The Journal of Developing Areas 12 (Jan. 1978): 133-152

A Comparative Study of Exchange Rate Policy under Inflation

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This paper presents the results of a first comparative case study of exchange rate policy in countries with rates of domestic inflation significantly and persistently above the world average. The analysis centers on Argentina, Brazil, Chile, and Uruguay, countries which, for at least two decades, have had (and continue) to formulate their exchange rate policies within the context of annual inflation rates averaging over 30 percent. These countries were selected because they are the ones with the longest and most severe history of inflation in Latin America and, as such, had to follow an active exchange rate policy long before the present system of floating exchange rates came into being. A period of approximately 16 years (roughly 1957-72, depending on the available data) was chosen because it provides a sufficiently long time span to examine the evolution of exchange rate policy. On the basis of this historical analysis, some observations are made on exchange rate policy developments since 1972.

The Rate of Devaluation and the Rate of Inflation

A world where individual countries inflate or deflate at different speeds is a world where, of necessity, countries' exchange rates will change over time. The proposition that exchange rate adjustments and price level movements are intimately related was developed and popularized by Gustav Cassel during the 1920s, a period characterized by individual episodes of disastrous hyperinflation and dramatic currency depreciation. His "purchasing-power-parity" theory holds that, in the long run, differential rates of inflation are the most, if not the only, significant determinant of exchange rate movements.[1] The notion can be illustrated as follows.

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[1] For recent contributions on the subject see L. H. Officer, "The Purchasing-Power-Parity Theory of Exchange Rates: A Review Article," *International Monetary Fund Staff Papers* 23 (March 1976).

Assume that, at a given (fixed) exchange rate and with the balance of payments in equilibrium, a country's monetary authority engages in excessive credit creation, and that this monetary disequilibrium, by increasing the aggregate demand for goods and services, succeeds in raising the rate of domestic inflation above the world average.[2] Ceteris paribus, there will develop an excess demand for foreign exchange: first, because higher prices at home will negatively affect the country's comparative cost advantage, increasing domestic demand for the now relatively cheaper foreign goods while reducing foreign demand for the now relatively dearer home exportables; second, because anticipation of a devaluation in view of a growing trade imbalance will lead to a speculative desire to hold foreign exchange as an asset.

Under a system of fixed exchange rates, this excess demand for foreign exchange must be satisfied through sales of central bank reserves and, indeed, it is this reserve depletion that alerts policymakers to a disequilibrium in the market for foreign exchange. At first, the authorities may attempt to resolve the situation by increasing tariffs on imports, reducing export taxes or subsidizing exports, or borrowing foreign exchange, or all three. Should the gap between inflation at home and in trading partner countries continue, however, a more permanent solution will have to be found: either the growth of monetary aggregates will have to be reduced until excess liquidity and, therefore, inflation are lowered, or the exchange rate will have to be devalued.[3]

Countries with permanently high rates of inflation are, by definition, unwilling to eliminate completely the monetary disequilibrium that feeds their inflation and, consequently, must forever devalue their currency in some relation to the differential between domestic and world inflation. When a government's only instrument of balance of payments adjustment is the exchange rate, the rate of devaluation and the relative rate of inflation have to remain closely related. On the other hand, when governments utilize tariffs, import quotas, export taxes, export subsidies, or currency controls for balance of payments purposes, engage in compensatory borrowing, or pursue fiscal or income policy objectives designed to affect the balance of payments in a certain manner, the relationship between the rate of devaluation and the relative rate of inflation can become very much blurred.

The actual nature of this relationship can be expressed, of course, by calculating what could be termed the real exchange rate, namely, the nominal exchange rate (X) deflated by the relevant price level differential (Pd/Pw, where Pd is the domestic price level of tradable goods and Pw is the world price level of tradables). A real exchange rate that remains virtually unchanged over time suggests government reliance on the exchange rate as the principal instrument of balance of payments adjustment,

[2] "Excessive," that is, when compared with the growth in the demand for real cash balances.

[3] It is assumed that the country can neither print international reserves, as the United States once could, nor has the political power to convince its trade partners to inflate so as to decrease the relative purchasing power of their currencies.

a policy of maintaining what is commonly known as a realistic exchange rate. In contrast, a real exchange rate that is not constant through time suggests the employment of policy instruments other than the exchange rate for balance of payments purposes, a policy of compensating for a frequently unrealistic exchange rate by various means.

For the purpose of further identifying a country's exchange rate policy it is useful, in addition to determining the variability of the real exchange rate, to define an equilibrium real exchange rate, namely, a unique ratio of X to Pd/Pw that is compatible with external balance. This can be done by calculating the real exchange rate for a period during which the current account of the balance of payments was in equilibrium and most other important policy instruments were not, in fact, manipulated to produce artificially a situation of external equilibrium. The objective is to determine whether departures from the equilibrium real exchange rate have tended to be in the direction of currency over- or undervaluation, thus shedding additional light on the use that authorities make of the exchange rate.

Table 1 shows the quarterly movement of the real exchange rate of the four high inflation countries with which we will be concerned: Argentina, Brazil, Chile, and Uruguay.[4] An equilibrium real exchange rate was identified for each country and used to establish a base period ($= 100$) that served to scale the series.[5] Increases in the real exchange rate should be taken to have resulted from exchange rate adjustments in excess of the differential between domestic and world inflation; instances when the equilibrium real exchange rate was surpassed (i.e., when observations greater than 100 are recorded) provide prima facie evidence that the currency may have been devalued to the point of undervaluation. On the other hand, decreases in the real exchange rate follow from devaluations that did not fully compensate for the inflation rate differential; observations below the equilibrium value suggest that the currency may have been overvalued.

At first sight, most striking of all is, perhaps, how these countries' real exchange rates have fluctuated over time as much as they appear to have done: in Argentina, from a low of 73.3 to a high of 122; in Brazil, from 80.9 to 126.4; in Chile, from 74.2 to 108.5; and in Uruguay, from 75.2 to 217.3. Closer examination of the data reveals, however, that not all countries exhibit the same trends. First, Uruguay's real exchange rate fluctuated far more violently than did the real parities of the other three countries.

