the points. This is a global interpolation method so that changing any one point (or adding an additional point) to the source series will affect all points in the interpolated series.

[34] The existence of aberrant corrections, a value that shows an unexpectedly large (positive or negative) difference, generates biased estimates and bad forecast, especially if the aberrant observation is close to the forecasting period. An observation is likely to be aberrant if the Jarque-Bera statistic (JB) is large (the variable distribution is far from being normal) and its value is four times bigger than its standard deviation.

Quarterly series of government expenditure (government consumption) series are available for Argentina and Chile only. Annual series of government expenditure were available for Mexico; these series were converted by the Cubic method mentioned earlier.

Current account, debt services, transfers and FDI series were obtained from the balance of payment sheets published by Argentinean Central Bank, Chilean Central Bank and BANXICO (Banco de Mexico). Quarterly balance of payments series are expressed in US dollars. These series have been converted into domestic currencies by the average nominal exchange rate corresponding to each quarter of the base year.

b) Seasonal Adjustment

Original data (no seasonally adjusted) does not allow, in general, for intra-annual analysis. They can only be benchmarked between similar quarters on different years; different economic sectors face intra-annual cyclical changes (seasonalities) due not necessarily to long-run trends but to climatic or institutional factors (agricultural cycles, holidays, fiscal calendars, etc). Thus, seasonal effects influence the statistical properties of time series.

Seasonal adjustment methods “remove regular effects from a time series in order that more fundamental components, such as trend and the business cycle, can be identified more easily” (Bianchi, (1997), p.1613). Thus, the analysis can be focused on points of the data due to economic factors different to seasonality. Assuming that all variables follow a stochastic rather than deterministic seasonal process,[35] all original data were seasonally adjusted using the XII-ARIMA model of the Census Bureau of National Statistics of the USA.[36]

Statistical tests were applied to check the regularity and stability of the seasonalities as well as the presence of identifiable seasonalities. If identifiable seasonality presence was not found, the seasonally adjusted series is identical to the original data. Where seasonality presence was found, the seasonally adjusted data were used. A detailed application of the XII-ARIMA method is available upon request.

We have applied the XII-ARIMA model to the Argentinean, Chilean and Mexican original values of CPI, WPI, X, M and N, LX, LM, LN, TT, L, K, GFI, FDI[37], CA and rDF. The seasonally adjusted data have been used to construct the following variables: SRER, Xshare, Mshare, Tshare, sectoral total factor productivities (TFP), labour and capital endowments, terms of trade (TT) and the ratio current account surplues net of services and transfers (CAMRDF = (CA minus rDF)/GDP).

[35] If seasonality changes, the regression method is not useful since a non-deterministic seasonality violates the implicit assumptions of regression estimation (Bravo et al, 2002, p.2).

[36] Similar moving average techniques are officially applied for statistical agencies. They include among them, the US Bureau of the Census Method II X-11 variant; the seasonal factor method; the Burman Method of the Bank of England; the Berlin Method, ASA II, the method of the Statistical Office of the European Communities of Brussels; and the method of the Dutch Planning Bureau. (Dagum, (2000), p.12)

[37] As expected, no seasonality presence was found in the FDI series.

Appendix III: TFP measures

Due to lack of data on Argentinean, Chilean and Mexican sectoral TFP, TFP series have been constructed based on restrictions imposed by the theoretical model. First, TFP in the non-tradable sector is equal to its labour productivity since the non-tradable technology has been assumed to be linear. Second, TFP in the primary and manufacturing sectors have been calculated based on the assumption that the relative factor prices have been constant; note that the 1st order conditions of the non-tradable producer's maximization problem imply constant relative factor prices.

Cobb-Douglas production functions are homothetic in the sense that in the producers' optimum point the capital / labour ratio depends only on the relative factor prices. Thus, if the relative factor prices are given, the proportional change in the labour and capital employed must be the same (%∆ki =%∆Li, i refers to the sector under analysis). Consequently, for any Cobb-Douglas production function, the proportional change in the product (%∆yi) is equal to: a) φi*(%∆Li)+ ψi*(%∆Ki)+(%∆TFPi) or b) (φi + ψi)* (%∆Li)+(%∆TFPi); where φi and ψi are the output elasticities of labour and capital employed in sector i.

It means that only one factor -labour (available) in this case- can be used to calculate the proportional change in TFP as a residual. Plus, the aggregate output elasticities ($\varphi_i+\psi_i$) can be estimated while calculating $\%\Delta TFP_i$. Table A.2.1 shows the estimation of the Solow residual and sectoral TFP while, Table A.2.2 displays the estimates of (φi + ψi).

