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3 Brazilian Export Growth: Estimating the Export Supply Response, 1955–74

José L. Carvalho and Cláudio L. S. Haddad

3.1 Introduction

That there was a rapid increase in Brazil's exports from the mid-1960s onward may be seen from table 3.1. Total exports, which were $1.4 billion in 1955, were only marginally above that level in 1965, and manufactured exports constituted only 16 percent of total exports. By contrast, export growth "took off" over the following decade. By 1975, total export earnings were $7.9 billion, almost five times their 1965 level, and manufactured exports had risen sharply to $2.4 billion, increasing at an average annual rate of 33.4 percent. Not only manufactured exports, but many natural resource based (NRB) commodities shared in the export boom,[1] while earnings from traditional exports, notably coffee, grew only slowly.

In analyzing the trade strategy–employment relationship, the Brazil study in this project took as a given the rapid expansion of Brazil's exports in the late 1960s and early 1970s (Carvalho and Haddad 1978). It is the purpose of this chapter to analyze the degree to which that boom was a function of the policy changes undertaken in the late 1960s. The export promotion strategy began haltingly in 1965, and it gained momentum over the next several years. By 1968, incentives for exporting had been raised significantly. The strategy was based on two main policy instruments: fiscal incentives and the mini-devaluations. The strategy

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Table 3.1 **Brazilian Exports, Broad Commodity Categories, 1955–74**
(F.o.b., Millions of U.S. Dollars)

	Exports				
Year	Total	Coffee	Noncoffee	Manufactures	NRB[a]
1955	1,423	844	579	51	528
1956	1,482	1,030	452	52	400
1957	1,392	846	546	64	482
1958	1,243	688	555	67	488
1959	1,282	744	538	81	457
1960	1,269	713	556	72	484
1961	1,403	710	693	104	589
1962	1,214	643	571	83	488
1963	1,406	747	659	84	575
1964	1,430	760	670	132	538
1965	1,595	707	888	263	625
1966	1,741	764	977	197	780
1967	1,654	705	949	248	701
1968	1,881	775	1,106	263	843
1969	2,311	813	1,498	361	1,137
1970	2,739	939	1,800	527	1,273
1971	2,904	773	2,131	663	1,468
1972	3,991	989	3,002	1,044	1,958
1973	6,199	1,244	4,955	1,528	3,427
1974	7,951	864	7,087	2,360	4,727

SOURCE: Carvalho and Haddad 1978, appendix table.

[a]NRB = total exports minus coffee exports minus exports of manufactures.

received additional support from the import liberalization measures taken in 1966 and 1967 (Carvalho and Haddad 1978, chaps. 2, 3, and 4).

In this chapter we present and discuss new estimates of Brazilian export supply functions, trying to measure the effect of the main policy instruments, as well as the other exogenous variables, on export growth. Although there are some very good earlier analyses of the impressive export performance,[2] they cover a relatively short period. We therefore decided to estimate new regressions, for manufactures and noncoffee NRB goods, covering the period 1955–74. First we will make some general comments regarding the estimation of export supply functions, then we will analyze the independent variables included in the estimates.

3.2 Some Aspects of the Estimation of Export Supply Functions

Specifying an export supply function poses some special problems, because the supply of exports is an excess supply, equal to the difference between the total domestic supply and the total domestic demand for the particular product. Hence the supply of exports is affected by forces that

influence both domestic supply and domestic demand. But in a general equilibrium framework, which is relevant once we estimate an aggregate supply function, forces that affect demand also affect supply, and conversely. Thus a proper specification of an export supply function is especially difficult, particularly for Brazil because of data limitations.

There is yet another problem involving the estimation itself. If the so-called small-country hypothesis is accepted, foreign prices would be exogenous, and the structural form of the model could be estimated by ordinary least squares. But then why should we include a proxy for the volume of world trade, like total world imports, in the estimates? When we do so we are assuming, implicitly, that shifts in foreign demand affect Brazilian exports. But, given the small-country hypothesis, foreign demand would influence Brazilian exports only through the indirect effect upon world prices, which would theoretically be captured by the real exchange rate or another price variable. So there would be no room to include the level of world trade, given the assumption of an infinitely elastic foreign demand.