[4] The variables were defined as follows: X = nominal exchange rate in terms of U.S. dollars, period average data from *International Financial Statistics (IFS)* (Washington, DC: International Monetary Fund, various issues); where multiple exchange rates were applicable, *IFS* has calculated a trade weighted exchange rate, and this was automatically applied. Pd = wholesale price index from *IFS*; in the case of Uruguay for 1957-67, when a quarterly wholesale price index was unavailable, the consumer price index was utilized. Pw = wholesale price index for the United States, a proxy for the world price level of tradables, from *IFS*.

[5] Two main criteria were applied in the choice of the equilibrium year(s): a current account deficit or surplus equivalent to less than 5 percent of the total value of FOB exports, and a growth of real gross domestic product (GDP) closest to the period trend. As much as possible, years during which there were significant tariff or other reforms were disqualified.

TABLE 1

Evolution of the Real Exchange Rate

	Argentina				Brazil				Chile				Uruguay			
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV
1957	120.7	101.9	108.1	100.7	85.2	85.4	85.6	86.6	92.5	74.2	74.9	74.9	103.7	109.3	102.6	112.6
1958	105.1	93.9	86.8	98.1	89.9	95.2	100.4	110.1	75.5	88.2	75.4	86.2	122.6	152.1	173.3	217.3
1959	121.9	122.0	108.7	106.3	126.4	117.5	112.9	102.7	85.1	94.8	84.1	83.7	173.9	157.8	162.8	156.7
1960	101.3	107.5	100.8	101.1	100.8	106.2	106.1	94.7	84.2	84.3	84.0	84.2	148.3	143.5	122.6	114.5
1961	101.1	100.3	90.3	90.5	94.5	98.7	115.5	121.8	92.8	83.6	83.6	92.1	107.3	106.3	99.9	100.0
1962	86.7	96.2	101.3	110.8	122.2	118.5	118.4	121.5	84.2	92.1	84.2	75.7	97.6	94.3	92.2	89.6
1963	98.2	96.9	94.4	89.3	111.5	106.8	103.4	100.0	81.1	80.3	85.6	80.3	89.2	107.2	112.8	97.0
1964	79.1	75.0	75.4	75.4	80.9	92.4	111.5	115.2	75.7	75.3	78.9	82.1	87.8	100.0	103.5	102.9
1965	74.0	77.9	73.3	76.0	122.5	125.3	125.9	123.3	88.3	85.1	85.5	88.3	115.1	175.5	199.5	169.4
1966	77.4	76.8	80.5	82.6	123.6	120.6	114.9	108.5	86.5	88.7	91.7	93.0	148.6	127.9	120.5	122.1
1967	93.3	110.6	102.6	100.3	103.1	113.9	112.9	108.5	92.0	95.5	98.9	106.2	110.3	105.7	108.1	133.8
1968	100.4	101.0	99.0	99.6	109.7	114.4	112.3	114.3	102.7	105.2	103.9	108.5	109.9	108.3	97.0	96.9
1969	101.0	100.0	95.2	97.1	121.5	125.4	121.2	124.9	97.8	97.9	100.9	104.7	96.8	96.9	96.2	95.0
1970	98.6	95.5	100.5	91.7	118.4	118.7	116.4	114.2	97.1	97.7	102.1	101.1	91.4	87.7	87.4	84.5
1971	86.7	83.6	84.9	93.2	119.5	117.7	117.8	118.0	99.6	96.4	93.8	88.7	80.9	80.3	77.1	75.2
1972	91.5	97.5	90.8	87.2	118.8	117.9	116.0	116.6	106.5	95.5	98.0	98.7	91.7	98.9	98.0	86.9
100 =		1968				1964				1969-70				1963-64		
Coefficient of variation:		12.3				10.6				10.4				26.9		
Minimum:		73.3				80.9				74.2				75.2		
Maximum:		122.0				126.4				106.5				217.3		
Mean:		94.8				110.9				89.8				114.6		
Median:		97.0				114.3				88.5				104.7		

While the coefficients of variation for Brazil and Chile were almost identical (10.6 and 10.4, respectively), and that for Argentina was only slightly higher (12.3), Uruguay's coefficient of variation was more than twice as high (26.9). This reveals that the Uruguayan authorities placed relatively little importance on the maintenance of a realistic exchange rate and, in general, did not rely on the exchange rate as a prime instrument of balance of payments adjustment. Second, while most deviations from equilibrium in Argentina and Chile were in the direction of currency overvaluation, in the case of Brazil such deviations were overwhelmingly on the side of currency undervaluation. As can be seen at the bottom of table 1, the mean and median of the Argentine and Chilean samples are well below 100, while, on the other hand, these statistics are substantially above 100 in the Brazilian sample. In terms of these indicators, the randomness of the Uruguayan sample does not allow for any firm conclusions about the bias of deviations from equilibrium.

The history of exchange rate policy over- and undershooting depicted in table 1 cannot but prompt the raising of at least two questions about the role and objectives of exchange rate policy in these high inflation countries. In the first place, what factors can account for the general reluctance to devalue pari passu with inflation rate differentials? And, secondly, what can explain the overvaluation bias in Argentina and Chile and the undervaluation bias in Brazil?

It is with these issues that the remainder of this paper is concerned.

Analysis of Exchange Rate Policymaking

Three hypotheses are here advanced in an attempt to explain the degree of government reliance on and bias in the use of the exchange rate as a policy instrument. They relate to the authorities' (1) balance of payments strategy, (2) attitude towards the inflationary impact of devaluations, and (3) perception of the effectiveness of exchange rate adjustments.

Balance of Payments Strategy. The belief that the maintenance of a constant real exchange rate is either necessary or desirable hinges on the assumption that balance of payments equilibrium is always a worthwhile policy objective. Clearly, even from a theoretical perspective this need not be the case. At times, governments may temporarily seek to generate fuller employment and greater capacity utilization by undervaluing the currency and thus inducing a trade surplus. Countries may also attempt temporarily to maximize the domestic availability of goods and services—for instance, in the context of an antiinflation program—in which case a policy of currency overvaluation designed to promote a trade deficit may come to be followed. The central bank of a country where exports are subject to strong seasonal or price fluctuations may seek to fine tune the trade balance by inducing, through alternate periods of currency under- and overvaluation, a closer coincidence of export and import cycles and thus greater internal economic stability.

