"Currency Boards and Productivity Growth"

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On March 20th, 1991, Argentina put its money supply under a dollar exchange standard. The Convertibility Law passed by the government on that date adopted a fixed exchange rate between the austral (the Argentine currency by that time) and the US dollar and restricted rigorously the issue of money by the Argentine Central Bank turning it into a currency board.

The Convertibility Law was the cornerstone of a new and desperate stabilization program devised to put an end to a history of almost fifty years of rates of inflation well above international standards which climaxed in two hyperinflation accelerations during April-July 1989 and December 1989- March 1990'. The Convertibility Law was the more visible feature of a program devised to stop inflation and to introduce structural reforms to make stabilization a lasting achievement.

The Law linked the value of the austral to the dollar in a free market in which the Central Bank committed itself to sell dollars against australes at a fixed rate of australes 10.000 per dollar (an exchange rate slightly higher than the one ruling in the free market at the time the law was passed) although this commitment might not hold for purchases.

On January 1992 the currency denomination was changed back to peso and australes 10.000 were converted into one peso or one dollar. To guarantee the convertibility rate, the monetary base was backed 100 percent by liquid international reserves, including dollar denominated government bonds valued at market prices.[1] The backing requirement implied that the only source of expansion of the monetary base was the purchase of international reserves.

The law had two main targets: to persuade economic agents that to hold domestic currency was equivalent to holding U.S. dollars and to restrict the

[1] The Law allowed the Central Bank to include government bonds in the backing of the monetary base up to a 30 percent of total reserves.

Treasury to have no deficit unless it could be financed in domestic or international capital markets.

The first target intended to avoid the complete dollarization of transactions in order to allow government to collect some kind of seignorage. Since the only way to meet an increase in money demand was to enlarge the backing of the monetary base made of international reserves, government was able to collect interest earnings on those increased reserves deposited abroad.

To achieve the second target, the government enforced some policy measures to strengthen its fiscal stance.

The backing of the monetary base with foreign reserves and the strict control on Central Bank liabilities set a limit to monetary expansion which, together with an opening up of the economy, drove down the inflation rate to international levels as it is shown in Table 1.

Table 1

Inflation Rates

(Percentage annual changes in consumer`s prices)

Year	1988	1989	1990	1991	1992	1993	1994
Inflation Rates	343.0	3079.5	2314.0	171.7	24.9	10.6	3.9

Source: INDEC

A set of structural reforms made to promote greater efficiency in the allocation of resources and to introduce more flexibility in the economy included the deregulation of markets, the privatization of public enterprises, the elimination of distorting taxes and a change from a pay-as-you-go to a capitalization retirement system.

Stabilization plus reforms produced a reduction in country risk rates and an important increase in capital inflows as it is shown in Table 2.

Table 2
Capital Inflows
(Millons of US dolars)

Year	1991	1992	1993	1994
Private Sector	2812	14078	12579	9292
Public Sector	972	-1896	3568	2176
Total	3784	12182	16147	11468

Source: Carta Económica, Estudio M.A.M. Broda

Credit that had disappeared during the inflation years, came back and consumption, investment and GDP grew as shown in Table 3.

Table 3
Macroeconomic Performance
(Percentage annual changes)

Year	GDP	Consumption	Inverstment	Exports	Imports
1990	0.1	- 0.4	- 9.9	18.9	0.6
1991	8.9	12.6	25.1	- 8.3	64.9
1992	8.7	11.4	30.9	- 1.3	66.0
1993	6.0	5.1	13.7	5.0	11.0
1994	6.0	4.0	18.1	12.2	17.0
1991/94	33.0	37.1	120.0	6.6	255.5

Source: Carta Económica, Estudio M.A.M. Broda

The growth in aggregate demand produced increases in the prices of non-tradable goods and in imports of tradable goods. The new set of relative prices encouraged new investments made to produce non-tradable goods (mainly services) and only in 1993 and 1994 a part of investment went to tradable goods production making exports to grow.

Although domestic savings recovered the level they had before the hyperinflation episodes (17,2 % of GDP), economic growth remained dependent of external savings (3,0 % to 4,0 % of GDP). A sudden stop of capital inflows would induce a strong change in relative prices. Such a stop came by the end of 1994 during the “Tequila effect”. Six alternative solutions to restore the economic equilibrium are available when the sudden stop comes: a recession could push the prices of non-tradable goods down, a devaluation of the exchange rate could drive the prices of traded goods up, an increase in the international terms of trade could work in the same way the devaluation does, an increase in domestic savings could replace external savings, a recession could reduce the rate at which the economy creates new jobs or an increase in total factor productivity

could validate the set of relative prices that ruled before the stop. The first three alternatives are short-run solutions (they require variables to adapt to new values of the parameters) while the rest could be addressed as structural solutions (they require parameters to change to keep variables at their original equilibrium levels).

Solow`s neoclassical growth model (Solow,R. 1956) can be used to analyze and evaluate each one of the six alternative solutions suggested. The model can easily accommodate supply side effects including total factor productivity growth which play a key rôle in this problem.

