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Distribution costs and real exchange rate dynamics during exchange-rate-based-stabilizations

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Abstract

This paper studies the role played by distribution costs in shaping the behavior of the real exchange rate during exchange-rate-based stabilizations. We document that distribution costs are very large for the average consumer good: they represent more than 40 percent of the retail price in the US and roughly 60 percent of the retail price in Argentina. Distribution services require local labor and land so they drive a natural wedge between retail prices in different countries. We show that introducing a distribution sector in an otherwise standard model of exchange-rate-based stabilizations dramatically improves its ability to rationalize observed real exchange rate dynamics.

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1 Introduction

There is a large literature that studies the macroeconomic impact of exchange-rate-based stabilizations. This literature has made substantial progress in explaining the behavior of consumption, investment, and the current account during stabilizations (see Calvo and Végh (1999) for a recent survey). In contrast, the behavior of the real exchange rate (RER) in these episodes remains difficult to understand.

In this paper we discuss whether the costs of distributing tradable goods (transportation, wholesaling, and retailing) are important to understand movements in the RER during exchange-rate-based stabilizations. To be concrete, we focus our analysis on a widely studied stabilization episode: Argentina's 1991 Convertibility Plan.

The standard model used to study exchange-rate-based stabilization features two types of goods: tradables and non-tradables. Purchasing power parity (PPP) is assumed to hold only for the tradable good. As a result all RER movements are associated with changes in the relative price of non-tradable goods.[1] This standard model has serious problems along three dimensions. First, there is evidence that relative PPP does not hold for tradable goods (see, for example, Isard (1977) and Giovannini (1988)). Second, and more surprisingly, Engel (1999) shows that movements in the US RER are driven almost exclusively by changes in the prices of *tradable* goods. Finally, calibrated versions of the standard model produce RER movements that are much smaller than those observed in the data.

Our analysis of the Argentina Convertibility Plan confirms the deficiencies of the standard model along these three dimensions. We find that relative PPP does not hold for the retail price of tradable goods in Argentina. We also find that most of the variation in Argentina's RER is due to changes in the retail prices of *tradable* goods. Finally, the RER appreciation in Argentina

[1] For examples of analyses of exchange-rate-based stabilizations that rely on variants of the standard model see Calvo and Végh (1993), Roldos (1995), Uribe (1997), and Mendoza and Uribe (1999). For an analysis of this class of models in a business cycle context see Stockman and Tesar (1995). Betts and Kehoe (1999) explore a more elaborate version of the tradables/non-tradables set up in which different goods vary in their degree of tradability.

was much larger than what the standard model would predict. Argentina's RER appreciated by 24.1 percent between April 1991, when the Convertibility plan was enacted, and April 1993.[2] In contrast, in a quantitative study of the effects of exchange-rate-based stabilizations in Argentina, Rebelo and Végh (1995) find an upper bound of 4 percent for the RER appreciation.[3]

We document that distribution costs are very large for the average consumer good: they represent more than 40 percent of the retail price of these goods in the US and roughly 60 percent of their retail price in Argentina.[4] We then show that the performance of the standard model along the three problematic dimensions can be greatly improved with the introduction of distribution costs. Our model embodies the notion, discussed in Sanyal and Jones (1982) and Erceg and Levin (1996), that there are no freely traded goods.[5] We assume that all goods require an important component of distribution services. Since these services are intensive in local labor and land and hence are non-tradable, they create a natural wedge between the prices of tradable goods in different countries. This wedge is likely to vary over time in response to the changes in the price of labor and land that take place after a stabilization.

Our paper is organized into six sections. In section 2 we use data for Argentina and the US to illustrate the three dimensions along which the performance of the standard model is problematic. In section 3 we use a simple model to discuss why introducing distribution costs can improve this performance. In section 4 we document the fact that distribution costs are empirically large for consumption goods. In section 5 we introduce a distribution sector into an otherwise standard

[2] This RER appreciation is similar to that of other exchange-rate-based-stabilizations. Calvo and Végh (1999) estimate that the RER appreciates on average 20 percent between the year prior to the stabilization and the second year of the stabilization period in the seven stabilization episodes in their sample.

[3] Rebelo and Végh (1995) report their results in terms of the relative price of non-tradable goods. Their upper bound of 8 percent for the increase in the relative price of non-tradables translates into a 4 percent RER appreciation.

[4] Dornbusch (1989) summarizes data from the World Bank national income comparison project to show that the price of an identical consumption basket, constructed with detailed price data, is higher in high income countries than in low income economies. He suggests that distribution services may account for this failure of PPP.

[5] Dumas (1992), Sercu, Uppal, and Van Hulle (1995), Benninga and Protopapadakis (1998) and Obstfeld and Rogoff (2000) discuss models with international trade costs. These models are significantly different from ours because they assume that goods produced domestically can be distributed at no cost. Erceg and Levin (1996) consider a model with a distribution sector similar to ours but focus on the effects of technology shocks.

small open economy model. In section 6 we calibrate the model and evaluate its quantitative implications for a permanent exchange-rate-based stabilization. A final section summarizes the main results and discusses directions for future research.

2 Prices and the RER in Argentina

In this section we use price data for the US and Argentina to discuss the behavior of the prices of tradables and non-tradables in the aftermath of the April 1991 Convertibility Plan. This plan involved the adoption of a currency board which pegged the Argentine peso to the US dollar. We chose the 1991 Convertibility Plan as our case study because Argentina has high quality data about prices and distribution costs.

The behavior of the Argentine economy after the Convertibility plan conforms closely to the patterns typical of other exchange-rate-based stabilizations: there is an economic expansion featuring a prominent consumption boom and a deterioration of the current account. These facts have been extensively documented and discussed elsewhere so here we focus our attention on the behavior of prices.[6] We will show that in the aftermath of the convertibility plan: (i) relative PPP fails dramatically for the retail price of tradable goods; (ii) there is a large appreciation of the RER measured with the consumer price index (CPI); (iii) most of this appreciation is due to changes in the retail price of tradable goods.

Relative PPP Fails for Retail Prices of Tradable Goods

Table 1 reports the cumulative logarithmic percentage change in the ratio of the price indexes for various comparable goods and services that are part of the CPI in the US and Argentina between April 1991 and April 1997. This Table shows clearly that relative PPP does not hold for the retail prices of tradable goods. For example, the price of cereals and meats in Argentina increased by more than 34 percent relative to the US.[7]

[6] See, for example, Rebelo and Végh (1995), Uribe (1997), and Calvo and Végh (1999).

[7] Anecdotal evidence suggest that the Mercosur tariff and quota reductions are the reason for the small price

There is a Large RER Appreciation

We define the RER in terms of the geometric consumer price indexes in the two countries:

$$RER = [S(P_{US}^{T})^{\gamma_{US}}(P_{US}^{NT})^{1-\gamma_{US}}]/[(P_{Ar}^{T})^{\gamma_{Ar}}(P_{Ar}^{NT})^{1-\gamma_{Ar}}], \tag{1}$$

where P_i^T and P_i^{NT} are the geometric average of the prices of tradables and non-tradables in country i, respectively.[8] The variable S denotes the peso/dollar exchange rate. The variable γ_i denotes the weight of tradable goods in the CPI of country i. This weight is 0.72 in Argentina and 0.43 in the US. The first panel of Figure 1 shows the cumulative changes in log(RER) from April 1991 to March 1998. The RER appreciated by 24.1 percent in the first two years of the convertibility plan (from April 1991 to April 1993) and became roughly stable in subsequent periods.[9] It is important to note that the exchange rate has been constant since April 1991, so this RER appreciation is due to large permanent increases in local prices. For this reason, theories that rely on price stickiness to explain the behavior of the RER have limited appeal in this context.[10]

Most of the RER Appreciation is Due to Changes in the Retail Prices of Tradables

Was this large RER appreciation the result of changes in the relative price of non-tradable goods, as the standard model would predict? Following Engel (1999), we can decompose the change in the RER ($\Delta \log(\text{RER})$) into one component associated with movements in the price of tradable goods in Argentina relative to the US ($\Delta \log(\text{RER}^T)$), and a second component associated

increases in a few tradable goods categories in Table 1, such as footwear. The Mercosur agreement between Argentina, Brazil, Uruguay and Paraguay began its implementation in June 1992.