A close reading of various in-depth studies of foreign sector policy in the four South American countries under consideration suggests that part of the observed failure to maintain a constant real exchange rate, as well as part of the tendency for certain countries to over- or undervalue their

currency, can be explained by making reference to their balance of payments strategy.[6] This is so because, during the period under review, in none of the four countries was the maintenance of external equilibrium the only objective of foreign sector economic policy. Indeed, official attitudes toward the balance of payments and, therefore, toward exchange rate adjustments, were shaped by and subordinated to more general economic policy objectives.

Consider first the cases of Argentina and Uruguay, two countries which, for the purpose at hand, were sufficiently similar as to allow for joint examination. In both, import substitution policies had been successfully applied during the 1930s, 1940s, and early 1950s, so that by the mid-1950s most substitutable imports had, in fact, been substituted. Consequently, the two countries' industrial base was heavily dependent upon permanently high tariffs and other import restrictions, except on raw materials and capital goods. Exports, on the other hand, were comprised overwhelmingly of agricultural commodities and livestock products—the output of technologically backward rural societies which utilized land-intensive methods of production and provided employment to a minority of the economically active population. The majority of the labor force resided in urban areas and was employed either by the industrial sector or by an overgrown services sector—a by-product of unusually rapid modernization, paternalistic government intervention, and inflation induced distortions. This urban constituency was, to a large extent, highly unionized, politicized, and, therefore, vocal.

Policy toward the foreign sector generally and the exchange rate in particular in both countries during the 1950s and 1960s was very much determined by the outcome of a sectoral conflict of interest. Urban interests demanded that (a) balance of payments policy should not be export-promoting, since that would not increase employment opportunities appreciably and, in the short run, would only increase the rents accruing to landowners while decreasing the availability (and thus raising the relative price) of food for domestic consumption; and (b) that balance of payments policy should seek to maximize the inflow of nonsubstitutable import goods at the lowest possible price, thus benefiting local industry and urban consumers. This stand clearly favored currency overvaluation. Rural interests, on the contrary, wanted policies that would stabilize and guarantee

[6] See Jere R. Behrman, *Foreign Trade Regimes and Economic Development: Chile* (New York: National Bureau of Economic Research, 1976); Joel Bergsman, *Brazil: Industrialization and Trade Policies* (London: Oxford University Press, 1970); Russell H. Brannon, *The Agricultural Development of Uruguay* (New York: Praeger, 1967); Carlos F. Diaz-Alejandro, *Essays on the Economic History of the Argentine Republic* (New Haven, CT: Yale University Press, 1970), and *Exchange-Rate Devaluation in a Semi-Industrialized Country* (Cambridge, MA: MIT Press, 1965); Juergen B. Donges, *Brazil's Trotting Peg* (Washington DC: American Enterprise Institute, 1971); Ricardo Ffrench-Davis, *Politicas Economicas en Chile, 1952-1970* (Santiago: Universidad Catolica de Chile, 1973); Richard D. Mallon and Juan V. Sourrouille, *Economic Policymaking in a Conflict Society: The Argentine Case* (Cambridge, MA: Harvard University Press, 1975); Markos J. Mamalakis, *The Growth and Structure of the Chilean Economy* (New Haven, CT: Yale University Press, 1976); Donald E. Syvrud, *Foundations of Brazilian Economic Growth* (Stanford, CA: Hoover Institution, 1974); and William G. Tyler, "Exchange-Rate Flexibility Under Conditions of Endemic Inflation: A Case Study of the Recent Brazilian Experience," in *Leading Issues in International Economic Policy*, ed. C. Fred Bergsten and Tyler (Lexington, MA: D. C. Heath, 1973).

adequate returns to investment in export-oriented agriculture, and thus lobbied against currency overvaluation.

It appears clear that, during most of the period under review, political leaders in both countries tended to favor urban interests, and this can help explain the nature of exchange rate policies pursued. The majority of the population regarded devaluations as something highly undesirable, to be adopted only when the balance of payments was posting unsustainable deficits. This was effectively conveyed to political leaders so that, although permanently high rates of domestic inflation warranted the adoption of a realistic exchange rate policy that would prevent external disequilibria, in both Argentina and Uruguay frequent departures from exchange rate equilibrium became common because any and all parity adjustments posed a difficult political dilemma.

In the case of Chile, exchange rate developments there can also be better understood when placed in the context of the country's inward-looking economic development strategy. The process of import substitution in Chile was virtually complete by the end of World War II. During the 1950s and 1960s, imports were perceived by public opinion as vital to the country, since they were made up of nonsubstitutable commodities (such as raw materials and capital goods), the inflow of which could not be discouraged lest domestic industry and capital formation generally be adversely affected. Export earnings, on the other hand, were generated by the extractive (mostly copper) sector. Successive governments and the public at large looked down upon the activities of their mostly foreign-owned export enclave, discounted its potential contribution to the nation's long-run economic well being, and regarded it primarily as a supplier of foreign exchange with which to foot the import bill.

Out of these attitudes there developed a policy toward the foreign sector that did not give priority to the maintenance of external equilibrium but, in fact, looked favorably upon trade deficits of manageable size. In this context, the exchange rate was often viewed as a discretionary policy instrument with which to curb excessive import growth, rather than as an automatic adjustment mechanism to prevent any and all inflation-induced departures from current account equilibrium.

The situation was a rather different one in Brazil. While by the end of World War II the country had a significant industrial sector, in the postwar period governments embarked on a sweeping and rapid program of further import-substituting industrialization. As part of a package of incentives to local producers, during the late 1950s and early 1960s the government rationed the availability of foreign exchange for import purposes. Several import categories were established and auctions were held to allocate the foreign exchange allotted for each category. The idea was to promote certain imports (say, of capital goods) by setting for them a more generous quota of foreign exchange than for nonessential (namely, substitutable) imports, so that the auction-determined exchange rate applicable to the former category of goods would in practice be much lower than that applicable to the latter. In other words, the use of the exchange rate for purposes other than balance of payments adjustment, plus the artificially high, shortage price of foreign exchange set for most imports,

partially explains observed fluctuations in the real exchange rate and the undervaluation bias that was sometimes evident during the 1957-63 period.