When included in the estimates, however, the level of world imports always turns up highly significant. Furthermore, that is in accord with the feelings and statements of most policymakers and businessmen in Brazil. On the other hand, to abandon the small-country hypothesis does not seem very sensible. Except for coffee, and in recent periods soybeans, it is very hard to see how Brazil could significantly influence the world prices of her other major NRB goods, not to mention manufactures. So how can we reconcile the empirical results and general intuition with the fact that Brazil is essentially a price taker in foreign markets? We do not have a definite answer to this question, but a possible explanation lies in terms of short run versus long run. The idea is that in the short run foreign demand may be relatively price inelastic (in the very short run it is certainly vertical) although it is perfectly elastic in the long run. This explanation, advanced by Harberger (1972), can be rationalized in two ways: first, by recognizing the existence of transaction and information costs that delay the response of foreign demand to changes in prices; second, by assuming that, though perfectly elastic in the long run, foreign demand would be subject to volume limitations. This would be the case if quotas were imposed abroad limiting the quantity of Brazilian products imported. The quotas could be either institutional barriers, government contracts, or ad hoc, as, for instance, the reluctance of importers to change drastically the share of each of their foreign suppliers.[3] In any of those cases, the expansion of world trade would have also an expansionary effect on Brazilian exports.

Therefore the export supply functions that were estimated are taken as reduced forms of a model we do not attempt to specify fully. But some comment is needed on the variables included and on the expected and

realized signs of the coefficients. The independent variables normally included in the estimates are discussed below.

3.2.1 Real Exchange Rate

The real exchange rate should incorporate the price effect on exports. For manufactures it is defined in two alternative ways: gross and net of subsidies to exports. The index of fiscal incentives was obtained from Tyler (1976, p. 220). We also introduced separately the real exchange rate and the subsidy index. Normally we should expect that the coefficients of the two variables would be similar to each other, since for the exporters an increase in the exchange rate should be the same as an equivalent increase in the subsidy rates. However, some factors may account for the difference in the coefficients: errors of measurement in the subsidy index; or the fact that, since imported inputs are used in export activities, a 10 percent increase in the nominal subsidy may have a more powerful effect than a devaluation of 10 percent, and, on the other hand, the higher administrative costs and the discretionary effects associated with the subsidies as compared with the devaluation.

The real exchange rate for manufactures is here defined as the product of the nominal rate received by exporters and the wholesale price index in the United States divided by a similar index in Brazil. For NRB goods we will substitute, alternatively, an index of dollar prices of noncoffee exports for the wholesale price index in the United States. Both rates are presented in table 3.2. Since fiscal incentives were granted only for manufactures, that variable was not included in the NRB equations.

3.2.2 The Variation of the Real Exchange Rate

As we mention elsewhere (Carvalho and Haddad 1978, chap. 4), one of the deterrents to export expansion until 1968 was the high risk involved in export activities owing to infrequent massive devaluations, common to countries under fixed exchange rate regimes and subjected to high rates of inflation. Supplicy (1976) handled this problem by introducing in his equations the annual average of absolute changes in the real exchange rate. Since what should matter is the relative and not the absolute risk, however, we decided to use instead the coefficient of variation (the standard deviation divided by the average) of the monthly real exchange rates during the year. The coefficient of variation of the real average export exchange rate is presented in table 3.2.

3.2.3 World Imports

We have already commented upon the role played by this variable and the possible rationales for it. In the estimates, world imports are the total dollar amount (c.i.f.) of imports of the United States, the United Kingdom, Japan, France, Germany, Italy, and the Netherlands deflated by the wholesale price index in the United States.

Table 3.2 Real Exchange Rate and Its Coefficient of Variation, 1955–74

Year	Real Exchange Rate for Manufactures[a] (1)	Real Exchange Rate Including Fiscal Incentives[b] (2)	Coefficient of Variation of Rate 1[c] (3)	Real Exchange Rate for NRB Products[d] (4)
1955	2,850	2,850	.1074	3,236
1956	3,398	3,398	.1245	2,457
1957	2,187	2,187	.1299	2,359
1958	3,315	3,315	.1124	3,292
1959	2,815	2,815	.0761	2,668
1960	2,600	2,600	.0761	2,613
1961	2,647	2,647	.0670	2,613
1962	2,517	2,517	.0867	1,982
1963	2,122	2,122	.0867	1,718
1964	2,583	2,589	.1666	2,197
1965	2,552	2,675	.0588	2,063
1966	2,190	2,426	.0922	1,821
1967	2,080	2,527	.0458	1,850
1968	2,216	2,852	.0346	1,948
1969	2,319	3,102	.0243	1,918
1970	2,272	3,166	.0187	1,864
1971	2,224	3,458	.0105	1,890
1972	2,215	3,678	.0076	1,971
1973	2,241	3,720	.0174	2,473
1974	2,287	3,797	.0403	2,732

[a]Export exchange rate times the wholesale price index in the United States (IMF, *International Financial Statistics*) divided by the wholesale price index in Brazil (column 12, *Conjuntura Econômica*).

[b]Column 1 divided by the index of fiscal incentives to exports of manufactures computed by Tyler (1976, p. 220). See note 4.

[c]Coefficients of variation computed within each year from monthly observations of the real exchange rate of column 1.

