The new techno-economic paradigm and Brazilian competitiveness*

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New techno-economic paradigm is globalizing markets and setting up new trade relations affecting Brazilian competitiveness. This note formulates and empirically tests the implied hypotheses. The tentative conclusion is that Brazil is competitive in new technologies.

1. Techno-economic paradigms: old and new

A consensus is growing that there is a radical change in the industrial function. Some argue about the emergence of the Third Wave,[1] others talk about the era of the Great Divide,[2] still others theorize in terms of the techno-economic paradigms.[3] The basic premise of all these theses is the same. In the last two decades, change has taken place that involves technology in an essential way. "The narrowest of these theses argue that a new techno-economic paradigm comes into being when the following three

* A part of this paper is based on our earlier study Can Brazil compete? and Filpo (1993). We are thankful to an anonymous referee for helpful suggestions.

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[1] Toffler (1980).

[2] Piore & Sabel (1984).

[3] Freeman & Perez (1988). Diwan & Desai (1990). Diwan & Chakraborty (1991). Diwan (1989) analyses the implications of flexible manufacturing, an element of this paradigm, for conventional economics.

conditions are satisfied: 1) the price of the basic element in the new technology starts to fall continually; 2) there is an ample supply of this element so that its demand and applications do not face bottlenecks; and 3) the technology is pervasive, in the sense that it has applications in all fields. Once these conditions are satisfied, the new technology becomes profitable and develops its own momentum through the institutionalization of the vested interests, of people who gain from its growth."[4]

It is now recognized that electronic and semiconductor based technologies satisfy all these three conditions. The price of the chip has been continuously falling while its processing speed and scale of integration were increasing. Generally, the supply of chips is available in as large a supply as desired. The chips are now embedded in virtually every consumer and producer goods. These conditions ensure continuous cost reductions of goods and processes in which these technologies are embodied. Their pervasiveness enlarges old and establishes new markets for products. Cost reductions and enlarged markets make them competitive and are the necessary conditions for a self propagating process.

One can discern now two different, old and new, techno-economic paradigms which may also be considered as two different paths to economic development and growth:[5] i) the old, transversed by the Western countries in the past 50 years whose most successful example has been the U.S., and ii) the new, travelled by the Pacific and Eastern Asian countries in the last 20 years, Japan being the most successful case.

The old techno-economic paradigm is defined by oil energy, product standardization and mass production. Standardization and mass production ensured cost reduction through economies of scale. These techniques have been pervasive indeed; thus one witnessed the growth of mass markets, such as mass media, mass transit systems, mass education, mass consumption. The mass production techniques are based on massive capital investments and large unskilled labor inputs. Underdevelopment, in this paradigm, is lack of capital.

The new techno-economic paradigm, on the other hand, is determined by information technologies that involve segmented markets, customized production and economies of scope. The technologies are science based and change continuously. They require both R&D and skilled labor in addition to capital in which these technologies are embodied. Furthermore, these technologies are international in the sense that the production process can be carried on in different parts of the world and in that the markets are globalizing. "Market

[4] Diwan & Chakraborty (1991), p. 6.

[5] Diwan (1991) has compared these two paths to two escalators. Developing the necessary infrastructure is akin to getting up on the escalator. Once one gets up on the escalator, one moves up, as if, effortlessly. The infrastructure for the two paths are different and so are the social and production relations between capital and labor. Firms also have different paths; see Diwan (1970, p. 89).

segmentation and globalization go together and set a dynamic process of self-propagation."[6] There are more entry points in the new paradigm and many newly industrialized countries can, and do, enter.

The world market is composed of the products from both these paradigms. However, the standardized products from the old paradigm are facing a shrinkage in demand both from the change in consumption patterns and the competitiveness from the new paradigm. It is thus no accident that major U.S. corporations, established over so many decades, such as General Motors, IBM, Westinghouse, are losing profits and market shares. On the other hand, products from new paradigms are growing at a fast rate. Major Japanese firms such as Mitsubishi, Toyota, Matsushita, Nippon, are now world's large corporations. As the world trade grows, the products from the new paradigm are forming its larger part.

2. Competitiveness

The new techno-economic paradigm globalizes markets and internationalizes production processes. It thus affects international economic relations of every country; its trade, capital markets etc. A country or industry that gets on its accelerator is able to produce the goods demanded and traded globally thereby gaining a larger share of the world trade. In other words, going up this accelerator makes a country competitive. At this point it may be useful to discuss about competitiveness.[7] What is competitiveness and what makes a country competitive?