After a military government was established in 1964, however, the market for foreign exchange was gradually unified in the context of a very different balance of payments and economic development strategy. Indeed, especially in the late 1960s, the Brazilian authorities adopted an avowedly export-promoting, outward-looking strategy, an explicit component of which was the maintenance of an allegedly realistic—in fact, a somewhat undervalued—exchange rate. A system of minidevaluations was adopted, together with a generous set of fiscal incentives, which were meant to facilitate the growth and diversification of exports. Once again, this very different view of the role of the exchange rate and of its contribution to a then very new balance of payments strategy can help account for the increasing stability of the real exchange rate in Brazil during the 1967-72 period, as well as for the tendency of the authorities to have an undervaluation bias.

The Inflationary Impact of Devaluations. Another possible explanation of the evolution of exchange rate policy in these four South American countries lies in the reaction of policymakers to the actual and expected inflationary impact of devaluations.

All devaluations have, of course, an inflationary impact, since they increase the domestic currency price of imported goods and, at least in the short run, increase the local price of exportable goods as greater foreign demand for export products is promoted. In fact, it is partly because of this inflationary impact that devaluations can induce at least a temporary improvement in a country's external situation: as import prices are suddenly higher, the demand for imports drops. However, the greater the inflationary impact of devaluations, the greater the probability that governments will try to avoid devaluing, even when a high rate of domestic inflation creates the need to devalue. If this hypothesis is true, it can help explain why instruments other than the exchange rate may have been used for balance of payments adjustment purposes and why, in some of the countries, there was a tendency to allow for currency overvaluation.

a) The Direct Inflationary Impact of Devaluations. To assess whether the inflationary impact of devaluations did affect the evolution of exchange rate policy one must begin by determining what could be termed the direct impact of devaluations on domestic inflation, namely, the effect of import price increases on general prices.

This cannot be done by estimating an equation of the form:

$$\log Pd = a_0 + a_1 \log Pm \qquad (1)$$

where *Pd* and *Pm* are the local currency indices of domestic and import prices, respectively. This is so because, when working with high inflation countries, one is really faced with a simultaneous equation system: higher domestic prices lead to devaluations, which cause higher import prices and, if validated by the central bank, to still higher domestic prices.

To reduce the simultaneous equation bias, a simple, three-equation econometric model was constructed. It specifies that domestic prices are a function of both import prices and the money supply (*Ms*); that import

prices are, in turn, a function of the exchange rate (X) and the level of tariffs (T); and that the exchange rate is a function of both domestic prices and world prices (Pw):

$$\log Pd = a_0 + a_1 \log Pm + a_2 \log Ms \tag{2}$$

$$\log Pm = b_0 + b_1 \log X + b_2 \log T \tag{3}$$

$$\log X = c_0 + c_1 \log Pd + c_2 \log Pw \tag{4}$$

where Ms, T, and Pw are determined exogenously.

This three-equation system was then estimated by a three-stage, least-squares method utilizing the available data for Argentina, Brazil, and Chile.[7] (Uruguay lacks a series on Pm.) The results for the first equation appear in table 2.

TABLE 2

EFFECT OF IMPORT PRICES ON DOMESTIC PRICES

COUNTRY	a_0	a_1	a_2	$\overline{R^2}$	DW	DF
Argentina	−0.08	0.62	0.37	0.99	0.60	13
	(0.73)	(3.46)	(2.18)			
Brazil	0.25	0.34	0.60	0.99	1.10	11
	(2.71)	(1.59)	(3.07)			
Chile	0.06	0.63	0.38	0.99	1.39	11
	(0.15)	(2.53)	(2.29)			

NOTES: See eq. 2. $\overline{R^2}$ = coefficient of multiple determination adjusted for degrees of freedom; DW = Durbin-Watson statistic of autocorrelation; DF = degrees of freedom; figures in parentheses indicate t statistic. These symbols are the same for the following tables.

Although the equations may be affected by autocorrelation, the estimated (a_1) coefficients strongly suggest that while in Argentina or Chile a devaluation which increased import prices by 10 percent caused a 6 percent increase in the general level of prices, the same devaluation-induced import price rise in Brazil would only increase prices by about 3 percent. This intercountry difference is quite plausible in that Brazil was, at the time, a relatively more closed economy than were the other two: during 1957-72, exports plus imports averaged 14.8 percent of Brazil's gross do-

[7] The variables were defined as follows: Pd = gross domestic product deflator—the indicator of inflation that takes the greatest number of goods and sectors into account while explicitly discounting the price of imported goods—from *IFS*; Pm = local currency price of imported goods, for Argentina from *U.N. Statistical Yearbook* (New York, various issues), for Brazil from *Anuario Estatistico do Brasil* (Rio de Janeiro: Instituto Brasileiro de Estatisticas, various issues), and for Chile from *Boletin Mensual* (Santiago: Banco Central de Chile, various issues); Ms = midyear average of the *Ml* money supply, from *IFS* (various issues); X, see n. 4; T = foreign trade taxation index (Argentina) or import taxation index (Brazil and Chile) calculated from data on revenues and actual trade flows from *U.N. Statistical Yearbook* (New York, various issues), *Conjuntura Economica* (Rio de Janeiro: Fundaçao Gertulio Vargas, various issues), and Ffrench-Davis, *Politicas Economicas en Chile*, respectively; and Pw, see n. 4. In view of the available data, the samples were: Argentina, 1957-72; and Brazil and Chile, 1957-70.

mestic product, but 18.1 percent and 27.1 percent of Argentina's and Chile's GDP.

However, when a Chow test was carried out to establish the statistical inequality of the three a_1 coefficients, it was found that, at the 0.05 level of significance, one cannot conclude that the coefficients were, in fact, statistically different from one another. Consequently, it is not possible to state with statistical certainty that the inflationary effect of devaluations on import prices and thus on general prices was indeed greater in Argentina and Chile than it was in Brazil.

b) The Indirect Inflationary Impact of Devaluations. Aside from affecting domestic prices through changes in import prices, exchange rate adjustments can also have an indirect inflationary impact if they have an effect on workers' wages and/or on general price expectations. To see whether the conduct of exchange rate policy may have been affected by the indirect inflationary impact of devaluations, one must first determine what the historical relationship between wages and prices was.