There are two markets in the model: the market for goods and the labor market. Both markets are linked through a production function that fulfills all Inada conditions (Inada,K. 1963) and presents GDP (Y) depending on capital (K) and labor (L)

$$Y = F(K, L) \tag{1}$$

In the market for goods, savings (S) are proportional (through the average propensity to save *s*) to GDP

$$S = sY \qquad 0 \langle s \langle 1 \tag{2}$$

Those savings become investment (I) to increase capital

$$S = I \tag{3}$$

In the labor market, supply for each instant *t* is L_t^s

$$L_t^s = L_0 e^{nt} \tag{4}$$

where L_0 is the number of workers willing to work at $t = 0$ and n is the exogenous and constant labor rate of growth. Equilibrium in the labor market requires

$$L_t^s = L_t^d \tag{5}$$

where L_t^d is labor used in the production function.

In this simple model there are two prices: the wage rate (w) and the rate of profit on capital *(n).* Under perfect competition and with firms maximizing benefits each price equals the respective marginal productivity. For given levels of K and L, equations (1), (2), (3), (4), and (5) allow to get equilibrium levels of GDP and prices. A convenient way to get equilibrium paths for the variables is to

work with *per capita* values. Inada`s conditions require a constant returns to scale production function and so (1) can be written as

$$y = f(k) \tag{6}$$

where $k = \frac{K}{L}$ and $y = \frac{Y}{L}$

The relative change of k through time is

$$\frac{\dot{k}}{k} = \frac{\dot{K}}{K} - \frac{\dot{L}}{L} \tag{7}$$

where a dot on a variable denotes its time derivative. Since

$$\dot{K} = I = S \quad \text{and} \quad \frac{\dot{L}}{L} = n$$

$$\frac{\dot{k}}{k} = \frac{S}{K} - n \tag{8}$$

From (2) and (6) it follows that (8) can be written as

$$\dot{k} = sf(k) - nk \tag{9}$$

Differential equation (9) describes the equilibrium path for capital *per capita*. Inada`s conditions guarantee that capital *per capita* converges to a steady-state path where

$$\dot{k} = 0, \quad k = k^*, \quad y = y^*, \quad r^* = f'(k^*) \quad \text{and}$$

$$w^* = f(k^*) - k^* f'(k^*).$$

Even in such a simple model there are two goods: tradables and non-tradables. The only good produced within the model is GDP which is also used in stock form as capital. It is a tradable good. Labor is the non-tradable good. The domestic price of GDP in this small open economy is $p = \bar{p}q$ where $\bar{p}$ is the

exogenously given international price of the tradable good and θ is the exchange rate (defined as θ pesos for one dollar). The real wage is $w' = \frac{w}{\bar{p}q}$ where w is the nominal wage rate. It must be remarked that the real wage is the relative price between non-tradable and tradable goods.

The model can be solved for a Cobb-Douglas production function

$$y = Ak^{a} \tag{10}$$

where $k = k^{*}$ is determined by domestic parameters. In this case

$$\dot{k} = sAk^{a} - nk \tag{11}$$

so that $\dot{k} = 0$ when

$$k^{*} = \left(\frac{sA}{n} \right)^{\frac{1}{1-a}} \tag{12}$$

and it implies that

$$w' = \frac{w}{\bar{p}q} = (1-a)Ak^{a} \tag{13}$$

Capital inflows will increase domestic capital whenever the marginal productivity of capital for k^{*} is greater than the international interest rate. Capital inflows will drive the capital *per capita* to $k^{**} \rangle k^{*}$ So GDP *per capita*, consumption *per capita* [2] and investment per capita will grow and new relative prices implying an increase in the real wage will appear inducing imports to grow quicker than exports. The real wage increases because the nominal wage in pesos goes up with no changes in international prices or in the exchange rate. These effects are consistent with the data shown in Table 1 on macroeconomic performance in Argentina.

The change in relative prices can be measured as an elasticity applying logs to (13) so that

[2] Consumption per capita will grow if in the original steady-state k^{*} was less than the level of k for which $n=r$

$$\frac{d \ln w'}{d \ln k} = a \qquad (14)$$

The new set of relative prices will remain unchanged if capital continues inflowing. If capital inflows stop the economy should come back to the original steady-state associated with k^*. Without changes in other parameters, relative prices should come back to

$$\frac{w}{\bar{p}q} = (1-a)A(k^*)^a \qquad (15)$$

While

$$\frac{w}{\bar{p}q} = (1-a)A(k^{**})^a \qquad (16)$$

could remain unchanged only if parameters s, A and n change to validate k^{**} with no capital inflows.

There are three ways by which $\frac{w}{\bar{p}q}$ can be reduced when k^{**} drops to k^*: decreasing the nominal wage in pesos (i.e. decreasing the prices of non-tradable goods) or increasing the exchange rate (i.e. devaluing the domestic currency) or through an improvement of the terms of trade (i.e. increasing the prices of tradable goods). These adjustments of the values of variables could be called "short-run" adjustments.