Competitiveness is a union of four sets: i) production of goods and services based on new technologies; ii) capacity to increase market shares in the world trade which implies advantages in export markets; iii) a move towards trade surplus; and iv) an increase in the level of per capita income in the country. Since international trade issues are fundamentally embedded in competitiveness, a question arises as to how is it different from standard trade theory that explains why and how a country exports certain goods? The standard Hecksher-Ohlin theory explains trade on the basis of comparative advantage that is defined in terms of factors of production. This factor intensive comparative advantage theory makes many heroic assumptions; e.g. identical technologies, no economies of scale and undifferentiated products whose demand is determined by price alone. In today's world these assumptions are, at best, unrealistic. It is not surprising that the theory no more explains the stylized facts: such as, growing

[6] Diwan & Chakraborty (1991), p. 6.

[7] Porter (1990) discusses some of the issues involved in the success of a country in international competition.

global markets in which countries trade identical goods where production involves similar factor proportions; Japan, and a number of similarly situated countries, as a successful exporter without any factor endowment advantages; increasing trade between multinationals and their subsidiaries. The new techno-economic paradigm has created a new global environment where competitive advantage involves localized process defined by local cultures, histories, institutions, structures and values; factors completely ignored by standard trade theory. Competitiveness also takes into consideration segmented markets, differentiated products, quality, innovations and innovative processes. Product and process innovations and improvements in technology are a continuous feature of the new trade environment. In fact competitiveness involves a constantly changing landscape; far different from the "equilibrium" of the standard trade theory.

The new techno-economic paradigm also provides more entry points so that countries other than the already industrialized can also enter on this escalator. It advances a different path to economic growth and development. In the old development paradigm, the developing countries would traverse the path treaded by the industrialized countries of the West. This paradigm provides an opportunity for leapfrogging to new technologies. It will be interesting to test this hypothesis. However, the new techno-economic paradigm and its related concept of competitiveness is dynamic. This process is still unfolding. In view of the nature of this process, any empirical test, based on historical data, will be a partial one. This does not diminish the value and importance of such a test. The test involves an analysis of a developing country which is a part of the global market. Brazil is such a case. Our interest here is to test Brazil's competitiveness in the new techno-economic paradigm.

3. Brazilian competitiveness: formalization of the hypotheses

If the above hypothesis is accepted, the issue about Brazilian competitiveness needs further elaboration. The question becomes: can Brazil compete in the new paradigm? For this to happen, it is necessary that Brazil produces goods in this paradigm and exports them. To be able to produce these goods, the economy has to develop the necessary and related infrastructures. In the beginning, many of these goods have to be imported. If these imports are used for production purposes, eventually, over time, the economy will develop enough capacity to produce and export these goods.[8] Since the

[8] The implication is that there is a new trade theory. In the standard trade theory of comparative costs, and Hecksher-Ohlin theorem, trading countries specialize in the production of goods. In the new paradigm, there is no specialization. Instead there is competitiveness defined by the dynamics of the infrastructure in R&D and skill training, on the one hand, and quality and innovativeness of new products. For example, Japan both exports, and imports, automobiles.

market for these new technology goods is expanding, exports will grow at a faster rate so as to generate a trade surplus in these goods, as shown in figure 1.

These arguments can be further refined in the form of the following hypotheses.

a) The imports of new technology goods increase at a decreasing rate. Its growth path is nonlinear, such that,

$$dM_N/dt > 0 \text{ and } d^2M_N/dt^2 < 0,$$

where M stands for imports, subscript N for new technology goods and t for time.

b) Development of the production capacity in Brazil means that it will be able to export these goods eventually leading to a positive trade balance in new technology goods. This implies that the export elasticity of income is greater than import elasticity of income, i.e.,

$$\varepsilon_{XN} > \varepsilon_{MN},$$

where ε stands for elasticity and X for exports.

c) The argument that trade in new technology goods is growing at a faster rate implies that the export and import elasticities of income for new technology goods are greater than the economy's total export and import elasticities of income. Mathematically,

$$\varepsilon_{XN} > \varepsilon_{XT} \text{ and } \varepsilon_{MN} > \varepsilon_{MT},$$

where subscript T stands for the total economy.