To do so, assume that the supply of labor (Ls) is a function of the nominal wage rate (W) and the level of domestic prices (Pd), while the demand for labor (Ld) is, in turn, dependent upon the productivity of workers (N), the unit cost of labor (W), and the price of output (Pd). In functional form:

$$Ls = d_1(W, Pd), \text{ where } Ls_W > 0 \text{ and } Ls_{Pd} < 0; \text{ and} \quad (5)$$

$$Ld = d_2(N, W, Pd), \text{ where } Ld_N > 0, Ld_W < 0, \text{ and } Ld_{Pd} > 0. \quad (6)$$

When the labor market tends toward equilibrium of labor supply and demand ($Ls = Ld$), the following wage equation can be derived:

$$W = d_3(N, Pd), \text{ where } W_N > 0 \text{ and } W_{Pd} > 0.^8 \quad (7)$$

Consequently, and to measure the relationship between nominal wages and domestic prices in the four countries, the following equation was estimated:[9]

$$\log W = a_0 + a_1 \log N + a_2 \log Pd. \quad (8)$$

The results, which are shown in table 3, suggest a much closer relationship between wages and prices in Argentina, Chile, and Uruguay than in Brazil. Indeed, the estimated values of a_2 imply that, for every 10 percent

[8] While it is traditional to include the rate of unemployment as a third explanatory variable, this is not done here because there are no long-run, national unemployment statistics for any of the four countries with which we are concerned.

[9] The variables were defined as follows: W = nominal wage rate (usually in manufacturing) for Argentina, from CONADE, *Distribucion del Ingreso y Cuentas Nacionales en la Argentina*, vol. 5 (Buenos Aires: Presidencia de la Nacion, 1965) and from Ministerio de Economia y Trabajo, *Informe Economico* (Buenos Aires, various issues); for Brazil, from *Conjuntura Economica* (various issues); for Chile, from *Boletin Mensual* (various issues); and for Uruguay, from Instituto de Economia, *Estudios y Coyuntura no. 3* (Montevideo: Fundacion de Cultura Universitaria, 1973). N = per capita gross domestic product, from *IFS* (various issues). Pd = consumer price index—the indicator of inflation with which workers are most concerned—from *IFS* (various issues). In view of the available data, the samples were: Argentina and Uruguay, 1957-72; Brazil, 1956-69; and Chile, 1959-72.

increase in domestic prices, workers in Argentina obtained a 9.1 percent increase in wages, workers in Brazil were awarded an 8.6 percent raise, workers in Chile achieved an 11.8 percent increase, and their counterparts in Uruguay received an increase of 9.6 percent.

TABLE 3

RELATIONSHIP BETWEEN DOMESTIC PRICES AND WAGES

COUNTRY	a_0	a_1	a_2	$\overline{R}^2$	DW	DF
Argentina	−4.14 (4.21)	0.98 (4.33)	0.91 (38.55)	0.99	1.53	13
Brazil	−1.70 (2.29)	0.52 (2.97)	0.86 (69.48)	0.99	1.92	11
Chile	−3.91 (0.65)	0.67 (0.49)	1.18 (11.87)	0.98	1.59	11
Uruguay	−1.13 (0.47)	0.26 (0.50)	0.98 (88.96)	0.99	1.71	13

NOTE: See eq. 8.

The relatively lower a_2 coefficient for Brazil follows, in part, from the reductions in real wages that took place during the 1964-69 period, when the military government actively repressed labor union activity and purposely lagged wage increases behind price rises. On the other hand, the very high a_2 coefficient for Chile can be explained by the fact that, especially during 1965-72, governments there undertook a program of income redistribution in favor of workers, an important aspect of which was the granting of wage increases in excess of inflation.

To confirm the implications of the above estimates, Chow tests were conducted and the resulting statistical inequality of the estimated a_2 coefficients proves that, statistically speaking, wages in Brazil did tend to be less responsive to prices than was the case in Argentina, Chile, or Uruguay.

This suggests that a policy of frequent or sizeable devaluations, ceteris paribus, could have led to less important wage-push pressures in Brazil than in the other three countries. Therefore, it is plausible to say that observed, frequent departures from exchange rate equilibrium and the overvaluation bias in Argentina and Chile—and, at times, in Uruguay—may have resulted from the fact that policymakers were reluctant always to devalue by as much as necessary because they feared the greater direct and indirect inflationary impact of devaluations.

Another method of ascertaining the relevance of anticipated, devaluation-related inflationary pressures to exchange rate policymaking is to verify whether there existed a direct link between exchange rate adjustments and labor market policy.

Indeed, in all four countries it was common for governments periodically to intervene in their labor markets with the purpose of keeping wages from spiraling in the aftermath of devaluations. Such interventions took the form

of wage controls, minimum wage freezes, strike prohibitions, the temporary cancelling of cost of living clauses, and other antilabor measures. Since such labor market intervention was designed to minimize the potential for large wage increases, it would be interesting to test for whether episodes of intervention did, in fact, coincide with movements in the real exchange rate.

For this purpose, the following equation was estimated:

$$\log X = a_0 + a_1 \log (Pd/Pw) + a_2 D \log (Pd/Pw) \qquad (9)$$

where, as previously, X, Pd, and Pw stand, respectively, for the nominal exchange rate and the domestic and world level of prices. The slope dummy D is meant to capture the relationship between labor market intervention and exchange rate policy: it was set equal to zero for observations when no labor market intervention took place and equal to one whenever such intervention did take place.[10] The results appear in table 4.

TABLE 4

RELATIONSHIP BETWEEN LABOR-MARKET INTERVENTION AND EXCHANGE RATE POLICY

COUNTRY	a_0	a_1	a_2	$\overline{R^2}$	DW	DF
Argentina	1.28 (37.89)	1.03 (26.95)	−0.09 (2.16)	0.99	1.09	13
Brazil	1.52 (37.18)	1.05 (65.76)	−0.01 (0.77)	0.99	2.09	11
Chile	−4.41 (72.58)	1.12 (31.34)	0.11 (3.22)	0.99	1.37	12
Uruguay	−1.29 (17.73)	0.97 (29.34)	−0.08 (2.26)	0.99	1.49	13

NOTE: See eq. 9.

The estimated values of the a_2 coefficients suggest that episodes of labor market intervention did not affect the traditional relationship between the exchange rate and the relative level of prices in the case of Brazil, while they did in the other three countries. Indeed, the a_2 coefficient was statistically significant at the 0.025 level in Argentina, Chile, and Uruguay, while it was insignificant even at the 0.20 level in Brazil. Since in Chile a_2 is strongly positive, it is possible to conclude that episodes of labor market intervention did coincide with periods when political administrations devalued in greater proportion to relative inflation than usual.