Table A.2.1: TFP measures, OLS estimations of %∆yi =(φi + ψi)* (%∆Li)+(%∆TFPi)

Argentinean Primary Sector

	d(LX(-3))	d(X(-1))	d(X(-2))	M2Q97	DM2Q03	R^2	Adjusted R^2
d(X)	0.11214**	-0.380754*	-0.29871**	-0.119953*	0.120514*	0.509570	0.459269
	(1.952607)	(-3.256616)	(-2.520589)	(-3.488583)	(3.514055)		

Argentinean Manufacturing Sector

	d(LM)	d(LM(-2))	DM1Q01	R^2	Adjusted R^2
d(M)	1.638459*	-0.728223*	-0.157809*	0.633142	0.615673
	(8.603403)	(-4.561450)	(-5.573543)		

Chilean Primary Sector

	d(LX(-4))	d(X(-3))	DM2Q98	DM3Q00	DM4Q02	R^2	Adjusted R^2
d(X)	0.592244*	0.297573**	0.041013**	0.034437**	0.051681*	0.402232	0.329775
	(2.769703)	(2.396297)	(2.637169)	(2.262018)	(3.221800)		

Chilean Manufacturing Sector

	d(LM)	DM4Q98	DM1Q04	R^2	Adjusted R^2
d(M)	0.034308	-0.057290*	0.045005**	0.225545	0.185830
	(0.223995)	(-2.976274)	(2.349108)		

Mexican Primary Sector

	D(LX(-4))	D(LX(-5))	D(LX(-6))	D(X(-1))	DM2Q97	DM3Q97	DM3Q05	R^2	Adj. R^2
d(X)	-0.5191*	0.344***	0.3611**	-0.4016*	0.0427**	-0.0557*	0.07648*	0.65384	0.59770
	(-3.0538)	(1.9496)	(2.0920)	(-3.6114)	(2.1694)	(-2.7184)	(3.7353)		

Mexican Manufacturing sector

	D(LM)	D(LM(-2))	D(M(-1))	D(M(-3))	DM1Q96	DM2Q97	DM1Q00	R^2	Adj. R^2
d(M)	1.2666*	-0.5762*	-0.4470*	0.194***	0.0492*	0.0353*	0.0250**	0.7015	0.656699
	(6.8569)	(-3.255)	(-4.287)	(1.9122)	(3.3426)	(2.7297)	(1.9971)		

X, M, L_X and L_M are the value added and the labour employed by primary and manufacturing sector, respectively
X, M, L_X, L_M are expressed in logarithms and (-k)/k=1,2,3 refers to the lagged values of the involved variables
DMiQj refer to crash dummy variables, variables with one in the quarter I of the year j
(*),(**) or (***) shows that the estimated coefficient is different from zero at the 10%, 5% or 1% significance level

Table A.2.2: Aggregate output elasticities (φi + ψi), based on the Wald-test applied to Table A.3.1 regressions

	Argentina		Chile		Mexico	
Sector	Primary	Manufacturing	Primary	Manufacturing	Primary	Manufacturing
(φi + ψi)	0.066770**	0.910236*	0.843140**	0.034308	0.133095	0.550993*
	(0.034881)	(0.178661)	(0.357435)	(0.223995)	(0.177864)	(0.085743)

Values in parenthesis are the t-ratios of the Wald-tests.
(*),(**) or (***) shows that the estimated coefficient is different from zero at the 10%, 5% or 1% significance level

Appendix IV: Long-run solution and an error correction mechanism

The evidence of unit root behaviour could suggest that the SRER and sectoral shares are driven by permanent exogenous shocks. Thus, the statistical properties of regression analysis using non-stationary series would be dubious and a cointegration analysis required. The Engle and Granger '87s formal two-step cointegration approach proceeds as follows: a) the order of integration of the variables involved in the postulated long-run relationship is tested and b) the cointegration vectors are estimated by the SUR model.[38]

a) Unit root analysis

Before performing any standard regression analysis, the order of integration of each variable is identified provided that they can be transformed into a stationary variable through differencing. It is in fact unusual for an economic series to be integrated of an order higher than two as virtually all economic series have an order of integration of maximally two (Plasmans, (2007), p.2). We apply, thus, the general to specific sequential procedure starting with third order of integration; a more efficient way to arrive to the appropriate order of integration of a series.[39,40]

The test sequence starts from the highest realistic order of integration for a series (as postulated by the investigator) and moves downwards to lower orders of integration. These unit root models are estimated by ordinary least squares (OLS). All unit root models have three versions: an unrestricted model (including trend and intercept), a trend restricted model (including intercept but not trend) and a trend-intercept restricted model (neither trend nor intercept). Detailed three, two and one unit root tests are available upon request.[41]

We do not find evidence of three unit roots on any Argentinean, Chilean and Mexican series at the 1% significance level. For all countries and series, the null of two unit roots is rejected at the 10% significance level except in the following cases: a) Argentinean L and K series according to all models, b) Argentinean g and CAMRDF following the unrestricted model, their trend coefficient are, however, not statistically significant even at the 10% levels and c) Chilean K according to the unrestricted and trend restricted model, d) Mexican L for the unrestricted model. In addition, a two-unit roots test for CAMRDF do not show persistence behavior but the trend coefficient of the unrestricted model is statistically significant at the 5% level.