d) The argument that new technology goods are sold in segmented markets where quality of the product is an important consideration translates into the proposition that exports of new technology goods are determined by income rather than by price. However, price plays an important role when dealing with imports of new technology goods. The explanation is simple. When Brazil starts producing new technology goods, these compete with the previously imported ones and therefore price matters. Mathematically,

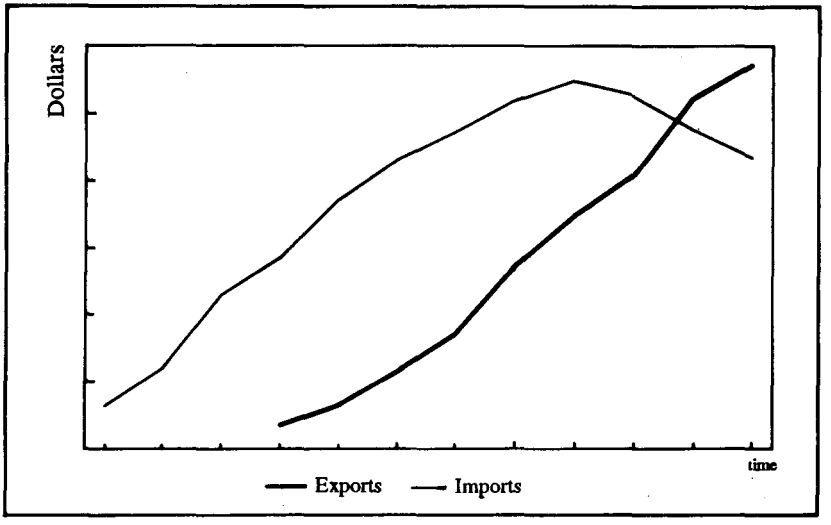
$\partial X_N/\partial P$ is not significant,

$\partial M_N/\partial P$ is significant,

where P refers to the price of these goods.

Thus, the question, about Brazilian competitiveness, reduces to testing the following hypotheses:

Figure 1
Exports and imports pattern
New technology goods



a) $dM_N/dt > 0$; $d^2M_N/dt^2 < 0$

b) $\varepsilon_{XN} > \varepsilon_{MN}$

c) $\varepsilon_{XN} > \varepsilon_{XT}$ and $\varepsilon_{MN} > \varepsilon_{MT}$

d) $\partial X_N/\partial P$ is small and not significant and $\partial M_N/\partial P$ is significant

4. Theory

To test the above hypotheses, one has to define economic relationships that describe and explain i) the time profile of imports of new technology goods, M_N. Determination of the time profile of an economic variable is straightforward. All it involves are the data on the relevant imports over time. ii) What determines the growth and decline of imports and exports of the new technology goods as well as of the country as a whole so that the various elasticities can be derived.

Economic theory explains exports and imports of commodities, and their aggregates, in terms of their demand and supply. Our interest is in demand elasticities of income and price. We can, therefore, formulate a standard demand relation, which is:

$$D = f(Y, P) \text{ with } f_Y > 0 \text{ and } f_P < 0$$

where D, Y, P, f_Y and f_P refer to demand, income, price and to the partial derivatives with respect to Y and P, respectively. What is important here is the precise definitions of demand, income and price. Standard trade theory argues that the domestic income and the international purchasing power of the local currency determines the demand for imports of either a single commodity, or of the aggregate. Mathematically, this argument amounts to:

$$D_{Mi} = f(Y_{BR}, P_E) \text{ with } f_{YBR} > 0 \text{ and } f_{PE} < 0; \; i=N,T$$

where D_M, Y_{BR} and P_E refer to import demand, Brazilian GNP and purchase price of the Cruzeiro (Brazilian real exchange rate), respectively; i takes the values N, and T; N is the aggregate of new technology goods imports and T of total imports of which N is a part.