[8] For the US we used the commodity price index as a proxy for tradable goods and the service price index as a proxy for non-tradables. For Argentina we classified the individual components of the CPI into tradables and non-tradables. The most important non-tradables in Argentina are rent, health expenditures, public transportation, food away from home, and domestic services. The most important tradable goods are meat, cereals, clothing, and vehicle parts.

[9] If we compute the RER using arithmetic price indexes, instead of geometric ones, we obtain a 27 percent appreciation from April 1991 to April 1993.

[10] Recent open economy models that emphasize price stickiness include Obstfeld and Rogoff (1995), Chari, Kehoe and McGrattan (2000), and Betts and Devereux (2000).

with changes in the relative price of non-tradables in Argentina and the US ($\Delta \log(\text{RER}^{NT})$):

$$\Delta \log(\text{RER}) = \Delta \log(\text{RER}^T) + \Delta \log(\text{RER}^{NT}),$$

where,

$$\begin{aligned}
\log(\text{RER}^T) &= \log(SP^T_{US}/P^T_{Ar}), \\
\log(\text{RER}^{NT}) &= (1-\gamma_{US})\log(P^{NT}_{US}/P^T_{US}) - (1-\gamma_{Ar})\log(P^{NT}_{Ar}/P^T_{Ar}).
\end{aligned}$$

Panels 3 and 4 in Figure 1 shows the cumulative changes in $\log(\text{RER})$, $\log(\text{RER}^T)$, and $\log(\text{RER}^{NT})$. Clearly, RER^T tracks RER very closely. The RER appreciated by 24.1 percent ($\Delta \log(\text{RER})=$ -0.241) between April 1991 and April 1993. The price of tradable goods in Argentina relative to the US increased by 21.4 percent ($\Delta \log(\text{RER}^T)$=-0.214). Changes in the relative price of non-tradables account for the remaining 2.7 percent change in the RER ($\Delta \log(\text{RER}^{NT}) = -0.027$). This means that almost all of the RER appreciation was caused by the fact that the price of *tradable* goods increased more in Argentina than in the US. The relative price of non-tradables in Argentina (P^{NT}_{Ar}/P^T_{Ar}) increased by 17 percent. However, this increase did not contribute much to the large RER appreciation for two reasons. First, the weight of non-tradables in the Argentine CPI is relatively small ($1-\gamma_{Ar} = 0.28$). Second, some of the increase in P^{NT}_{Ar}/P^T_{Ar} was offset by the fact the relative price of non-tradables in the US (P^{NT}_{US}/P^T_{US}) increased by 3.6 percent.[11]

3 The RER in a Simple Model with Distribution Costs

We will now discuss why introducing distribution costs may improve the performance of an otherwise standard non-monetary model along the three dimensions discussed in section 2. We use a stripped down version of the model that we consider later on to study the response of the RER

[11] We decomposed the change in the RER for the other major stabilization episode for which we have detailed price data–the Mexican stabilization of March 1988. Between March 1988 and November 1994 the Mexican RER appreciated by 40.4 percent. We found that movements in tradable prices were also an important determinant of the RER appreciation. However, in the Mexican case the increase in the price of housing was also an important element. This reflects the large weight of housing in the Mexican CPI. While housing has a 22 percent weight in the Mexican CPI it has only a 2.3 percent weight in the Argentine CPI. Of the 40.4 percent RER appreciation, 17 percent is accounted for by movements in the price of tradables, 6.6 percent by movements in the price of non-tradables excluding housing, and 16.5 percent by increases in housing prices. These calculations were based on a database obtained from Banco de México.

to a supply shock. Here we will consider the effects of a permanent increase in the endowment of tradable goods. This shock generates an effect that is similar to that of the exchange-rate-based stabilization that we study using the full model in section 5.

Consider a small open economy populated by a representative agent who has utility defined over sequences of consumption of tradable (C_t^T) and non-tradable goods (C_t^{NT}):

$$\begin{aligned} U &= \sum_{t=0}^{\infty} \beta^t \frac{[(C_t^T)^{\gamma}(C_t^{NT})^{1-\gamma}]^{1-\sigma} - 1}{1-\sigma} \quad , \\ 0 &< \gamma < 1,\, \sigma > 0,\, 0 < \beta < 1, \end{aligned} \tag{2}$$

where β is the discount factor and σ is the inverse of the intertemporal elasticity of substitution. Agents in this economy can borrow and lend in international capital markets at a fixed interest rate r. To abstract from trends in the current account we assume that: $(1+r) = 1/\beta$.

The economy has in every period an exogenous endowment of tradables (Y_t^T) and nontradables (Y_t^{NT}). The economy's intertemporal resource constraint is given by:

$$a_{t+1} = (1+r)a_t - C_t^T + Y_t^T,$$

$$\lim_{t\to\infty} a_t/(1+r)^t = 0,$$

where, a_t denotes the representative agent's net foreign asset position. To simplify we assume that the initial value of a_t is zero: $a_0 = 0$.

We introduce a distribution sector by assuming, as in Erceg and Levin (1996), that consuming a tradable good requires ϕ units of distribution services. We do not require distribution services for the consumption of non-tradables for two reasons. First, the most important non-tradables are typically housing, health, and education expenditures, which are sectors where wholesaling, retailing and transportation do not play a significant role. Second, it is easy to show that, for Cobb-Douglas momentary utility, assuming that distribution services are required to consume non-tradable goods does not affect our results.[12]

[12] We thank Carlos Végh for pointing this out to us.

There is a competitive distribution sector that combines tradable goods with non-tradable distribution services to produce final tradable consumption goods. Since the endowment of non-tradable goods and services can either be consumed or used to supply distribution services, we have that in equilibrium:

$$\phi C_t^T + C_t^{NT} = Y_t^{NT}. \tag{3}$$

The standard model is a particular case of this formulation where $\phi = 0$.

We will use a '$*$' to denote prices denominated in a foreign unit of account (e.g. the dollar). The remaining prices are denominated in a local unit of account. The exchange rate S is the number of domestic units of account per foreign unit of account.[13] We denote the producers price of tradable goods (i.e. the price exclusive of distribution services) as $\bar{P}^T$. PPP is assumed to hold at the producer level:[14]

$$S_t \bar{P}_t^{T*} = \bar{P}_t^T. \tag{4}$$

We denote the retail price of a tradable good (i.e. the price inclusive of distribution services) as P^T. PPP does not typically hold for retail prices, which are given by:

$$P_t^T = \bar{P}_t^T + \phi P_t^{NT}, \tag{5}$$

where P_t^{NT} denotes the price of non-tradable goods. It is useful to define p_t as the price of nontradables relative to the producer price of tradables:

$$p_t = P_t^{NT} / \bar{P}_t^T. \tag{6}$$

The distribution margin, which we denote by s_t^d, is given by:

$$s_t^d = \frac{P_t^T - \bar{P}_t^T}{P_t^T} = \frac{\phi p_t}{1 + \phi p_t}. \tag{7}$$

[13] Note that in this non-monetary model there are multiple values of the nominal prices and the exchange rate that are compatible with the equilibrium allocations. Later on we introduce money into this basic model in a way that pins down uniquely the equilibrium value of S.

[14] There is some evidence that this weak form of PPP may hold in practice. One reason why PPP holds for gold contracts is that these do not include delivery of the gold.

The CPI-based RER in this model is:

$$RER = \frac{S_t(P_t^{T*})^{\gamma^*}(P_t^{NT*})^{1-\gamma^*}}{(P_t^T)^{\gamma}(P_t^{NT})^{1-\gamma}}. \tag{8}$$

We assume that the distribution sector in the foreign country is analogous to that of the domestic country, so foreign retail prices are given by:

$$P_t^{T*} = \bar{P}_t^{T*} + \phi P_t^{NT*}, \tag{9}$$

where $\bar{P}_t^{T*}$ is the producers price of tradable goods. Using equations (4), (5), (8) and (10) we can rewrite the RER as:

$$RER = \frac{(1+\phi p^*)^{\gamma}(p^*)^{1-\gamma}}{(1+\phi p_t)^{\gamma} p_t^{1-\gamma}}, \tag{10}$$

where, to simplify, we assume that p_t^* is constant over time.