In the cases of Argentina and Uruguay, a_2 is negative, suggesting that increases in the real exchange rate took place when real wages were not

[10] The variables were defined as follows: X, Pd, and Pw, see n. 4; $D = 1$ when real wages suffered an absolute decline, since institutional studies (see n. 6) suggest that this was the most common result of episodes of labor market intervention. $D = 1$ for Argentina in 1957, 1959-60, 1962-63, 1968, and 1972; for Brazil in 1958, 1960, 1962-63, 1965-67, and 1969; for Chile in 1956, 1958, 1963-64, and 1968-69; and for Uruguay in 1958-59, 1963-66, 1968, 1970, and 1972. In view of the available data, the samples were: Argentina and Uruguay, 1957-72; Brazil, 1956-69; and Chile, 1956-70.

falling. This apparently puzzling result can be understood when one realizes that, as previously mentioned, in these two countries the urban labor unions wielded great political power. While government labor market intervention did have the purpose of periodically minimizing the effect on unemployment of contractionary measures or the threat of an explosive wage-price spiral, unlike in Chile, evidently, governments did not have the political strength to maintain or increase the real exchange rate while inducing a fall in real wages. Indeed, improvements in the real exchange rate had to coincide with real wage gains. The powerful Argentine and Uruguayan labor unions would have felt that governments were adding insult to injury had they devalued in greater proportion to relative inflation than usual while workers were unable to maintain their standard of living.[11]

In summary, the maintenance of the real exchange rate in Argentina, Chile, and Uruguay was very much a function of events in the labor market, and this can help explain why there were frequent departures from exchange rate equilibrium or why there was often an overvaluation bias. In Brazil, on the other hand, and probably because repression of labor union activity and a tough wage policy throughout much of the 1964-72 period helped diminish the danger of wage-push complications, the authorities were apparently free to conduct their exchange rate policy without being hampered by labor market considerations.

The Effectiveness of Exchange Rate Adjustments. A final explanation of exchange rate policy to be tested here refers to the perceived effectiveness of exchange rate adjustments in affecting trade flows. In essence, the hypothesis is that uncertainty about the sensitivity, or knowledge of the nonresponsiveness, of trade flows to devaluations may have been partially accountable for a comparatively lesser reliance on the exchange rate as an instrument of external adjustment. The implication is that countries whose trade flows are more price elastic may be more eager to maintain an approximately constant real exchange rate while countries whose trade flows are essentially not determined by relative price considerations may be the ones to devalue comparatively less simply because they use other, more effective instruments for balance of payments purposes.

a) Price Elasticity of Aggregate Import and Export Demand. To determine the sensitivity of trade flows to changes in price, the usual procedure is to estimate the price elasticity of export and import demand. This entails estimating one equation for the quantity of exports and another for the quantity of imports in terms of relative prices and income, just as in any other study of consumer demand. In order to do this without encountering an identification problem it is best to focus on countries that can be safely assumed to be facing a perfectly elastic supply of imports and to have a perfectly elastic supply of exportable goods. On the import side this is a sound assumption for the four countries with which we are dealing because they were relatively small consumers in the world market and were thus unable to influence the foreign currency price of imports.

On the export side the assumption is also realistic within relevant ranges for two reasons: first, because these were countries with substantial un-

[11] In the case of Argentina, there is one obvious and well-researched exception: that of 1959. See Diaz-Alejandro, *Exchange-Rate Devaluation.*

employed and underemployed resources in their export sectors; and, second, because these countries' devaluations were not intended to attract resources to the export sector but, rather, to restore the comparative cost advantage of existing export oriented resources—an advantage lost as a result of domestic inflation. As evidence, consider how the four countries not only failed to expand their share of world exports but how, in fact, they gradually lost it. In 1955 Argentina's exports constituted 0.97 percent of the world's total, Brazil's were 1.38 percent, Chile's were 0.45 percent, and Uruguay's were 0.13 percent of world exports. By 1972, however, the countries' export shares had fallen to 0.52 percent, 1.06 percent, 0.23 percent, and 0.06 percent respectively. Therefore, we proceed on the assumption that a single-equation estimation is adequate to determine the price elasticity of export and import demand.

While there are few previous empirical studies of this kind,[12] one author recently estimated such elasticities for Argentina, Brazil, Chile, and Uruguay in the context of a much broader analysis of export and import demand in 15 developing countries.[13] The results, which are duplicated in table 5, are estimates of the following 2 equations, using annual data for the 1951-69 period:

$$\log Qm = a_0 + a_1 \log (Pm/Pd) + a_2 \log (Yd/Pd) \qquad (10)$$

$$\log Qe = b_0 + b_1 \log (Pe/Pw) + b_2 \log (Yw/Pw) \qquad (11)$$

where Qm and Qe stand for quantum indices of imports and exports, re-

TABLE 5

PRICE AND INCOME ELASTICITIES OF AGGREGATE IMPORT AND EXPORT DEMAND

COUNTRY	a_0	a_1	a_2	$\overline{R^2}$	b_0	b_1	b_2	$\overline{R^2}$
Argentina	−1.70	−0.36	0.48	0.94	4.07	−0.38	0.42	0.96
	(1.56)	(0.74)	(1.24)		(6.81)	(2.01)	(4.97)	
Brazil	0.78	−1.36	0.13	0.91	4.33	−0.12	0.43	0.91
	(0.64)	(5.94)	(4.45)		(5.83)	(0.76)	(3.99)	
Chile	2.82	−1.14	−0.00	0.74	1.90	−0.12	0.62	0.99
	(1.16)	(4.56)	(0.11)		(17.30)	(3.33)	(39.32)	
Uruguay	0.72	−1.49	−0.45	0.99	3.63	0.84	0.17	0.82
	(1.07)	(3.87)	(1.25)		(4.47)	(3.64)	(1.48)	

SOURCE: See n. 13.

NOTE: See eqq. 10 and 11.

[12] See Behrman, *Foreign-Trade Regimes*; Hendrick S. Houthakker and Stephen P. Magee, "Income and Price Elasticities in World Trade," *Review of Economics and Statistics* 51 (May 1969); Mallon and Sourrouille, *Economic Policymaking*; and Samuel A. Morley, "Import Demand and Import Substitution in Brazil," in *The Economy of Brazil*, ed. Howard S. Ellis (Berkeley: University of California Press, 1969).