Similarly, classical trade theory argues that exports are determined by income of the importing countries and the purchasing price of the local currency. U.S. is Brazil's largest trade partner, it accounts for one fifth to one fourth of the Brazilian imports and exports. As a result, largest proportion of Brazilian exports are imported by the U.S. For purposes of total exports, it is the U.S. GNP that determines their demand. So far as the exports of new technology goods are concerned, their markets are global. However, U.S. economy defines a large part of this global market. U.S. GNP, therefore, determines the demand for Brazilian exports of new technology goods as well. This argument can be expressed mathematically as:

$$D_{Xi} = f(Y_{US}, P_E) \text{ with } f_{YUS} > 0 \text{ and } f_{PE} > 0; \; i= N,T$$

where D_X, Y_{US} refer to export demand and U.S. GNP. Once again $i=N,T$ stands for the new technology goods exports and total exports respectively.

5. Data

Variables M_T and X_T refer to the economy as a whole (Brazilian total imports and total exports from all its international partners, respectively). The concepts of total exports and imports is straightforward. The idea of exports and imports of "new technology goods" is new. No separate data are collected for "new technology goods". We work with two alternative sets for this concept, N_1, at the aggregate level — aggregation over all the industries classified as high tech, and N_2 at a disaggregated one industry classification level. Our hope is that new technology goods measured at two different levels of aggregation will catch the basic elements of the argument.

M_{N1}, M_{N2}, X_{N1} and X_{N2} refer to the imports and exports of new technology goods (N) sector.[9] The data for M_{N1} and M_{N2} are for the 25 country members of the OECD. X_{N1} and X_{N2} are the Brazilian new technologies goods exports to U.S. In our analysis, new technology imports are necessary to develop production and export potential in these goods. These imports have to come from all countries who produce and promote new technologies. These are the OECD countries. For the Brazilian exports of new technology goods, on the other hand, we have restricted the market to the U.S. because: i) U.S. market is a large part of the global market; ii) its imports of new technology goods are increasing; and iii) Brazilian traders have greater familiarity and more developed relations with the U.S. market.

Our analysis involves the following variables: M_T, M_{N1}, M_{N2}, X_T, X_{N1}, X_{N2}, Y_{BR}, Y_{US}, P_E and t. We need data on the nine variables. Data for M_T, X_T, Y_{BR}, C and P_{BR} are quite standard. We have obtained them from *Estatísticas Históricas do Brasil*. Similarly, the data on Y_{US} and P_{US} are standard, we obtained them from *Statistical Abstract of the United States*. We used annual data from 1970 to 1985 and all variables are measured in 1980 constant dollars.

M_{N1}, M_{N2}, X_{N1} and X_{N2}, on the other hand, are new variables. They define the value of exports and imports of "new technology goods" consistent with the new techno-economic paradigm. Quantifying these variables poses a number of conceptual questions. What are new technology goods? How does one distinguish new from old technologies? Since the new technologies are growing over time, how does one take into consideration such change? Many of these questions have been discussed at length by other scholars. Diwan & Chakraborty (1991) have argued that "high technologies" form the primary technological base of these new technology goods. They distinguish between product-based and occupation-mix based definitions and develop a definition based on two different rankings derived from the i) ratio of technology-oriented workers to total workers, and ii) proportion of R&D expenditure to sales. On that basis they have determined 29, 3-digit SIC industries that form the U.S. high tech sector.[10]

We have followed Diwan & Chakraborty (1991) and define, firstly at an aggregate level, the Brazilian high tech trade sectors, M_{N1} and X_{N1}. These are composed of the following four industries: i) chemicals and related products (SITC section 5), ii) manufactured goods (SITC section 6), iii) machinery and transport equipment (SITC section 7) and iv) miscellaneous manufactured articles (SITC section 8). Since all industries are undergoing change, any

[9] Diwan & Filpo (1992) studied at the aggregate level, $N1$, and has a slightly different set of hypotheses.

[10] Diwan & Chakraborty (1991) also compared and analyzed different methodologies to classify the high technology sectors.

aggregate is composed of some old and some new technologies. Short of going over every product individually, any classification scheme will make some errors; this is the nature of quantification and classification. Our hope is that some of the excluded new technologies operative in other than these four industries will compensate for some of the old technologies included here, so that the aggregate still represents a meaningful proxy to the "new technology good" sector. We have collected these data from *Foreign Trade by Commodities.*

We further disaggregate (micro level) the data on high tech goods, M_{N2} and X_{N2}. M_{N2} and X_{N2} are composed of: power generating machinery and equipment; machinery specialized for particular industries; metalwork machinery; general industrial machinery and equipment and machine parts; office machines and automatic data processing equipment; telecommunications, sound recording and reproducing apparatus and equipment; electrical machinery; apparatus and appliances; and electrical parts thereof; road vehicles (including air-cushion vehicles); other transport equipment (SITC7).