The representative agent's optimization problem implies the familiar requirement that the marginal rate of substitution between tradables and non-tradables be equal to their relative price, P^{NT}/P^T:

$$\frac{1-\gamma}{\gamma}\frac{C_t^T}{C_t^{NT}} = \frac{P^{NT}}{P^T}. \tag{11}$$

Note that the price of tradable goods that is relevant for the consumer is the retail price (P^T), not the producer's price ($\bar{P}_t^T$). Given that $(1+r) = 1/\beta$ and that agents expect Y^T and Y^{NT} to be constant over time, the equilibrium consumption of the two goods is constant and given by:[15]

$$C^T = Y^T, \tag{12}$$

$$C^{NT} = Y^{NT} - \phi C^T. \tag{13}$$

We now study the effect on the RER of a small permanent, unexpected increase in the endowment of tradable goods (Y^T). Since this shock is permanent it has no impact on the level of net foreign assets. We will show that the presence of distribution costs in our model increases: (i) the elasticity

[15] The condition $Y^{NT}/Y^T > \phi/\gamma$ is necessary so that $C^T = Y^T$. When this condition does not hold $C^T < Y^T$. Since Y^{NT} is small relative to Y^T agents prefer to devote non-tradables to consumption instead of using them to produce the distribution services necessary to consume tradable goods.

of RER with respect to p (ii) the elasticity of p with respect to Y^T; and (iii) the fraction of the RER variation that is accounted for by movements in the prices of tradable goods (which is zero in the standard model). To see the first effect note that equation (10) implies that the response of RER to a change in p is:

$$\frac{d \log RER}{d \log p} = -[\gamma s^d + (1-\gamma)]. \tag{14}$$

The change in the RER is clearly increasing in the distribution margin, s^d. When $s^d > 0$, the consumption of tradables requires the use of non-tradables. This means that an increase in p has a larger impact on the RER because it raises both the price of non-tradables and the retail price of tradables.

To see the second effect it is easy to show that (6), (7), (11), (12), and (13) imply:

$$\frac{d \log p}{d \log Y^T} = 1 + \frac{1}{1-\gamma}\frac{s^d}{1-s^d}, \tag{15}$$

so a given increase in Y^T produces a larger change in p the larger is the distribution margin, s^d.[16] This is intuitive since increasing the distribution margin has similar effects to lowering the elasticity of substitution between tradables and non-tradables in a model without distribution.

The combination of the first and second effects imply that $d \log RER / d \log Y^T$ is increasing in the distribution margin, s^d (see (15), and (14)).

To see the third point we need to compute the fraction of the movement in the RER that is accounted for by changes in the prices of tradable goods:

$$\frac{\Delta \log(\mathrm{RER}^T)}{\Delta \log(\mathrm{RER})} = \frac{s^d}{\gamma s^d + (1-\gamma)}.$$

This expression is increasing in s^d. This means that the fraction of the RER accounted for by movements in the prices of tradable goods is higher in an economy with a higher distribution

[16] This result holds for a much more general specification of the role of distribution services. Suppose that momentary utility is $u(C^T, C^{NT})$ and that the consumption of tradables requires combining the tradable endowment with distribution services: $C^T = h(D, Y^T)$, where $h(.)$ is homogeneous of degree one. As long as the elasticity of substitution implied by the function $h(.)$ is lower than the elasticity of substitution implied by the function $u(.)$ this result continues to hold.

margin. Note that the fraction of the movement in the RER that is accounted for by changes in the prices of tradable goods is equal to zero in the standard model since $s^d = 0$.

Is the introduction of distribution costs equivalent to modifying the utility function of the standard model? We can show that from the standpoint of magnifying the response of the RER to changes in Y^T, the effects of introducing a distribution sector can be mimicked by taking the standard model and modifying preferences so that the share of non-tradables in utility is larger and the elasticity of substitution between tradables and non-tradables is lower. However, this modification to the standard model does not change its counterfactual implication for the role played by tradables prices in RER movements. The standard model would still imply that movement in tradable goods prices do not contribute to RER fluctuations.

4 The Importance of Distribution Costs

Economists frequently invoke distribution costs as one of the reasons for the failure of relative PPP.[17] However, these costs are often thought to be too small to be an important determinant of RER fluctuations. This is partly because the transportation costs associated with international trade are usually estimated to be small.[18] However, distribution is much more than transporting goods across countries. It includes wholesale and retail services, marketing and advertisement, and local transportation services. Feenstra (1998) discusses the production and distribution costs for Mattel's Barbie doll, which is a colorful, but suggestive example of the importance of distribution services in modern economies. The doll is produced in Asia at a cost of one dollar per unit (35 cents for labor and 65 cents for materials). It costs an additional dollar of distribution services to get the doll to the US via Hong Kong. Mattel makes one dollar of profit from each doll. The sale

[17] See Rogoff (1996) and Froot and Rogoff (1995) for a comprehensive discussion of reasons for the failure of the PPP hypothesis, including pricing to market behavior.

[18] Rauch (1996) computes transportation costs (insurance and freight as percentage of customs value) for US imports from Japan or similarly distant countries for 1970, 1980 and 1990. He obtains estimates that range from 6% to 16%. Hummels (1999) estimates the average trade-weighted freight cost in 1994 to be 3.8% for the U.S. and 7.5% for Argentina. Note that these measures, which are based on the costs incurred in international trade, are likely to underestimate true transportation costs. This is because we do not observe the cases in which transportation costs were so high that the transaction did not take place.

price is $10 dollars of which $7 pay for transportation, marketing, and retail services in the US. Production costs are a mere 10 percent of the retail price of the product.

In this section we argue that distribution costs associated with consumption goods are large both in the US and in Argentina. We rely heavily on measures of the distribution margin, which we define as:

$$\text{Distribution Margin} = \frac{\text{Retail Price - Producers Price}}{\text{Retail Price}}.$$

Note that we measure the distribution margin as a fraction of the retail price. Thus a 50 percent margin means that half of the retail price represents production costs and the remaining 50 percent represents distribution costs. In our model we assume that the distribution sector is competitive, so economic profits are zero and the distribution margin reflects the costs associated with providing distribution services. Obviously, if the distribution sector is monopolistically competitive, the distribution margin also includes a markup component.

We use four different sources to document the importance of distribution costs in the US: (i) data on distribution margins for agricultural products; (ii) the Input-Output tables for 1992 and 1997; (iii) the 1992 Census of Wholesale and Retail Trade data; and (iv) data on employment and value added in the wholesale and retail sectors.

Data on distribution costs in Argentina is scarce. The three pieces of evidence that we have available are: (i) the 1993 Census of Wholesale and Retail Commerce data on distribution margins; (ii) data on employment and value added in the wholesale and retail sectors; (iii) data on the Producer Price Index.

4.1 Distribution Margins for US Agricultural Goods

The US Department of Agriculture collects data on production and distribution costs for agricultural products. Table 2 displays the distribution margins for different agricultural products in 1997. This Table shows that distribution costs are more important than production costs for agricultural products–the distribution margins are above 50 percent in all product categories. These margins range from 54 percent (eggs) to 82 percent (fresh fruits).[19]

4.2 Input-Output Tables

The 1992 Input-Output Table for the US economy, published by the Bureau of Economic Analysis, is another valuable source of information on the importance of distribution costs. Using this Table we computed distribution margins for four expenditure categories: (i) personal consumption expenditures; (ii) gross private fixed investment; (iii) exports of goods and services; and (iv) federal government consumption and gross investment. To focus on tradable goods we eliminated services and considered only the components of final expenditure that were supplied by manufacturing, agriculture, forestry, fisheries or mining.[20] The results are presented in Table 3. Note that in some sectors the distribution costs could not be isolated from the production costs, since some goods are sold directly by the producer to the retailer or consumer (see Betancourt (1992)). For this reason the estimates in this Table are likely to represent a lower bound on the importance of distribution.