Table A.5.1 shows the observed t-statistic of Argentinean, Chilean and Mexican one unit root tests; except for the L and K series. One unit roots reveal that most of the variables have one unit roots, except:[42] a) the Chilean SRER, Mshare, LPX, TFPX, LPM, TFPM, TFPN, FDI

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[38] Engle, Granger and Hallman have pointed out that the use of seasonal data may give rise to inconsistent estimates of long-run parameters. Charemza and Deadman (1997, pp. 130-131) add that a straightforward (but probably generally sub-optimal) procedure is to assume that stochastic seasonality can be approximated by deterministic seasonal dummy variables, and include these in the long-run cointegrated relationship. They alternatively suggest that seasonal data may be used provided the series which may be cointegrated are 'filtered 'or 'seasonally adjusted first'. Once the data are seasonally adjusted, Engle and Granger's cointegration procedure can be applied to the seasonally adjusted data. In this paper, the alternative procedure is adopted.

[39] Following Charemza and Deadman (1997, p. 110), statistical tests may have better properties if one starts from the most general hypothesis and works downwards towards more specific hypothesis, an approach which may be described as 'testing downwards'.

[40] According to this so-called Dickey and Pantula (1987) approach, when the null is that the series is I(k), it means precisely I(k) and not higher since hypothesis concerning higher order of integration will have been tested previously. This means that the series contains at most k unit roots.

[41] A crash dummy variable (variable with ones in the first and second quarter of 2002 and zero elsewhere) has been included in the Argentinean unit root tests because at the end of 2001 the SRER depreciated by 19% and 21% in the first and second quarter of 2002, respectively.

[42] Standard Augmented Dickey-Fuller unit root tests do not find two unit roots in any of the series

and g following the unrestricted model, b) the Chilean LPX, TFPX, TT and g according to the trend-restricted model, c) the Chilean LPX, TFPM, L and TT for the trend-intercept restricted model, d) Mexican Mshare, Tshare, FDI and g following the unrestricted model, e) the Mexican g for the trend restricted model and f) Mexican Xshare, LPM, TFPM, TFPN and g for the trend-intercept restricted model.

Table A.5.1: Unit root tests: H_0=The corresponding series has a unit root

Countries	Argentina			Chile			Mexico		
Variables	U	T	TI	U	T	TI	U	T	TI
SRER	-1.72	-0.59	0.32	-3.00***	0.12	1.45	-0.14	-0.30	-0.32
Xshare	-1.79	-1.73	-0.22	-0.72	-1.80	0.20	-2.32	-2.39	-1.96**
Mshare	-1.52	-1.84	-0.36	-2.25**	-1.70	-1.36	-4.08**	-1.03	-0.15
Tshare	-1.42	-1.85	-0.75	-1.59	-1.92	-0.58	-4.38***	0.25	-1.16
LPX	-2.70	-2.92*	-1.25	-2.28**	-2.69*	2.15**	-1.10	-1.09	0.35
TFPX	-2.02	-1.48	0.95	-2.88***	-2.71*	1.11	-2.14	-1.37	1.46
LPM	-2.72	-2.55	0.11	-2.77***	-1.46	1.22	-1.43	-0.83	0.71
TFPM	-3.02	-1.98	0.93	-3.49***	-1.17	2.17**	-1.97	-0.78	2.59**
LPN=TFPN	-2.18	-0.70	-1.71	-3.10***	-1.25	1.18	-1.96	-1.44	-2.13**
L^a	-2.48	-2.50	-2.01	-1.08	0.77	3.02***	-3.72^{+++}	-3.41^{+++}	-1.65
K^a	-0.50	-1.03	-0.28	-1.01	-1.53	-1.19^{+++}	-2.62	-2.45	-4.48^{+++}
FDI	-2.58	-2.22	-0.97	-2.51**	-2.46	0.02	-4.11**	-1.77	0.83
TT	-2.30	-1.51	0.71	1.17	2.79*	2.49**	-2.00	-0.41	1.31
g	-2.03	-2.08	-0.62	-4.12***	-4.18***	-0.01	-4.56***	-2.68*	-3.27***
CAMRDF	-2.33	-1.42	-1.20	-0.32	1.53	2.00	-2.17	-2.35	-0.48

where
All variables are expressed in logarithms, except Xshare, Mshare, Tshare, g, CAMRDF and Argentinean FDI
U, T and TI refer to the unrestricted, trend restricted and trend-intercept restricted models, respectively
(*),(**) and (***) indicate that the null of one unit root is rejected at 1%, 5% and 10% significance levels, respectively
a: These cells; except from the Chilean L, display the t-statistics corresponding to the two unit roots test. Plus, (+), (++), (+++) indicate that the null of two unit root is rejected at the 1%, 5% and 10% significance levels, respectively

b) Cointegration Analysis and Error Correction Models (ECM)