[13] Mohsin S. Khan, "Import and Export Demand in Developing Countries" (unpublished International Monetary Fund, Research Department memorandum, 1974), pp. 8, 11; a shorter version of this paper appeared in *International Monetary Fund Staff Papers* 21 (November 1974). The estimates appearing in table 5 are reprinted by permission of the author.

spectively; *Pm* and *Pe* are unit value indices for imports and exports derived from data in U.S. dollars; *Pd* and *Pw* are foreign currency indices of the price of domestic substitutes for import goods and of the price of foreign substitutes for domestic exportables; and *Yd* and *Yw* are indices of the level of nominal domestic and world income, respectively—also in U.S. dollars. Given the use of data in logarithms, a_1 and b_1 are the price elasticities of import and export demand, and a_2 and b_2 are the income elasticities of import and export demand, respectively.

The econometric results shown suggest that export and import demand in Brazil and Chile were sufficiently price elastic so that devaluations could have resulted in at least a temporary improvement of the trade account. In both these countries the sum of the price elasticities of import and export demand is greater than one—the critical minimum value necessary to fulfill the well-known Marshall-Lerner condition for a successful devaluation. The picture is not as clear, however, in the cases of Argentina and Uruguay. In the former, the price elasticity of import demand is (statistically) insignificantly different from zero, while the price elasticity of export demand is only −0.38. In the latter, while the price elasticity of import demand is a satisfactory −1.49, the relevant elasticity of export demand has the wrong sign (+0.84)—suggesting that foreigners' demand for Uruguayan exports varied directly with the price of exports, a troubling contradiction of the law of demand.[14]

b) Price Elasticity of Disaggregated Import and Export Demand. To confirm and further clarify these results a similar study of demand elasticities was carried out here using disaggregated data on raw material and manufactured exports and imports. A Laspeyres quantum and a Laspeyres unit value index were constructed for each of the four countries on the basis of annual U.N. international trade data by S.I.T.C. (Standard International Trade Classification) categories. For background purposes, it should be pointed out that in 1955 about 45 percent of Argentine and Brazilian imports were raw materials; by 1969, however, that proportion had decreased to 30 percent. As concerns their exports, in 1955 close to 100 percent were raw materials; by 1969, the proportion of raw material exports represented about 90 percent of the total. In Chile, about 55 percent of total 1955 imports were raw materials; by 1969, only 32 percent. Chilean exports, however, have always been heavily represented by manufactured commodities (mostly processed copper); raw material exports thus constituted about 20 percent of the total. In Uruguay, approximately 62 percent of total imports were raw materials in 1955, but by 1969 that figure had been reduced to 41 percent. Raw material exports, nevertheless, accounted for between 80 percent and 85 percent of total export value throughout the 1955-69 period.

The equations tested are, in essence, identical to the two noted above,

[14] In case these estimates were erroneous because the assumption of infinitely price elastic import and export supply did not hold, Khan (n. 13) proceeded to estimate such supply curves and then to reestimate the demand for imports and exports using the two-stage, least-squares method. The results shown in table 5 were not significantly altered, and the estimates for Argentina and Uruguay continued to be unsatisfactory—and for the same reasons.

with the exception that separate estimates were obtained for raw material and manufactured export and import demand:

$$\log Q^{m}_{rm} = a_0 + a_1 \log (P^{m}_{rm}/P^{d}_{rm}) + a_2 \log (Yd/Pd) \qquad (12)$$

$$\log Q^{m}_{mf} = a_0 + a_1 \log (P^{m}_{mf}/P^{d}_{mf}) + a_2 \log (Yd/Pd) \qquad (13)$$

$$\log Q^{e}_{rm} = a_0 + a_1 \log (P^{e}_{rm}/P^{w}_{rm}) + a_2 \log (Yw/Pw) \qquad (14)$$

$$\log Q^{e}_{mf} = a_0 + a_1 \log (P^{e}_{mf}/P^{w}_{mf}) + a_2 \log (Yw/Pw) \qquad (15)$$

where the subscripts *rm* and *mf* stand for raw material and manufactured, respectively. All data were converted into U.S. dollars.[15]

The results appear in table 6. In the case of Argentina, the posited equations suggest that the bulk of the country's trade is sufficiently price elastic to ensure that export and import demand could have responded adequately to exchange rate adjustments. However, Argentine demand for raw material imports is not at all explained by relative price and real income considerations—and thus other factors (such as tariffs and other import restrictions) must have had a dominant effect. With regard to Brazil, the bulk of trade (manufactured imports and raw material exports) is again well explained by changes in relative prices and incomes, and the value of a_1 in equations 2 and 3 is sufficiently high to have ensured that devaluations would have been effective in temporarily restoring equilibrium in the trade account. However, relative price considerations appear to have been irrelevant as far as manufactured exports were concerned.

In the case of Chile, the price elasticity of demand for the bulk of international trade (manufactured imports and exports) is too low to satisfy the minimum requirements of the Marshall-Lerner condition. Therefore, the Chilean authorities may have had to resort to instruments other than the exchange rate, or in conjunction with exchange rate, to correct the trade account. The case of Uruguay remains problematic. In all cases, the adjusted correlation coefficient was very low (0.57, 0.04, 0.39, and 0.12, respectively), which suggests that factors other than relative prices and real income tended to determine changes in Uruguay's trade flows. With regard to the price elasticities themselves, manufactured imports and exports appear sufficiently price sensitive, but a positive a_1 coefficient is still encountered, this time in the case of raw material imports. In other words, additional (missing) variables must have played a dominant role.