This Table suggests that tradable consumption goods embody an important element of distribution services: these services represent 42 percent of the final price. In contrast, distribution services play a smaller role in investment, exports, and government spending. The distribution margin varies widely across the individual goods that are part of the personal consumption basket: it ranges from zero to 64.2 percent with a standard deviation of 13 percent.

Table 4 provides additional information on distribution margins for the US using the 1997 Input-Output Table. The distribution margin for tradable consumption is slightly higher in 1997 than in 1992 (43.4 versus 41.9 percent). As an additional check on the plausibility of these estimates, Table 4 reports distribution margins for six additional countries: Canada, France, Germany, Italy, Japan, and the U.K.[21] Notice that distribution margins for these countries are

[19] These margins do not seem closely related to the perishable character of the different goods. For example, fats and oils, which are arguably less perishable than eggs, have a margin of 79%.

[20] The distribution margin for the service sector is close to zero.

[21] These margins were computed using input-output matrices by assuming that the distribution margin for

similar to those for the US. For consumption goods these margins range from 35 percent in France to 50 percent in Japan.

4.3 Distribution Margins from the 1992 US Census of Wholesale and Retail Trade

Two other sources of information on US distribution costs are the 1992 Census of Wholesale and Retail Trade published by the Department of Commerce. The Census reports the retail and wholesale margin at three levels of aggregation: all goods, durable goods, and non-durable goods.[22]

The retail margins in Table 5 are similar to those reported by Euromoney (1997, Table 3.48), which estimates for 1996 an average retail margin of 36.2 percent for all goods except automobiles.

Using the retail and wholesale margins reported in Table 5 we computed the total distribution margin for a good that goes through one wholesaler and one retailer.[23] This margin is on the order of 46 percent. Since not all goods go through these distribution channels, the total margin is likely to be overstated by this calculation.

4.4 Distribution Margins from Argentina's 1993 Census of Wholesale and Retail Commerce

Table 6 uses information on production and value added from Argentina's Census of Wholesale and Retail Commerce to compute the average distribution margin. This margin is very high– 61 percent. This high margin is likely to reflect the inefficiencies of the Argentine distribution system. Bailey (1993) and Itoh (2000) attribute the high distribution margins observed in Japan to a system of small retail stores and long tunnels of small wholesalers. Similar problems seem

services is zero. The sectors wholesale, retail, transport, storage, and repair were used a proxy for the distribution sector. The repair sector was included because it is bundled with the other sectors. Ideally we would like to exclude it from the calculation.

[22] We computed the distribution margins as the ratio of gross margin to sales. An alternative measure is the ratio of value added to sales. Value added is equal to the gross margin minus the cost of supplies, materials, fuel and other energy, and the cost of contract work on materials of the wholesaler. In practice the difference between these two margins is small.

[23] We assumed that the wholesale margin is α^W = (wholesale price - producers price)/wholesale price and that the retail margin is α^R = (retail price - wholesale price)/retail price. It is easy to see that the total distribution margin, defined as α^D =(retail price - producers price)/retail price is given by $\alpha^D = 1 - (1 - \alpha^W)(1 - \alpha^R)$.

to plague the Argentine distribution system, which is comprised of numerous small retailers and wholesalers. The Census of Retail and Wholesale estimates that there were 506,659 establishments in the sector in 1993. This represents roughly one establishment for every 70 inhabitants. Large supermarkets account only for 5.4% of the employment in the retail sector in 1999 according to the Coordinadora de Actividades Mercantiles Empresariais.

4.5 Employment and Value Added in the Distribution Sector in US and Argentina

Table 7 describes the structure of employment and value added in the US and in Argentina in 1997. This Table, which shows that the distribution sector is large, both in terms of employment and value added, provides further evidence that distribution costs are economically significant. One salient fact that emerges from this Table is that employment in wholesale and retail is more important than employment in manufacturing in both the US and Argentina. In the US roughly one in every four workers is employed in the wholesale and retail sectors.

4.6 Argentina's Producer Price Index

To shed more light on the importance of distribution costs in Argentina, we computed the RER using the producer price index (PPI) for Argentina (Indice de precios internos al por mayor, published by Indec) and the US producer price index for finished goods. These indexes have a very small share of non-tradable goods. The PPI also excludes retail services and includes goods, such as capital equipment and intermediate industrial products that are likely to embody a small component of distribution services. This measure of the RER, is displayed on the second panel of Figure 1. While the CPI-based RER appreciated by 24.1 percent in the first two years of the stabilization plan, the PPI-based RER appreciated only by 2.7 percent. By April 1996 the total depreciation relative to April 1991 of the CPI-based RER rate was 23.2 percent, compared with only 10 percent for the PPI-based RER. This difference between the two measures of the RER is consistent with our presumption that distribution costs and non-tradable goods play less of a role in the PPI.

5 The Model

We will now study the effects of a permanent exchange-rate-based stabilization using an extended version of the simple model discussed in section 2 that incorporates production and money. We will compare the quantitative implications of two versions of this model, with and without distribution costs. The version that abstracts from distribution costs is similar to the model used in Rebelo and Végh (1995).

The Household's Problem

The representative household seeks to maximize its lifetime utility defined in (2). Each agent supplies inelastically N units of time per period which are allocated between the tradables (N_t^T) and non-tradables (N_t^{NT}) sectors:

$$N_t^T + N_t^{NT} = N. \tag{16}$$

Households supply capital to the tradable (K_t^T) and non-tradable (K_t^{NT}) sectors. In addition, they supply land (T), which is in fixed supply, to the non-tradable sector. Since we will focus on the long run impact of a stabilization we assume that capital (K_{t-1}) can be freely reallocated across the two production sectors:

$$K_{t-1} = K_t^T + K_t^{NT}. \tag{17}$$

To simplify we abstract from adjustment costs to investment.[24] The law of motion for the aggregate capital stock is assumed to be:

$$K_t = I_t + (1-\delta)K_{t-1}. \tag{18}$$

[24] In the working paper version of this paper (Burstein et al. (2000)) we introduced adjustment costs by incorporating three elements into the model: investment irreversibility, immobility of capital across sectors, and a construction sector. These elements produce a smooth adjustment towards the steady state but do not have a significant impact on the quantitative comparison of RER movements in the model with and without distribution. Adjustment costs reduce somewhat the movement in the RER that both models generate. The fact that investment is costly to adjust reduces the wealth effect and hence the expansion in the consumption of non-tradables that underlies the RER movements. Since this effect is symmetric in the model with and without distribution costs, the absence of adjustment costs does not bias our comparisons.

As in section 3, households can borrow and lend in the international capital market at rate r. As before we assume that $\beta = (1+r)^{-1}$. Household's net foreign asset holdings in the beginning of period t are denoted by b_{t-1}. The household's intertemporal budget constraint is:

$$
\begin{aligned}
& W_t N + Q_t^K K_{t-1} + Q^T T + \Pi_t^T + \Pi_t^{NT} + \Omega_t + S_t b_{t-1}(1+r) \\
= \;& P_t^T C_t^T + \bar{P}_t^T (I_t + Z_t) + P_t^{NT} C_t^{NT} + S_t b_t + M_t - M_{t-1}.
\end{aligned} \tag{19}
$$