Table 1 gives ratios M_{N1}/M_T, X_{N1}/X_T, M_{N2}/M_T and X_{N2}/X_T (in percentage) over time.

Table 1 confirms our general idea that Brazil has been developing its export potential by importing new technology goods. Thus, the imports of new technology goods M_{N1} (M_{N2}) as a percentage of total imports have declined by

Table 1
Trade in new technology goods

Year	M_{N1}/M_T(%)	M_{N2}/M_T(%)	X_{N1}/X_T(%)	X_{N2}/X_T(%)
1970	68.58	36.62	2.29	0.02
1975	55.84	30.61	4.85	1.38
1980	37.29	19.85	6.90	2.12
1985	38.80	24.04	17.68	5.24

almost half (one third) over the 15 year period, while the ratio of new technology exports X_{N1} (X_{N2}) to total exports has grown by virtually 8 (260) times.

Price variable P_E has a standard definition. It takes into consideration the purchasing price parity. It is calculated as:

$$P_E = C * P_{US}/P_{BR}$$

where P_{US} and P_{BR} refer to U.S. producer prices and Brazilian wholesale prices respectively. C is the cruzeiro's exchange rate in terms of the U.S. dollar. Data on C and P_{BR} have been taken from *Estatísticas Históricas do Brasil* and for P_{US} from *Statistical Abstract of the United States.*

Figure 2 shows the evolution over time of M_T, M_{N1} and M_{N2}, as does figure 3a for X_T, X_{N1} and X_{N2}. Since the magnitudes of X_{N1} and X_{N2} are much smaller than the magnitude of X_T we show X_{N1} and X_{N2} in figure 3b for exposition purposes.

By analyzing figure 2 we see that both M_{N1} and M_{N2} have an inverted U shape profile over time. Therefore, when modelling M_{N1} and M_{N2} we add a dummy variable $D1$ ($D1 = 0$ from 1970 to 1974, and $D1 = 1$ otherwise) to capture these non-linearities. M_T has a likely M pattern over time. We also add a dummy variable ($D = 0$ from 1970 to 1980, and $D = 1$ otherwise) to the model specification of M_T. It is interesting to notice that the supreme peak of M_T (1980) does not coincide with the peaks of M_{N1} and M_{N2} (1974). M_{N1} and M_{N2} have a steadily decreasing pattern since 1974, which is different from the pattern of M_T, fact that supports our argument that imports of new technologies increase at decreasing rates, even though we recognize that the Brazilian import