Charemza and Deadman (1997, p. 128) argue that "the order of integration of the dependent variable cannot be higher than the order of integration of any of the explanatory variables. Moreover, there must be either none or at least two explanatory variables integrated to an identical order higher than the order of integration of the dependent variable". Hence, the following variables have been included in first difference: a) the Chilean CAMRDF, b) labour force series (L) in all blocks,[43] and c) the Argentinean and Chilean capital series.

In the second step, all block are jointly estimated by the SUR model. This model itself cannot evaluate for structural breaks in the analyzed equations. Hence, OLS has been separately applied to each country cointegration relationship, and then the Quandt-Andrews unknown break point test has been performed to detect the structural break points.[44]

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[43] All labour force series, the Argentinean and Chilean K series and the Chilean CAMRDF series are trend stationary process rather than data stationary process. If the variables are trend stationary process, the regression will be spurious as the variables follow their own deterministic trend (Vogelvang, (2004), p.293). As a result, 'regression analysis makes sense only for data which are not subject to a trend. If an economic series contains trend, it has to be detrended before any sensible regression analysis can be performed' Charemza and Deadman (1997, p. 96).

[44] This test performs a single Chow break point test at every observation between two points in time. The statistics of each Chow break point test are then summarized as follows: a) the sup or Maximun statistic is the maximum of the Chow Likelihood ratio (LR) or Wald F-statistic (W_F); 'it detects a single abrupt change over

If the null of no break points is rejected at 10% significance levels, an intercept dummy variable is included. Additionally and for equations with non-stationary residuals, crash dummy variables (variable with one in the crash period and zero elsewhere) have been included for observations with residuals twice bigger than their standard deviation. Also, when the residuals of an equation are not stationary, non-significant variables at 10% significance levels are dropped.

Following Charemza and Deadman (1997, pp. 131), the fact that variables are cointegrated implies that there is some adjustment process which prevents the errors in the long-run relationship from continuously increasing. Note that the residuals of these long-run relationships can be interpreted as the deviations of the dependent variable from its long run path. Thus, the estimated relationships are non-spurious if such residuals are stationary.

The Standard Augmented Dickey-Fuller (ADF) test, without trend and intercept, is correctly applied since these residuals are expected to have at most one unit root. Plus, they are not expected to have trend or constant. The student t-ratio that results from the residual's regression does not have the conventional student-t distribution if the null hypothesis is true (Charemza and Deadman, (1997), p. 129).

The distribution of the student-t ratio depends on the number of coefficients estimated in the long-run relationship, apart from the coefficient representing deterministic exogenous variables (constant, deterministic seasonality and intercept and crash dummy variables). Charemza and Deadman ((1997), p. 284) set out the critical t-values restricted the number of observations involved in the cointegrated relationships.

If the residuals are stationary, the estimated long-run relationships have a matching error correction model (ECM). The converse is also true, in that cointegration is a necessary condition for ECM models to hold. An ECM model is an equation specified with variables in first differences and with an error correction term (ECT) equal to the residual of the long-run relationship lagged one period. The model incorporates both a long-run solution and has an ECM when the estimated ECT parameter (ECF) is negative.[45]

The variance of the ECF is correlated to the variance of the explanatory variables. Hence, the ECM estimation approach should take into account the presence of heteroskedastic disturbances. Thus, the ECM models of each block are estimated by the iterative SUR model.[46] ECM models are also estimated by modeling from general to specific; variables that are not significant at the 10% confidence level are, in general, dropped.

Also: a) the Chilean ECM block includes the second difference of CAMRDF as explanatory variable, b) all blocks include L expressed in 2nd differences c) the Argentinean and Chilean blocks include K in second differences and d) the first difference of the dependent variables lagged up to three periods have included in each ECM equation.

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sample periods' (Maddala and Kim, (1998), p.396), b) The Ave or average statistic is the simple average of the LR or W_F statistics of the individual Chow tests and c) the exp LR or W_F statistics, it is an average statistic that places higher values on large values of LR or Wald statistic of the individual Chow tests, while small values have relatively less importance. If according to these three statistics, the null hypothesis of no break points within the 15% trimmed data is rejected at 10% significance levels, an intercept dummy variable is included.

[45] ECT parameters measure the degree of adjustment of the actual SRER with its equilibrium value; the convergence to the equilibrium is faster as long as this parameter is close to one.

[46] This approach obtains first a consistent estimator of the variance-covariance matrix and then uses it to obtain generalized least squares estimators of the regression parameters.