The no-Ponzi game condition for the representative household is: $\lim_{t\to\infty} b_t/(1+r)^t = 0$. As in section 3, P^T denotes the retail price of tradable goods. The producer price of tradables is denoted by $\bar{P}_t^T$. We assume that investment goods are bought at producer prices since in section 4 we saw that distribution services were much less important for investment than for tradable consumption goods. The variable W_t represents the nominal wage rate, while Q_t^K and Q_t^T represent the nominal rental price of capital and land, respectively. The variable Ω_t represents nominal lump sum transfers from the government measured in units of the tradable good. Domestic money holdings in the beginning of period t are denoted by M_{t-1}. The variables Π^T and Π^{NT} denote nominal profits in the tradable and non-tradable sectors, respectively. We introduce money in the model by assuming that money balances allow agents to economize on resources spent transacting. We denote these costs by Z_t and assume, to simplify, that they are denominated in terms of tradable goods:[25]

$$Z_t = A^S(P_t^T C_t^T + P_t^{NT} C_t^{NT} + \bar{P}_t^T I_t) v \left[\frac{M_t}{P_t^T C_t^T + P_t^{NT} C_t^{NT} + \bar{P}_t^T I_t} \right], \tag{20}$$

where A^S is a level parameter and p_t denotes, as in section 2, the relative price of non-tradables in terms of the producer price of tradables, $p_t = P_t^{NT}/\bar{P}_t^T$.We assume that the function $v(.)$ has the following quadratic form:

$$v(X) = X^2 - X + 1/4, \tag{21}$$

where $X_t = M_t/[P_t^T C_t^T + P_t^{NT} C_t^{NT} + \bar{P}_t^T I_t]$ is the inverse of the velocity of circulation with

[25] Alternatively, we could have assumed that transactions costs were denominated in units of labor as in Kimbrough (1986). This introduces a non-trivial transition to the steady state which makes the description of the results somewhat more cumbersome. We recalibrated our model using a shopping time technology and obtained results that are very similar to those we report in the text.

respect to expenditure.[26] This transactions cost technology allows the model to display a realistic decrease in the velocity of circulation in response to a fall in inflation, such as the one we will study.

The household's problem then consists of maximizing lifetime utility, defined in (2), subject to the constraints (16)-(21).

Output Producing Firms

Production of tradables (Y_t^T) and non-tradables (Y_t^{NT}) are described by the following production functions, where A^T and A^{NT} are time-invariant level parameters:

$$Y_t^T = A^T(K_t^T)^{1-\alpha}(N_t^T)^{\alpha} \qquad 0 < \alpha < 1, \tag{22}$$

$$Y_t^{NT} = \left\{\upsilon\left[A^{NT}(K_t^{NT})^{1-\eta}(N_t^{NT})^{\eta}\right]^{(1+\rho)/\rho} + (1-\upsilon)T^{(1+\rho)/\rho}\right\}^{\rho/(1+\rho)}, \; 0 < \eta < 1. \tag{23}$$

The parameter ρ denotes the elasticity of substitution between land and the other factors of production in the non-tradable sector. The tradable good Y_t^T can be used for investment or consumption, while the non-tradable good can only be consumed.

Firms choose the amount of labor, capital and land that they hire from households so as to maximize profits. Since the firm problem is static, maximizing real profits is equivalent to maximizing nominal profits, which are given by:

$$\Pi^T = \bar{P}_t^T Y_t^T - Q_t^K K_t^T - W_t N_t^T,$$

$$\Pi^{NT} = P_t^{NT} Y_t^{NT} - Q_t^K K_t^{NT} - W_t N_t^{NT} - Q_t^T T.$$

The Distribution Sector

As in section 3 we introduce a distribution sector by requiring that each tradable good be combined with ϕ units of distribution services before being consumed. We assume that the distribution sector is competitive, that PPP holds for the producer prices of tradable goods (equation

[26] This quadratic form, borrowed from Végh (1989), has the property that, when the nominal interest rate is zero, $X = 1/2$ and transaction costs are zero ($v(1/2) = 0$). Note that for $X < 1/2$, the function $v(X)$ is decreasing in X. This means that increasing the amount of money held by the households while keeping expenditures constant, reduces the transactions costs Z.

(4)), and that distribution services are produced in the non-tradable sector.[27] This implies that retail prices are given by (5). The expression for the RER is the same as in (10).

The Government

We consider two cases. In the first case, the government rebates the seignorage revenue to the households through lump sum transfers. In the second case, seignorage revenue is used to finance government spending that does not affect private utility or production. Real government net foreign asset holdings (f_t) evolve according to:

$$S_t f_t = S_t f_{t-1}(1+r) + M_t^S - M_{t-1}^S - \Omega_t. \tag{24}$$

The no-Ponzi game condition for the government is: $\lim_{t\to\infty} f_t/(1+r)^t = 0$. Together these two equations define the government's present value budget constraint.

Monetary Policy

Since we are interested in fixed exchange rate regimes we model the rate of devaluation ε_t as the exogenous policy parameter that the government controls. The level of M_t will be endogenously determined by money demand. We will study the exchange-rate-based stabilization experiment that is conventional in the literature. We start the economy in a steady state with $\varepsilon > 0$ and study the impact of an unanticipated reduction in ε to zero.

The Competitive Equilibrium

A perfect foresight competitive equilibrium for this economy is a set of paths for quantities $\{C_t^T, C_t^{NT}, N_t^T, N_t^{NT}, K_t^T, K_t^{NT}, K_t, I_t, Z_t, b_t, M_t, M_t^S, \Omega_t, f_t, \Pi_t^T, \Pi_t^{NT}\}$ and prices $\{S_t, W_t, Q_t^K, Q^T, \bar{P}_t^T, P_t^T, P_t^{NT}\}$ such that (i) $C_t^T, C_t^{NT}, I_t, K_t, Z_t, b_t, M_t$ solve the household's problem given the path for prices and profits; (ii) $N_t^T, N_t^{NT}, K_t^T, K_t^{NT}, T$ solve the firms maximization problem given the prices of capital, labor, land, and the two goods; (iii) the government's intertemporal budget constraint holds; (iv) the labor market clears, $N_t^T + N_t^{NT} = N$; (v) the capital market clears, $K_{t-1} = K_t^T + K_t^{NT}$; (vi) the land market clears; (vii) the money market clears, $M_t^S = M_t$; (viii) the exchange rate market

[27] In an empirical study of retail prices in Chile, Morande (1986) finds evidence in support of the assumption that retail and wholesale dealers combine tradable goods with non-tradable distribution services.

clears, $\bar{P}_t^T = S_t \bar{P}_t^{T*}$; (ix) the market for the non-tradable good clears, $C_t^{NT} + \phi C_t^T = Y_t^{NT}$; and (x) the tradable good market clears, which requires:

$$Y_t^T = C_t^T + I_t^T + Z_t + TB_t, \quad (25)$$

$$a_t = (1+r)a_{t-1} + TB_t, \quad (26)$$

$$\lim_{t\to\infty} a_t/(1+r)^t = 0, \quad (27)$$

where $a_t = b_t + f_t$ represents the consolidated net asset holdings of the government and the private sector, while TB_t is the economy's trade balance.[28]

6 Quantitative Performance

To conduct our experiments we calibrate the model to replicate the average values of some key ratios for the Argentine economy in the decade prior to the 1991 Convertibility Plan. Each time interval represents one quarter. All numerical results were computed using a simple shooting algorithm.[29]

6.1 Calibrating the Model

Our baseline parameters are summarized in Table 10 in the Appendix. We used the same rate of inflation for the pre-stabilization period as Uribe (1997) in his study of the Convertibility Plan: 25 percent per month, which is equivalent to 95 percent per quarter. We set $\sigma = 5$ which accords with the estimate of the elasticity of intertemporal substitution obtained by Reinhart and Végh (1995) for Argentina. We chose γ so that 70 percent of consumption expenditures were devoted to non-tradable goods. This is consistent with the share of tradable goods in the Argentine CPI for the base year of 1993.

[28] The current account is given by $CA_t = ra_{t-1} + TB_t$. In the absence of shocks, this economy is always at a steady state where $TB = -ra$. Any level of a is consistent with the steady state.

[29] We found that the linearization methods that are often used to study the effects of stabilization in models similar to ours are somewhat inaccurate. This is not surprising for two reasons. First, we are studying a large shock that takes the economy far from its initial steady state. Second, this shock has permanent effects: the economy never returns to the initial steady state.

We chose A^T and A^{NT} to be identical and set their value so as to generate plausible capital-labor ratios in the two sectors. The stock of land, T, was chosen so as to obtain a reasonable value of the share of land in GDP (5 percent for the model without distribution). Neither of these parameters influence the change in the RER that occurs in response to a stabilization; they simply control the level of different variables.