Figure 2
M_T, M_{N1} and M_{N2}
Billions of U.S. constant (1980) dollars

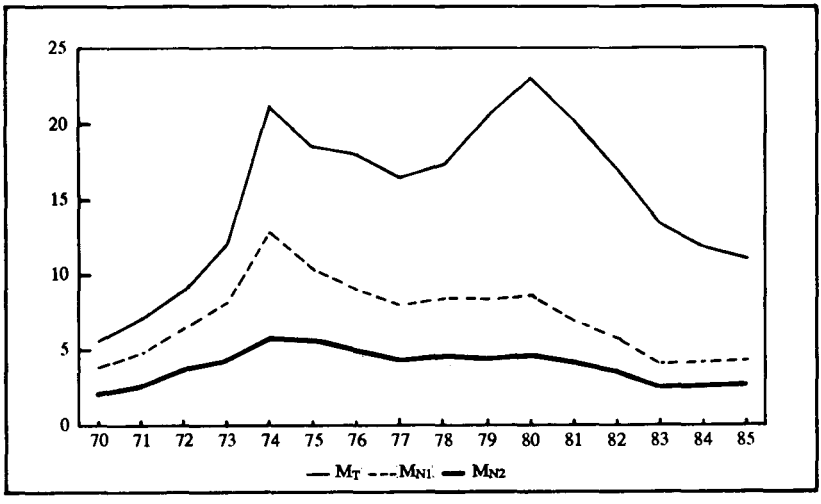


Figure 3a
X_T, X_{N1} and X_{N2}
Billions of U.S. constant (1980) dollars

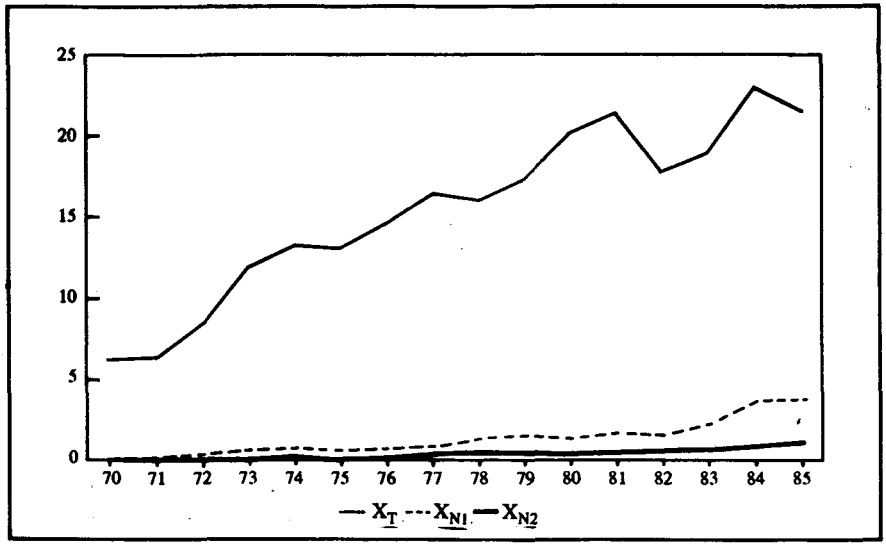
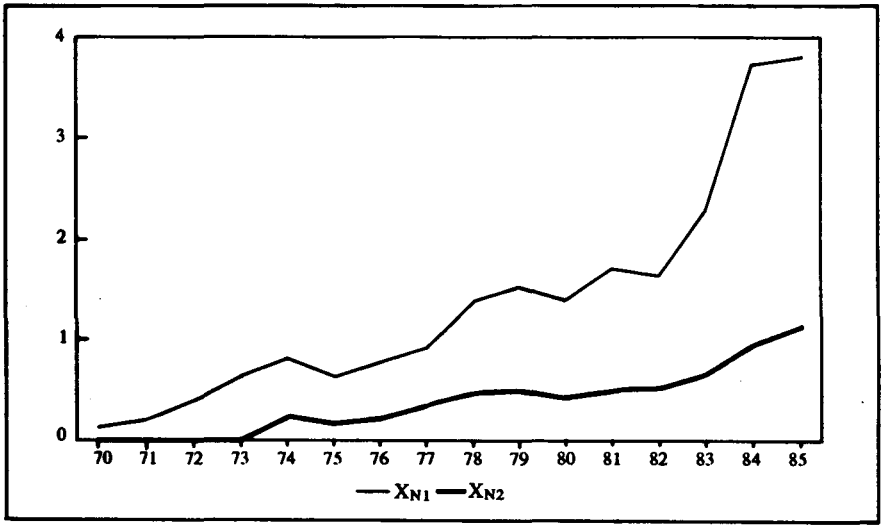


Figure 3b
X_{N1} and X_{N2}
Billions of U.S. constant (1980) dollars



substitution policy (and associate controls) might also have helped in the decrease of Brazilian new technologies imports since the midseventies.

For modelling X_{N2} we add a dummy variable ($D2 = 0$ from 1970 to 1973, and $D2 = 1$ otherwise) since X_{N2} is almost nonexistent until 1973 as can be observed in figure 3b.

Following our logic and convention, the time profiles and the demand and supply functions may be further specified as:

$$M_{N1} = \delta_0 + \delta_1 t + \delta_2 t^2 ; \delta_1 > 0; \delta_2 < 0 \quad (1)$$

$$M_{N2} = \delta'_0 + \delta'_1 t + \delta'_2 t^2 ; \delta'_1 > 0 ; \delta'_2 < 0 \quad (2)$$

$$M_{N1} = \alpha_0 + \alpha_1 Y_{BR} + \alpha_2 P_E - \alpha_3 D1; \alpha_1 > 0; \alpha_2 < 0; \alpha_3 < 0 \quad (3)$$

$$M_{N2} = \alpha'_0 + \alpha'_1 Y_{BR} + \alpha'_2 P_E - \alpha'_3 D1; \alpha'_1 > 0; \alpha'_2 < 0; \alpha'_3 < 0 \quad (4)$$