[15] The variables were defined as follows: *Qm* and *Qe* were obtained by calculating a Laspeyres type quantum index using the formula $\Sigma p_0 q_1 / \Sigma p_0 q_0$ and a Laspeyres type unit value index applying the formula $\Sigma p_1 q_0 / \Sigma p_0 q_0$ to information at the S.I.T.C. level in *U.N. Yearbook of International Trade Statistics* (New York, various issues), where raw material imports and exports were defined as those in categories 0 through 4 while manufactured imports and exports were defined as those in categories 5 through 8. *Pw* = indices of the average world price, in U.S. dollars, of raw materials and manufactured goods, from the *U.N. Statistical Yearbook* (New York, various issues). *Yw/Pw* = world real gross domestic product, in U.S. dollars, from the *U.N. Statistical Yearbook*. *Yd/Pd* = gross domestic product in real terms, from *IFS*. *Pd* = index of raw material and manufactured goods' prices, respectively, deflated by *X* (as previously defined), from the wholesale price index of the various countries; for sources, see nn. 7 and 9. In view of the available data, the samples were: for Argentina, 1955-58 and 1963-70, except for equation 4, for which data were only available for the period 1963-70; for Brazil and Chile, 1955-70; and for Uruguay, 1955-69.

TABLE 6

PRICE AND INCOME ELASTICITIES OF DISAGGREGATE IMPORT AND EXPORT DEMAND

COUNTRY	EQUATION	a_0	a_1	a_2	$\overline{R^2}$	DW
Argentina	12	1.95 (1.66)	0.04 (0.29)	0.08 (0.17)	0.00	1.73
	13	−1.14 (3.31)	−0.81 (4.13)	2.34 (9.19)	0.90	1.59
	14	1.94 (2.96)	−0.80 (2.95)	0.82 (5.97)	0.84	0.94
	15	0.70 (0.27)	−1.50 (1.87)	2.17 (2.76)	0.67	2.76
Brazil	12	0.68 (1.76)	−0.08 (1.76)	0.73 (11.19)	0.90	1.67
	13	3.16 (4.72)	−2.39 (3.55)	1.87 (3.76)	0.45	0.98
	14	1.41 (1.59)	−0.67 (3.26)	0.97 (4.01)	0.95	1.17
	15	−7.48 (1.64)	0.79 (0.99)	3.88 (1.33)	0.61	1.11
Chile	12	−1.64 (3.13)	−0.25 (1.57)	2.02 (10.32)	0.88	1.67
	13	−1.22 (1.36)	−0.51 (1.26)	2.09 (3.62)	0.46	1.83
	14	2.18 (3.21)	−1.04 (5.95)	0.93 (5.22)	0.97	1.69
	15	0.65 (4.11)	−0.17 (2.73)	0.85 (12.38)	0.91	1.61
Uruguay	12	1.13 (0.25)	0.70 (4.04)	−0.24 (0.11)	0.57	2.03
	13	13.99 (1.38)	−0.70 (1.11)	5.08 (1.00)	0.04	0.97
	14	3.90 (6.23)	−0.82 (2.69)	−0.11 (0.36)	0.39	1.85
	15	2.02 (1.78)	−0.28 (0.77)	0.28 (1.01)	0.12	2.05

NOTES: See eqq. 12-15. DF for Argentina, eqq. 12-14 = 9, for eq. 15 = 5; for Brazil, DF = 13; for Chile, DF = 13; for Uruguay, DF = 12.

In summary, a quantitative examination of the historical responsiveness of export and import demand to changes in relative prices (and real income) suggests that exchange rate policy was probably a more effective instrument of trade account adjustment in Brazil than in the other three countries. This is because the price elasticity estimates obtained at the aggregate level for Argentina and Uruguay, and at the disaggregate level

for Chile and Uruguay, cast doubts on the efficacy of exchange rate policy. Perhaps this can help explain why, in Argentina, Chile, and Uruguay, government efforts to correct inflation induced balance of payments disequilibria often necessitated not only the use of the exchange rate, but also the application of a host of auxiliary fiscal, monetary, tariff, incomes, and other policy measures. This could well be another reason for the observed, frequent departures from real exchange rate equilibrium and for the tendency, on the part of Argentine and Chilean authorities, to have an overvaluation bias.

Conclusions

This study has important practical implications for the understanding of exchange rate policy in these four South American countries since 1972 and, perhaps, in other high inflation countries as well.

In the first place, one can conclude that development patterns and strategies are likely to affect the conduct of exchange rate policy. The pursuit of a development strategy which emphasizes export-led growth requires a policy of frequent exchange rate adjustments designed to keep pace with, or even stay ahead of, the differential between domestic and world inflation. On the other hand, the choice of a nationalistic, inward-looking development pattern which deemphasizes the export sector is compatible with an exchange rate policy that seeks to accumulate only a minimum amount of foreign exchange necessary to finance key imports.

In the second place, exchange rate policies may well be a function of policymakers' attitude toward and their ability to minimize the inflationary impact of devaluations. Political administrations that fear an acceleration of inflation because of the establishment of a potentially explosive inflation-devaluation-inflation nexus can be expected to want to delay and minimize the magnitude of devaluations. The same applies to governments which are vulnerable to open criticism from a large importing constituency whose political power outweighs that of the exporting community. On the contrary, authoritarian regimes which are able to prevent the full adjustment of wages to (devaluation induced as well as other) price level increases through labor-market intervention are in a better position to devalue pari passu with inflation rate differentials.

In the third place, the behavior of exchange rate policymakers is also determined by their assessment of the responsiveness of trade flows to parity adjustments. Governments of countries where, as development proceeds, the composition of exports and imports is altered in the direction of more price elastic commodities, as well as where trade flows are freed from quantitative restrictions and other controls, may increase their reliance upon the exchange rate as an effective instrument of external adjustment. However, governments which are skeptical of the price sensitivity of their country's current trade flows and, because of existing market imperfections, are accustomed to rely upon trade controls or multiple rate practices, will probably continue to shun the necessary exchange rate adjustments.

These general conclusions allow one to understand why, in fact, the present governments of Argentina, Chile, and Uruguay have all followed what could be called the Brazilian example of establishing a system of

minidevaluations designed to stabilize the real exchange rate and to prevent episodes of currency overvaluation. They have done so because, first of all, their balance of payments and development strategies have changed from inward-oriented to export-promoting. Secondly, the inflationary impact of devaluations has been reduced through incomes policies that have purposely induced a fall in real wages, as well as through strong contractionary fiscal and monetary measures. And, finally, the observed sensitivity of import and export demand to exchange rate changes has been greatly increased through important reductions in tariffs, quotas, export taxes, and other restrictions that previously minimized the price elasticity of trade flows and distorted the market for foreign exchange.

These fundamental ideological, political, and economic developments are at the root of the observed evolution of exchange rate policy.