We chose the transactions technology parameter A^S to match the 7 percent ratio of seignorage to GDP estimated by Kiguel (1989) for the period 1984-87. The level of net foreign assets, a, was chosen so as to generate a steady state trade surplus to GDP ratio that coincides with the average for this variable in the period 1970-1990 (2.7 percent).

In the model with distribution we set ϕ to 1. This implies that the distribution margin is 50 percent. We use this conservative value instead of the distribution margin estimated for Argentina in Table 6 (62 percent) because not all consumption goods go through the wholesale and retail distribution channels. We set the labor share in the tradable sector (α) to 41 percent, which is the average labor share in the non-service sector (defined as Agriculture, Forestry, Fisheries, Mining and Manufacturing) in Argentina. The parameters ν and η were chosen so that in our baseline parameterization, the labor share in the non-tradable sector (defined as Services) coincides with our estimates for the share of labor in the Argentine service sector (50 percent).[30]

Unfortunately, we could not find any empirical studies to guide our choice for ρ, the elasticity of substitution between labor and land. To overcome this problem we tried to choose a reasonable value for our baseline calibration (-1/3) and then studied the behavior of the RER in the two models for different values of ρ (see Table 9).

While we view our baseline parametrization as a plausible benchmark, there is substantial uncertainty about individual parameter values. For this reason we ran numerous experiments to test the sensitivity of the model. While we only report a subset of this information to conserve on

[30] Labor shares were computed as the average from 1993 to 1997, using producer prices and excluding specific taxes. These shares are very sensitive to whether we treat "mixed income" (an income category similar to proprietors income in US data) as labor or capital compensation. In our computations we eliminated mixed income from total income. Our data source is: Informe Económico, n. 30, 1999 Ministério de Economia, Argentina.

space, in all of our simulations the model with distribution did remarkably better than the basic model in terms of its implications for the behavior of the RER, while producing equally plausible results for the other variables.

6.2 A Permanent Stabilization

We will now study the behavior of the RER in response to a permanent stabilization.[31] Specifically, we assume that in period 0 the economy is in the no-stabilization steady state where the quarterly rate of devaluation, ε, is 95 percent. In period 1 there is an unanticipated stabilization that permanently reduces ε to zero. Since there are no adjustment costs, the economy reaches a new steady state in period 2. In the experiments reported, we rebate the seignorage revenues to the private sector. To simplify we assumed that the US relative price of non-tradables in terms of the producer price of tradables (p^*) remains constant.

Table 8 describes the response of some key prices to a permanent stabilization, both in the benchmark model and in the economy with distribution costs. The PPI-based RER was computed using the PPI index defined as $(1 + \phi^w p_t)$. The value of ϕ^w was set to 0.25. This implies that the wholesale margin is 20 percent, which is consistent with the evidence presented in Table 5. Table 11 reports results for additional variables.

The economic mechanisms at work in this model are well-know and thus can be summarized briefly. There are two effects at work. The first is the "wealth effect" that stems from the fall in resources devoted to transactions (Z_t) caused by the reduction in inflation. The second is the decline in the effective price of investment also caused by the fall in the rate of inflation. The "wealth effect" has an impact that is similar to that of the increase in the endowment of tradable goods studied in the simple model of section 3: it leads to an expansion in consumption.[32] Since

[31] In the working paper of this paper we show that introducing distribution costs also dramatically improves the performance of the standard model for temporary stabilizations.

[32] When the seignorage revenue is not rebated the wealth effect associated with reducing inflation is larger, leading to much larger movements in the RER. When seignorage revenues are not rebated, the impact of a permanent stabilization on the RER is -25.1 percent and -6.1 percent in the model with and without distribution costs. For another evaluation of the impact of rebating seignorage see Mendoza and Uribe (1999). In their experiments, which involve the Mexico 1987-1994 temporary stabilization, rebating the seignorage revenue reduces the rise in

non-tradable consumption has to be produced locally, capital and labor are reallocated toward the non-tradable sector in the first period of the reform, leading to a decline in tradables production. The reduction in the effective price of investment generates an investment boom. This is in large part financed by foreign borrowing, creating a current account deficit.

As a result of the permanent decline in ε the price of non-tradables relative to the producer price of tradables increases, both in the short run and in the long run. The short run effect is driven by: (i) the reallocation of capital and labor from tradables to non-tradables production; and (ii) the presence of land in non-tradables production (which implies that there are decreasing returns to scale to capital and labor in this sector). In the long run the increase in p is driven by: (i) the presence of land in non-tradables production; and (ii) the labor-intensive nature of the non-tradable sector, which implies that the price of its output rises in response to an increase in the aggregate stock of capital (the so-called Rybczinsky-effect).

In section 3 we discussed three dimensions along which the introduction of distribution improves the performance of the standard model. We can now evaluate the quantitative significance of these improvements.

First, the model with distribution produces a much larger RER appreciation both in the short run (13.1 versus 3.2 percent) and in the long run (17.3 versus 4.6 percent). As we discussed in section 3 this results from two elements: distribution costs increase the elasticity of RER with respect to p (from 0.30 to 0.67) and the response of p to the reduction of ε to zero (from 15.4 to 25.7 for the long run effect). To assess the robustness of the magnification effect of distribution costs on the RER we report in Table 9 the long run RER appreciation for various combinations of the elasticity of substitution between land and the other two factors of production in the non-tradables sector (ρ), and the fraction of the retail price accounted for by distribution.[33] The last row of this Table provides an upper bound on the RER appreciation in the context of our

the relative price of non-tradables from 17% to 5%.

[33] In all these experiments A^S was adjusted so that seignorage was 7% of GDP in the pre-stabilization steady state. The pre-stabilization level of a was also adjusted to be consistent with a trade balance of 2.7%.

experiment. This pertains to the case where the production of non-tradables is constant since it is Leontief in land and the stock of land is fixed. In the model without distribution, it is virtually impossible to generate a RER appreciation of more than 5.7 percent. In contrast, in the model with distribution there are many plausible combinations of parameters that produce realistic movements in the RER.

Second, the model with distribution has more realistic implications for the sources of RER fluctuations. In the basic model *all* of the movement in the RER is caused by changes in the relative price of non-tradables ($\Delta \log(\text{RER}^{NT}) = \Delta \log(\text{RER})$). Recall that the data discussed in section 2 suggests that only 2.7 of the 24.1 percentage points RER appreciation is accounted for by changes in the relative price of non-tradables. In the distribution model the RER falls by 17.3 percent, with 13.7 percent of this change explained by chances in the retail price of tradables and only 3.6 percent explained by the changes in the price of non-tradables. Note that in our model the movements in RER^{T} and RER^{NT} are closely related because they both originate from changes in p_t:

$$\begin{aligned}\Delta \log(RER^{T}) &= -\Delta \log(1+\phi p_t), \\ \Delta \log(RER^{NT}) &= -(1-\gamma_{Ar})\Delta \log[p_t/(1+\phi p_t)].\end{aligned}$$

The last two panels of Figure 1 show that, consistent with this implication of our model, RER^{T} and RER^{NT} share a similar trend–the raw correlation between RER^{T} and RER^{NT} is 0.86.[34] However, there are high frequency movements in these two variables that are clearly not captured by our simple model. These movements could reflect, for instance, nominal rigidities and pricing to market which invalidate the equation $S_t\bar{P}_t^{T*} = \bar{P}_t^{T}$, and/or the presence of distribution costs that are not related to the price of non-tradables.

Third, the model is consistent with the differences between the CPI-based RER and the PPI-based RER discussed in section 2. While the CPI-based RER appreciated by 24.1 percent in the

[34] We thank Charles Engel for suggesting this calculation to us.

first two years of the stabilization plan, the PPI-based RER appreciated only by 2.7 percent. By April 1996 the total depreciation relative to April 1991 of the CPI-based RER rate was 23.2 percent, compared with only 10 percent for the PPI-based RER. In the model the RER appreciation of the CPI based index is also much more pronounced than the movement in the PPI-based index (17.3 versus 5.7 percent in the long run).