There are also three ways by which parameters in the model could change to validate the set of relative prices associated with k^{**}: increasing the domestic propensity to save or increasing total factor productivity or decreasing the rate at which the economy creates new jobs,. These adjustments of the values of parameters could be called "structural adjustments".

"Short run" adjustments imply a drop in the transition growth rate and reduced permanent levels for real wages, income *per capita* and consumption *per capita.* These adverse effects do not appear if "structural adjustments" are promoted.

A reduction of real wages comes through a recession (a drop of the rate of growth of GDP below the rate of growth of labor supply) which is brought about by the stop in capital inflows. This solution endangers the fiscal equilibrium which is a key requirement for a smooth performance of a currency board. To devalue is equivalent to break the commitment the currency board adopted and it may drive agents behavior towards a flight from domestic currency triggering a hyperinflation. On top of that both "short run" adjustments could put under stress the whole banking system because investment projects financed by credit that

were profitable with the former set of relative prices are unsustainable with the new set of relative prices.

The analysis of the changes in the values of parameters required for an "structural adjustment" can be made comparing steady-states. Elasticities will be used. So

$$d\ln w = \frac{d\ln w}{d\ln k} d\ln k \qquad (17)$$

and

$$d\,lnk = \frac{k_0}{k^{**}}\, d\,lnk_0 \;+\; \frac{k^*}{k^{**}}\; d\;ln\,k^* \qquad (18)$$

where $d\ln k_0$ is the rate of change of *k* driven by capital inflows and $d\ln k^*$ is the rate of change of *k* induced by changes in parameters *s*, *A* and *n* . From (12), (14), (15) and (18) it follows that

$$\hat{w} - \hat{q} - \hat{\bar{p}} = a \left\{ \frac{k_0}{k^{***}}\, \hat{k} + \frac{k^*}{k^{**}}\, \frac{1}{1-a}\, \left(\hat{s} + \hat{A} - \hat{n}\right) \right\} \qquad (19)$$

where a circumflex accent over a variable denotes its rate of change. And so

$$\frac{\hat{w} - \hat{q} - \hat{\bar{p}} - \frac{k^*}{k^{**}}\, \frac{a}{1-a}\, \hat{s} - \frac{k^*}{k^{**}}\, \frac{a}{1-a}\, \hat{A} + \frac{k^*}{k^{**}}\, \frac{a}{1-a}\, \hat{n}}{\frac{k_0}{k^{**}}\, \hat{k}} = a \qquad (20)$$

Equation (20) shows that each one per cent reduction in capital inflows will entail either a reduction of $a\,\frac{k_0}{k^{**}}$ per cent in the prices of non-tradable goods $\left(\hat{w}\right)$ or an improvement of $a\,\frac{k_0}{k^{**}}$ per cent in the terms of trade $\left(\hat{\bar{p}}\right)$ or a devaluation of $a\,\frac{k_0}{k^{**}}$ per cent $\left(\hat{q}\right)$. The change in relative prices can be avoided either by increases of $\frac{k_0}{k^*}(1-a)$ per cent in the domestic propensity to

save $(\hat{s})$ or in total factor productivity $(\hat{A})$ or by a reduction of $\frac{k_0}{k^*}(1-a)$ per cent in the rate at which the economy creates new jobs $(\hat{n})$.

Table 4 reports the evolution of total factor productivity in the Argentine economy for the period 1990-1994

Table 4
Total Factor Productivity Evolution

a	**1-**a	**Â anual**	**Â (1990/94)**
0.60	0.40	0.040	0.177
0.62	0.38	0.040	0.174
0.64	0.36	0.039	0.171
0.66	0.34	0.038	0.168
0.68	0.32	0.038	0.165
0.70	0.30	0.037	0.161

The change in total factor productivity together with the observed values for α (the share of capital in GDP) help to estimate the level of capital outflows that the economy could accommodate avoiding recessions and devaluations. For example, for $\hat{A} = 0.04$ per year and $\alpha = 0.65$, equation (20) with $\hat{w} = \hat{q} = \hat{p} = \hat{s} = \hat{n} = 0$ yields

$$\frac{-\frac{a}{1-a}\hat{A}}{\hat{k}} = a \quad \text{if} \quad k_0 \cong k^*$$

or $$\frac{-(1.86)(0.04)}{\hat{k}} = 0.65$$

This implies that those values for Â and a made the economy strong enough to bear an external capital flow reversal equal to $\hat{k} = -\frac{(1.86)(0.04)}{0.65} = -0.11$ without going either through devaluations or recessions. On the other hand, equation (20) shows that for

$$\hat{A} = \hat{s} = \hat{n} = \hat{w} = \hat{\bar{p}} = 0$$

$$\frac{-\hat{q}}{\hat{k}_0} = a \qquad \text{if} \qquad k_0 \cong k^{**}$$

or that the required devaluation for an 11% drop in capital inflows is

$$\hat{q} = (0.65)(0.11) = 0.07$$

These illustrations show that an increase in total factor productivity of four per cent yearly allows the economy to accommodate a drop in capital inflows that would require a seven per cent devaluation per year.

These results stress how important is for a safe currency board operation to encourage “structural reforms” to favor total factor productivity improvements.

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