[d]Computed in the same way as rate 1, substituting the dollar price of noncoffee Brazilian exports (*Conjuntura Econômica*) for the wholesale price index in the United States. Both indexes are equal to 100 in 1970, therefore rates 1, 2, and 4 are comparable.

3.2.4 Domestic Income

Since exports are the difference between domestic supply and domestic demand, they should be affected by the growth in domestic income. However, when the country grows, both domestic demand and domestic supply are shifted, and therefore the expected overall effect of growth on exports is ambiguous. The variable included in the estimates is an index of Brazilian gross domestic real output.

3.2.5 Short-Run Changes in Income

Besides being affected by the level of income, which enters the estimates as a scale factor, exports might be affected by short-run expansion or contraction in domestic output above or below its normal trend. This is the so-called capacity-utilization variable used in previous studies. The

sign of the coefficient of this variable is ambiguous, since it depends on whether the cause of the disturbance originates on the demand side or the supply side. The capacity variable used was computed as the ratio between real output (with three alternative definitions) and its long-run geometric trend estimated by least squares.

3.3 The New Estimates

In table 3.3 we present our best estimates concerning exports of manufactures and of NRB goods other than coffee. Alternative (and less satisfactory) models are also presented in Carvalho and Haddad (1978).

The estimates of manufactures yielded very good results. In equation (i) we separate the real exchange rate from the fiscal incentives, although in equation (ii) they are combined in an "effective exchange rate." We can see from equation (i) that the price elasticity due exclusively to the real exchange rate is about 1.2 and the elasticity of fiscal incentives is near 0.6, or about half.[4] Therefore, according to our estimates, a simple devaluation would be more stimulative to exports of manufactures than the same percentage increase in fiscal incentives. Bureaucracy and redundancy may explain that result.[5] In equation (ii) the combined price elasticity is equal to one. The coefficients of the real exchange rate are significantly different from zero at 1 percent significance in both equations.

The coefficient of variation of the real exchange rate enters with a negative sign, implying that the higher the exchange rate risk the lower would be the volume of exports. Its coefficient is not, however, statistically different from zero at 10 percent significance.

As mentioned above, the world imports variable has also a positive and highly significant coefficient in both equations. Real GDP does not turn up significant, but if we estimate equation (ii) without the world imports variable the GDP coefficient becomes equal to 2.26 with a t-value of 11.50. That is, we need a scale factor in our model, and that role is played by either world imports or GDP.[6] When both are included, however, the world imports variable captures most of the explanation of the variance of manufacturing exports, which indicates that the overall growth in world trade is in fact an important variable explaining annual changes in Brazilian exports of manufactures. Finally, the capacity utilization variable appears with a negative coefficient,[7] which indicates that, on average, excess capacity in industry favored increased exports of manufactures.[8]

As a test of whether there was a "structural change" in the export supply function in the mid-1960s, we performed a Chow test for the periods 1955–64 and 1965–74. The F statistic was 3.586 for the hypothesis that the two periods belong to the same structure, with a critical F for 95

Table 3.3 **Estimates of Export Supply Functions: Annual Data, 1955–74**

Dependent Variable	Independent Variables and t – Coefficients									R^2	F	DW
	Constant	LREX	LFIX	L(REX/FIX)	LREX1	CVREX	LGDP	LWM	CAPI			
Manufactures												
LMANEX (i)	−11.248	1.246	−0.580			−0.0002	−1.204	2.825	−0.576	0.998	179.1	1.58
	(5.87)	(3.37)	(−0.77)			(−1.21)	(−1.44)	(3.93)	(−0.76)			
LMANEX (ii)	−10.608			1.050		−0.0001	−0.756	2.292	−0.732	0.998	229.0	1.72
	(3.65)			(3.65)		(−0.82)	(−1.04)	(4.22)	(−1.44)			
NRB noncoffee												
LNRBNC (iii)	−5.031				0.258	−0.0001	0.345	0.753		0.974	140.0	2.05
	(−7.73)				(2.01)	(−1.10)	(0.76)	(2.22)				

NOTES:
L before a variable means logarithm on base e.
MANEX = exports of manufactures in real dollars; deflator used: wholesale price index in the United States.
NRBNC = exports of noncoffee NRB goods in real dollars; deflator used: index of dollar prices of Brazilian noncoffee exports.
REX = real exchange rate for manufactures; deflators used: wholesale price indexes in Brazil and United States.
FIX = index of fiscal incentives, equal to the inverse of total incentives given to manufactures.
REX1 = real exchange rate substituting the dollar prices of Brazilian noncoffee exports for the wholesale price index in the United States.
CVREX = coefficient of variation of REX during the year; computed from monthly observations.
GDP = Brazilian gross domestic product in real terms (index).
WM = imports of the United States, Germany, United Kingdom, Japan, France, Netherlands, and Italy in real dollars; deflator used: wholesale price index in the United States.
CAPI = ratio of the industrial product index to its long-run trend.

percent confidence level of 3.64. The test therefore marginally accepts the hypothesis of no structural changes.