7 Conclusion

Economists frequently invoke distribution costs as one of the reasons why purchasing power parity fails. Since distribution services are intensive in labor and land they introduce a natural wedge between the price of the same good in different countries. However, distribution costs are often thought to be too small to be an important determinant of the RER. In this paper we gather empirical evidence that suggests that the fraction of the retail price accounted for by distribution costs is large: more than 40 percent of the retail price in the US and roughly 60 percent of the retail price in Argentina. This evidence lead us to study the RER implications of a model that incorporates a simple distribution sector. Since there is a large literature on the behavior of the RER during exchange-rate-based stabilizations, these episodes provide a natural road test for our theory. We thus calibrate our model to the Argentine 1991 Convertibility plan and study its implications for the RER. While incorporating a distribution sector in the standard model is technically trivial, this small extension of the standard model improves dramatically its performance. The model with distribution is obviously consistent with the fact that relative PPP fails for tradable goods. But, more importantly, the model can produce realistically large RER appreciations, while being consistent with the observation that movements in the RER are driven mostly by changes in the prices of tradable goods.

While we focus on the behavior of the RER during exchange-rate-based stabilizations, extending the standard model to incorporate distribution costs may be useful in other contexts. One such context is Cordoba and Kehoe's (1999) study of the Spanish capital flow liberalization, which finds that the magnitude of the RER appreciation is difficult to rationalize on the basis of their model. Another context is Engel's (1999) empirical investigation of the behavior of the US RER. Engel finds that the relative price of non-tradables does not seem to vary enough to explain a significant fraction of the observed RER variability. A model with a distribution sector can easily generate larger fluctuations in the RER than in the relative price of non-tradables.

We suspect that incorporating a distribution sector may also contribute to the explanation of several outstanding puzzles in international macroeconomics, namely the fact that the cross country correlation of output is higher than that of consumption (see Backus, Kehoe, and Kydland (1995) and Baxter (1995)) and the fact that consumption is too smooth in a small open economy with standard preferences (see Correia, Neves and Rebelo (1995)). Work on the role that distribution may play in these puzzles would greatly benefit from more information on the behavior of distribution margins across different countries and over time.

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Table 1
Ratio of US CPI to Argentina CPI by Component
Cummulative Logarithmic Percentage Changes Relative to April 1991

	Apr-92	Apr-93	Apr-94	Apr-95	Apr-96	Apr-97
Cereals	-25.8	-34.1	-38.8	-39.8	-44.9	-40.7
Meats	-46.9	-46.6	-43.5	-44.9	-43.3	-36.6
Dairy	-25.7	-32.2	-33.7	-38.2	-38.1	-37.0
Sugar and Sweets	1.5	-7.8	-13.1	-14.6	-7.5	-6.1
Fats and Oils	-18.1	-32.0	-48.0	-52.5	-51.0	-44.8
Non-alcoholic Beverages	-26.7	-38.4	-42.6	-28.8	-28.4	-21.9
Food Away From Home	-30.2	-39.8	-41.5	-41.2	-38.1	-33.8
Alcoholic Beverages	-1.4	-19.6	-24.9	-22.8	-7.8	-5.4
Rents, Residential	-39.3	-69.1	-85.9	-87.4	-84.2	-79.1
Fuel and Other Utilities	-13.5	-21.8	-21.0	-29.7	-31.5	-31.6
Furniture and Bedding	-6.3	-10.2	-5.8	-5.7	-1.6	0.3
Housekeeping Supplies	-9.8	-15.6	-16.3	-14.8	-10.8	-9.4
Footwear	-2.8	-1.2	2.4	0.1	5.0	8.3
New Vehicles (new and used cars)	-6.9	-5.2	-1.9	-1.6	0.4	2.8
Maintenance, Repair of Transportation	-3.6	-6.9	-5.5	-8.6	-7.6	-11.8
Public Transportation	-4.1	-9.4	-12.7	-29.9	-28.5	-37.2
Medical Care Commodities	1.9	-10.8	-23.4	-30.2	-27.9	-25.9
Medical Care Services	-26.7	-39.4	-42.8	-42.4	-39.3	-36.1
Tobacco	7.4	17.5	9.0	11.3	12.1	13.8
Toilet Goods and Personal Care Appl.	-6.2	-11.2	-8.9	-10.0	-11.5	-10.1
Personal Care Services	-39.9	-54.7	-59.4	-60.5	-56.2	-49.1
School Books and Supplies	1.5	-1.5	-1.0	-6.0	-1.6	2.4
Educational Services	-2.5	-18.6	-21.0	-18.1	-13.3	-8.8

Source: Estudio Broda, Indec, and DRI BASIC Economics.

Table 2

Distribution Margin For US

Agricultural Products (%), 1997

Fresh Fruits	82
Fats and Oils	79
Fresh Vegetables	79
Dairy Products	68
Meat Products	64
Poultry	59
Eggs	54
Source: Economic Research Service, US Dept. of Agriculture.[35]	

Table 3

US Distribution Margins by Expenditure Category (tradable goods only)

	Personal Consumption Expenditures	Gross Private Fixed Investment	Exports of Goods and Services	Fed. Government Consumption and Gross Investment
Weighted Average	41.9	16.0	12.7	8.8
Standard Deviation	13.0	10.1	7.0	10.7
Max	64.2	37.4	42.2	72.6
Min	0.0	0.0	0.0	0.0
Source: 1992 US Input-Output Matrix, Table C, Bureau of Economic Analysis.				

[35] The source for this data is: http://www.econ.ag.gov/briefing/foodmark/cost/data/index/basket2.htm. The US Department of Agriculture reports the farm value share of retail cost. This is the percentage of the retail price of a given product that is paid to the farmer. Our table reports the distribution margin which is one minus the farm value share of retail cost.

Table 4

Distribution Margin by Expenditure Category

(tradable goods only)

Country	Year	Personal Consumption Expenditures	Gross Private Fixed Investment
Canada	1990	41.2	15.1
France	1995	35.0	10.1
Germany	1995	41.5	10.3
Italy	1992	43.3	14.0
Japan	1995	50.1	22.2
UK	1998	45.4	11.1
US	1997	43.4	14.1[1]

[1]It includes only Private Equipment and Software expenditures.

The comparable number for 1992 is 15.5.

Source: Input-Output Tables for various countries.

Table 5

US Distribution Margins (%)

	Wholesale Margin	Retail Margin	Total Distribution Margin
All Goods	20.6	32.2	46.2
Durable Goods	25.0	26.8	45.1
Non-Durable Goods	16.3	35.3	45.9

Table 6

Production and Value Added

Census of Wholesale and Retail Commerce

Argentina, 1993

506,659 Establishments

(Billions of Pesos)

		Wholesale and Retail	Wholesale	Retail
(1)	Intermediate Inputs	9.21	5.40	3.80
(2)	Labor Income	4.93	2.92	2.01
(3)	Taxes, Depreciation and Interest	3.28	1.81	1.47
(4)	Other Components of Value Added	9.84	4.85	4.99
(5)	Total Value Added	18.05	9.58	8.47
(6)	Value of Production	27.26	14.98	12.27
(7)	Distribution Margin, [(5)-(3)]/[(6)-(3)]	61.60%	58.98%	64.79%

Source: INDEC

Table 7

Sectoral Employment and Value Added

US and Argentina, 1997

Sector	US*		Argentina	
	Employment (% of total)	Value Added (% of total)	Employment (% of total)	Value Added (% of total)
Retail	17.9	7.3	n.a	n.a
Wholesale	5.4	9.8	n.a	n.a
Retail and Wholesale	23.3	17.1	21.4	16.1
Manufacturing	15.2	18.8	15.1	18.2
Services (excluding Retail and Wholesale)	40.4	45.8	47.7	54.0
Government	15.9	12.2	n.a	n.a

*Excludes agriculture.

Source: US Bureau of Economic Analysis and INDEC.