$$X_{N1} = \beta_0 + \beta_1 Y_{US} + \beta_2 P_E ; \beta_1 > 0; \beta_2 > 0 \quad (5)$$

$$X_{N2} = \beta'_0 + \beta'_1 Y_{US} + \beta'_2 P_E + \beta'_3 D2; \beta'_1 > 0; \beta'_2 > 0; \beta'_3 > 0 \quad (6)$$

$$M_T = a_0 + a_1 Y_{BR} + a_2 P_E + a_3 D; a_1 > 0; a_2 < 0; a_3 < 0 \quad (7)$$

$$X_T = b_0 + b_1 Y_{US} + b_2 P_E ; b_1 > 0; b_2 > 0 \quad (8)$$

Coefficients a_i, b_i refer to the economy as a whole, while α_i, α'_i, β_i, β'_i, δ_i and δ'_i relate to the new technology goods sector.

6. Testing the hypotheses

We have argued that the question of the Brazilian competitiveness can be formulated in the following hypotheses:

a) $\delta_0 > 0$, $\delta_1 < 0$ and $\delta'_0 > 0$, $\delta'_1 < 0$;

b) $\beta_1 > \alpha_1$ and $\beta'_1 > \alpha'_1$;

c) $\alpha_1 > a_1$, $\beta_1 > b_1$ and $\alpha'_1 > a_1$, $\beta'_1 > b_1$.

Our object is to test these hypotheses. We have followed the standard practice of estimating functions (1) to (5) for the Brazilian time series data by the OLS method, using the Hildreth-Lu procedure for correction of first order serial correlation whenever necessary, and assuming all the necessary and relevant assumptions about the random term. Given below are the quantitative estimates of these equations.

(1')	M_{N1}	=	3.7195	+	0.2495 t	-	0.0159 t^2			
			(23.633)		(5.8549)		(-6.5086)			
	R^2 *adj.*	=	0.7476; *D.W.*	=	1.0593					
(2')	M_{N2}	=	3.7586	+	0.2316 t	-	0.0142 t^2			
			(27.7996)		(6.3278)		(-6.7688)			
	R^2 *adj.*	=	0.7499; *D.W.*	=	0.9905					
(3')	M_{N1}	=	7.0379	+	1.9964 Y_{BR}	-	2.3850 P_E	-	0.77443 $D1$	
			(3.7510)		(5.3413)		(-6.4594)		(-4.1841)	
	R^2 *adj.*	=	0.7772; *D.W.*	=	1.9230					
(4')	M_{N2}	=	5.9645	+	1.8595 Y_{BR}	-	2.0239 P_E	-	0.6673 $D1$	
			(3.8638)		(6.0471)		(-6.6623)		(-4.3826)	
	R^2 *adj.*	=	0.7975; *D.W.*	=	1.7498					
(5')	X_{N1}	=	-22.8641	+	5.7502 Y_{US}	+	0.2635 P_E			
			(-7.3245)		(7.1934)		(0.6215)			
	R^2 *adj.*	=	0.9752; *D.W.*	=	1.8834; ρ	=	0.6 (2.9047)			
(6')	X_{N2}	=	-26.7687	+	6.9088 Y_{US}	-	0.6352 P_E	+	2.7289 $D2$	
			(-5.5069)		(5.5103)		(-0.9632)		(12.7465)	
	R^2 *adj.*	=	0.9900; *D.W.*	=	1.3311; ρ	=	0.6 (2.9047)			
(7')	M_T	=	3.9007	+	1.0568 Y_{BR}	-	0.9341 P_E	-	0.2500 D	
			(1.3624)		(2.1616)		(-1.7945)		(-1.4942)	
	R^2 *adj.*	=	0.7808; *D.W.*	=	1.6267; ρ	=	0.5 (2.2361)			
(8')	Xt	=	-4.7811	+	2.0794 Y_{US}	-	0.0615 P_E			
			(-1.5144)		(2.7185)		(-0.1757)			
	R^2 *adj.*	=	0.9199; *D.W.*	=	1.5609; ρ	=	0.7 (3.7963)			

[All the variables are measured in natural logarithms and with *t*-statistics in parentheses]

Statistically, all these results are satisfactory. R^2 is in the high range and *D.W.* statistics are in the acceptable range. In terms of economic theory, all the significant coefficients have the signs as expected *a priori*. Furthermore, all the expected coefficients have low standard errors so that they are statistically significant. As expected from theory, the price elasticities for both X_{N1} and X_{N2} are not statistically significant, and the price elasticities for both M_{N1} and M_{N2} are statistically significant.