These results enable one to attempt an estimate of the extent to which changes in the real exchange rate contributed to the spectacular expansion of Brazilian exports. The average real exchange rate in the period 1955–59 was 22.3 percent below its level in 1970–74, as can be seen from table 3.2. From the regression results in table 3.3, the elasticity of Brazilian exports with respect to the exchange rate is estimated to be 1.050. Combining these numbers would imply that Brazil's manufactured exports might have been about 23 percent less than they were in the early 1970s had the real exchange rate been kept at its level of the 1950s. To be sure, it is inconceivable that other export promotion policies would have been pursued without an alteration in exchange rate policy, and it may be inappropriate to attempt to estimate the contribution of one factor to export growth. Nonetheless, the results suggest that the altered real exchange rate was an important factor in Brazil's successful export growth of the late 1960s and early 1970s.

The estimate of supply of noncoffee NRB exports also shows good statistical results, though not as good as for manufactures. Since the changes in relative dollar prices of NRB goods are very important in determining their growth, and since those changes are very well correlated with the movement of wholesale prices in the United States, we substituted an index of dollar prices of Brazilian exports for the latter index, both in the deflation of the dollar amounts of exports and in the computation of the real exchange rate received by exporters.

As can be seen, the estimated price elasticity in equation (iii) is about 0.26, much lower than the corresponding estimates for manufactures. The estimated coefficient is different from zero at 5 percent (one-tail). The elasticity of world imports in constant dollars is 0.75, indicating that, as in the case of manufactures, that variable is important in explaining the growth of NRB exports, though less important than in the former case. On the other hand, the coefficient of real GDP does not appear significantly different from zero in any of the three models. Again, this is probably due to its collinearity with the world imports variable, which indicates that the scaling role may be played by either of the two.

Summing up our findings regarding the estimates of supply functions of noncoffee exports:

1. The real exchange rate received for exports is estimated to have played an important role in fostering the growth of exports of manufactures. Based on the model estimates, we would tend to place the price elasticity of supply of those goods near unity.

2. For NRB exports, the supply appears quite inelastic, confirming, in a sense, the expectations of policymakers in the fifties. However, though low (about 0.25), the elasticity is significantly different from zero, show-

ing that a devaluation would still have had a positive effect on NRB exports. We note that export quotas and other restrictions placed on exports of NRB goods over the period of this analysis may account for the low value of the elasticity.

3. Another variable that appears to have been important in explaining the growth of Brazilian exports is the level of world trade, defined as the volume of imports in real terms of several leading developed countries. This variable seems particularly important in explaining the success of the export promotion strategy in recent periods, especially with regard to manufactures. However, owing to the high correlation between that variable and the Brazilian real GDP, we cannot completely separate the effects of the two variables. Hence the importance of the growth in world trade may have been overestimated in the equations.

Notes

1. Undoubtedly some manufactured exports, such as orange juice and packed meat, can be regarded as NRB. However, since they receive the same incentives as the others we decided to treat them as manufactures, which greatly simplified the computations.

2. Because of their depth, three studies are of particular interest: Tyler (1976), Supplicy (1976), and Doellinger et al. (1971). All three models were estimated with quarterly data, though Supplicy also worked with annual data for NRB goods. The Doellinger study covers the period 1963–68, the estimates by Tyler refer to the period 1963–72, and the work by Supplicy is for 1964–1972 II. Supplicy also cites another study by Tyler where he estimates an export supply of manufactures for 1961–70 (Tyler 1971). Generally the estimated price elasticity of the export supply functions turned out positive and significantly different from zero. The estimates yielded elasticities of between 0.9 and 1.4 for manufactures and of about 0.5 for noncoffee NRB exports. For a fuller analysis see Carvalho and Haddad (1978, chap. 4).

3. It is clear that considerations of risk would imply that the importers would be willing to pay a price for diversification of their supply sources.

4. Note that the index of fiscal incentives in the equation is defined by its inverse, which explains the negative sign of the coefficient. This index is in fact $(1 - S)$ where S is the subsidy rate given to manufacturing exports.

5. The risk of not receiving from the local state the ICM credits awarded to exports of manufactures could also explain this low elasticity with respect to the fiscal incentives.

6. The simple correlation coefficient between the logs of the two variables is equal to .99. Therefore collinearity is certainly present in the estimates of the coefficients of the two variables.

7. Significantly different from zero at 10 percent, one tail, in equation (ii).

8. Additional estimates of supply functions are presented in Carvalho and Haddad (1978 chap. 4).

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