Table 8

Effects of a Permanent Stabilization

	Standard Model			Model with Distribution		
Variables	$t=0$	$t=1$	$t=2$	$t=0$	$t=1$	$t=2$
Devaluation rate (ε)	0.95	0.0	0.0	0.95	0.0	0.0
Percentage Change in CPI-based RER	0.0	-3.2	-4.6	0.0	-13.1	-17.3
Percentage Change in Relative Price of Non-Tradables (p_t)	0.0	10.6	15.4	0.0	19.6	25.7
Percentage Change in CPI-based RER^T	0.0	0.0	0.0	0.0	-10.3	-13.7
Percentage Change in PPI-based RER	0.0	0.0	0.0	0.0	-4.2	-5.7

Table 9

Long Run Change in RER (%)

ρ	Distribution Margin			
	0	25	50	75
-1	-3.9	-7.2	-10.2	-12.8
$-1/3$	-4.6	-10.9	-17.3	-22.2
$-1/5$	-5.0	-13.9	-25.1	-33.5
0	-5.7	-28.8	$-\infty$	$-\infty$

Table 10

Parameters, Basic Model

$\sigma = 5$	Inverse of the elasticity of intertemporal substitution
$\varepsilon = 0.95$	Quarterly depreciation rate in the pre-stabilization period
$\alpha = 0.41$	Labor share, tradable sector
$\rho = -1/3$	Elasticity of substitution between value added and land, non-tradables production
$\eta = 0.71$	Parameter, non-tradables production function
$\nu = 0.159$	Parameter, non-tradables production function
$\gamma = 0.7$	Share parameter, utility function
$A^T = 0.15$	Level parameter, tradables production
$A^{NT} = 0.15$	Level parameter, non-tradables production
$A^S = 0.725$	Level parameter, transactions technology
$a = -1.195$	Initial value, net foreign assets
$r = 0.01$	Quarterly real interest rate
$\beta = 0.99$	Discount factor
$\delta = 0.025$	Depreciation rate
$T = 0.128$	Land endowment

Parameters, Model with Distribution

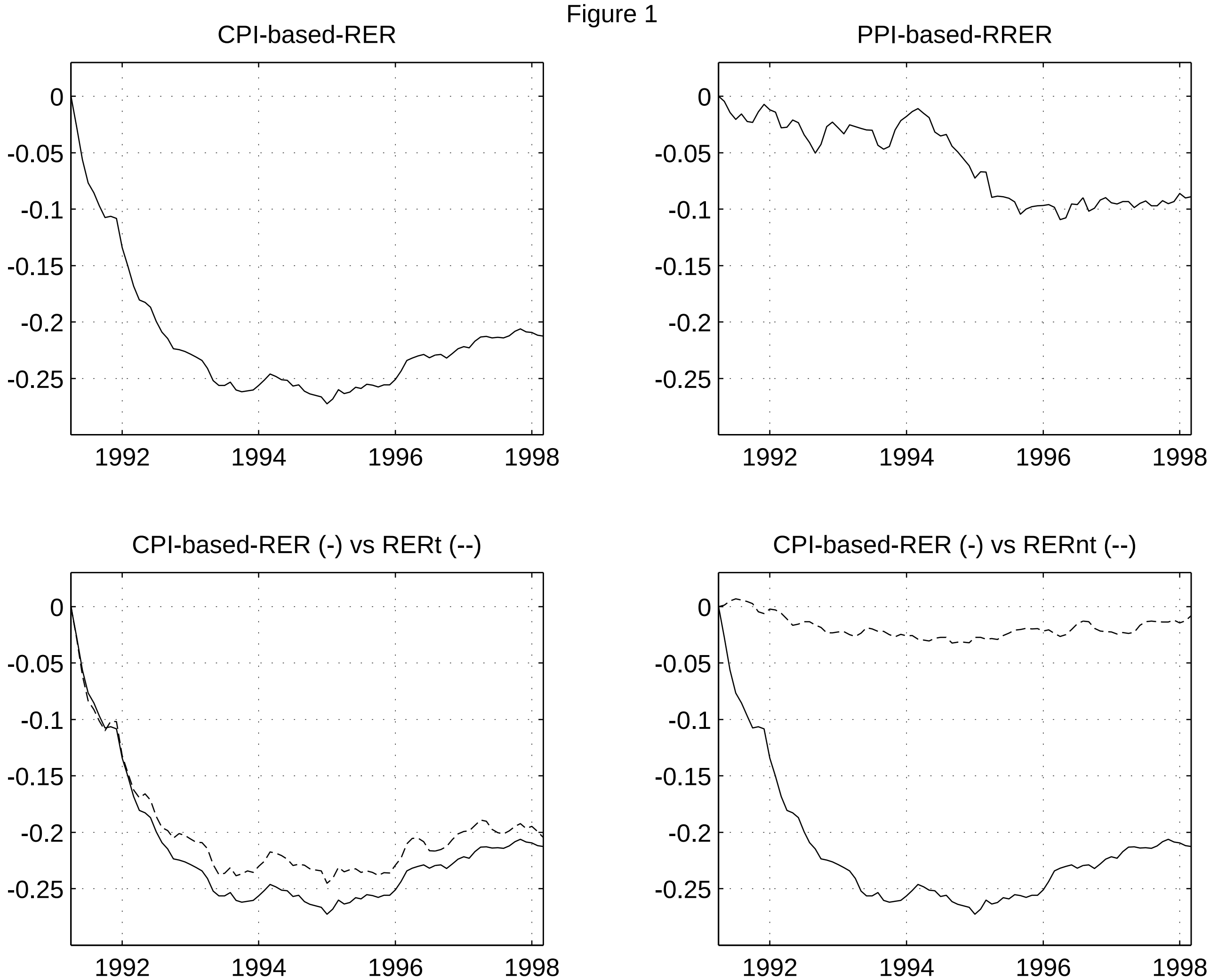
$\phi = 1$	Distribution coefficient
$T = 0.29$	Land endowment
$a = -1.139$	Net foreign assets

Table 11

Effects of Permanent Exchange-Rate-Based Stabilization

	Standard Model			Model with Distribution		
Variables	$t = 0$	$t = 1$	$t = 2$	$t = 0$	$t = 1$	$t = 2$
Devaluation rate (ε)	0.95	0.00	0.00	0.95	0.00	0.00
Output, tradables sector (Y_t^T)	0.366	0.360	0.457	0.248	0.226	0.294
Output non-tradables sector (Y_t^{NT})	0.0765	0.0821	0.0792	0.174	0.194	0.192
Employment tradable sector (N_t^T)	0.798	0.777	0.808	0.541	0.469	0.519
Capital stock (K_t)	5.689	8.189	8.189	4.467	6.223	6.223
Capital stock, tradables sector (K_t^T)	5.308	5.260	7.673	3.601	3.380	4.927
Cons., tradable good (C_t^T)	0.179	0.213	0.216	0.094	0.109	0.109
Cons., non-tradable good (C_t^{NT})	0.0765	0.0821	0.0792	0.080	0.085	0.083
Net foreign assets (a_{t-1})	–1.195	-3.702	-3.702	-1.139	-2.902	-2.902
Relative price of non-tradables (p_t)	1.00	1.112	1.166	1.00	1.216	1.293
Rental price of capital (q_t^K)	0.0407	0.0404	0.0352	0.0407	0.0394	0.0352
Rental price of land (q_t^L)	0.179	0.246	0.232	0.179	0.305	0.313
Real wage rate (w_t)	0.188	0.190	0.232	0.188	0.197	0.232
Trade balance (TB_t)	0.012	-2.50	0.037	0.011	-1.75	0.029
Real exchange rate (RER_t)	1.00	0.969	0.955	1.00	0.878	0.841
Real wage deflated by CPI	0.188	0.184	0.222	0.116	0.107	0.120

Figure 1



CPI-based-RER
PPI-based-RRER
CPI-based-RER (-) vs RERt (--)
CPI-based-RER (-) vs RERnt (--)
0
-0.05
-0.1
-0.15
-0.2
-0.25
1992
1994
1996
1998