Coming to the tests of our hypotheses, we find that $\delta_1 = 0.2495 > 0$, $\delta'_1 = 0.2316 > 0$, and $\delta_2 = -0.0159 < 0$, $\delta'_2 = -0.0142 < 0$. Not only $\delta_1, \delta'_1 > 0$ and $\delta_2, \delta'_2 < 0$, they are highly significant. The time profile of imports of new technology goods has the desired non-linear shape as suggested in figure 1.

Table 2a places the relevant import elasticities, and table 2b the relevant export elasticities, for easy comparison.

Table 2a
Import elasticities

Sector	*Income elasticities*	*Price elasticities*
N2	1.860	- 2.024
N1	1.996	- 2.385
T	1.057	- 0.934

Table 2b
Export elasticities

Sector	*Income elasticities*	*Price elasticities*
N2	6.909	- 0.635*
N1	5.750	- 0.263*
T	2.079	- 0.062*

Note: * Statistically non-significant at a 10% interval confidence level.

There are no studies that provide quantitative estimates for α_1, α'_1 and β_1, β'_1. These are new parameters that this study has quantified. However, there are other studies that have estimated a_1 and b_1. Bahmani-Oskooee (1986) estimated these elasticities for the period 1974-1980 from quarterly data. His estimation for import income elasticity is 0.88, very close to ours. However, his export income elasticity was not significant and hence is not comparable with ours.

We can now test our *a priori* hypothesis. We find that α_1, $\alpha'_1 > a_1$ and β_1, $\beta'_1 > b_1$. [11] In other words income elasticities of export and import demand

[11] At a 95% confidence interval, with confidence intervals constructed based on the *t* Distribution. Since the M_T profile has two peaks, it is not very clear where and if we should add a dummy variable for its specification. This is evidenced by the nonsignificance of coefficient of D. Regressing M_T without incorporating a dummy variable, we have

(7'') $M_T = 6.1863 + 0.8547\ Y_{BR}\ 1.2546\ P_E$
(2.4343) (1.7324) - (2.5190)
R^2 adj. = 0.7583; *D.W.* = 1.5832; $\rho = 0.5$ (2.2361).

As can be noticed, both income and price elasticities are significant, with magnitudes not statistically different from the ones of (7').

for the new technology goods are higher than those for the total exports and imports. This is as postulated in our theory.[12]

Again, $\beta_1 > \alpha_1$, and $\beta'_1 > \alpha'_1$ (both at a 95% confidence interval); the income elasticity of demand for exports is greater than that for imports of the new technology goods. This is consistent with our theoretical argument.[13]

7. Conclusion

Since market globalization is being defined by a new techno-economic paradigm the question of competitiveness of Brazilian exports turns into its capacity to produce, and export, new technology goods. A tentative conclusion from our econometric analysis is that Brazil has developed the necessary technology to produce, and export, new technology goods. However, the dynamics of the new techno-economic paradigm implies that the technologies are changing continuously. To maintain its competitiveness it is necessary for Brazil to develop a large infrastructure in R&D, science and skill training. Our analysis does not deal with this dynamic aspect. This is a matter of government policy.

Resumo

O novo paradigma tecno-econômico é a globalização dos mercados e a instauração de novas relações comerciais que afetam a competitividade brasileira. Este artigo formula e testa empiricamente a hipótese implícita. Chega-se à conclusão experimental de que o Brasil é um país competitivo em termos das novas tecnologias.

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[12] Bonelli (1992) found a bigger export income elasticity in the eighties when comparing with the Brazilian exports' performance in the seventies. Moreover, he concludes that the Brazilian exports' growth from 1980 to 1984 is due mainly to competitiveness' gains, fact which favors and reinforces our arguments.

[13] In social sciences, the final outcome is a result of a number of factors acting interdependently. Different models can, and do, highlight different causes. It is clear that other macroeconomic policies were also operative. Baer (1989) provides information on it. Still the statistical results based on these data are consistent with theory and thus provide a strong support for it.

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