

PROBLEMATIZING THE COMMERCIAL LIBERALIZATION – TECHNOLOGY ACCESS – PRODUCTIVITY CHANNEL, BRAZIL POST 1990

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The aims of this paper is to show that foreign commercial openness, the central objective of the model adopted in the 90's, did not materialize its objectives concerning productivity, by its channel toward imported embedded technology.

In the literature, there are two opposite schools of thought concerning the impacts of commercial openness. The mainstream literature lists three channels through which commercial liberalization leads to a higher increase in productivity: (1) the competitive pressure from imported goods induces national industry to restructure, for example, by adopting technology innovations or leaving industry; (2) changes in relative prices between exportable goods and substitutes imported goods turn exportations more attractive. The increase in exportations raises productivity by scale effect and from a broader knowledge about foreigner's technology and techniques; (3) lower protective levels reduce importation's costs, allowing all firms to have access to cheaper or better foreign technology, mainly the ones embedded in machines and equipments. This line of thought prescribes commercial openness as an essential premise to promote technology progress.

The alterative vision, based in neo-schumpeterian tradition, is concerned with the innovative process and its impacts on growth, development or productivity. The technology is deeply embedded in knowledge that embraces also a tacit dimension. So, increases in productivity growth that comes from generation and diffusion of new technologies are not automatically linked to commercial openness. Also, knowledge accumulations and its application towards innovative issues may need a previous time of learning, that can be *learning-by-doing*, *learning-by-interacting*, *learning-by-using*, among others. So, innovation is a systemic, interactive and cumulative process, which depends on endogenous capacities. The technology generation is deeply localized and depends on economic, political social and institutional characteristics of different national contexts.

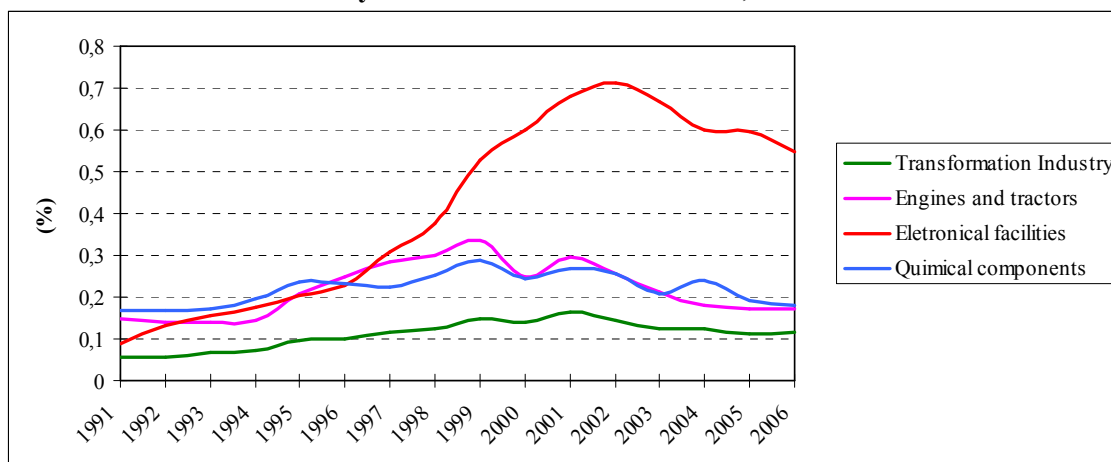
Brazil as other Latin American countries started its commercial openness in the 90's during Fernando Collor de Mello government. The openness was fast in all industrial sectors, resulting in an increase of import of goods especially electronic equipments and equipments and engines. So, the empirical data from this decade suggests a higher increase in the access to foreign technology by transformation industry sector and other selected ones (figure 1).

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Figure 1 – Comparative of evolution of penetration import coefficients, transformation industry and selected sectors – Brazil, 1991-2006.



Source: Ipeadata. Available in: <http://www.ipeadata.gov.br>. Access 23 aug. 2007. Elaboration by the authors.

In order to understand the dynamics that involved commercial opening, access to the technology, productivity and innovation in the Brazilian industry the authors realized a three steps analysis: examination (i) of commercial openness data; (ii) of Granger's test results and (iii) of innovation data. A brief view of second e third steps can be seen below.

2nd step: Granger's test

It permits evaluate the causality between variables. The variables used were: (a) labor productivity in transformation industry (PRODUTINDTRF); (b) penetration import coefficient in four sectors – transformation industry (PCTRFIND), engines and tractors (PCENGTRAC), electronic equipments (PCLETRON), chemical products (PCCHEM). The penetration coefficient were used as proxy for foreign embedded technology access.

Results:

Table 1 – Granger Test's Results

Causality direction (Granger)		Lags	Error
D(PRODUTINFTRF_SA)	→ PCINDTRF_SA	3 e 2	5% e 9%, respectively
D(PRODUTINFTRF_SA)	→ D(PCENGTRAC_SA)	5, 4, 3 e 1	1%, 1%, 6% e 7%, respectively
D(PRODUTINFTRF_SA)	None D(PCELETRON_SA)	-	-
D(PRODUTINFTRF_SA)	None PCCHEM_SA	-	-

Notes: SA means seasonal adjustment; D before the coefficients implies that the series is in 1st differences.

Source: elaboration by the authors.

The results allow rising some hypothesis:

(i) only firms with past experience of learning (specially the big ones) have benefit form the openness;

(ii) with the openness, the survivor firms were those that reduced costs, mainly labor ones. The increasing of productivity produced investment capacity and allowed acquisition of foreign technology;

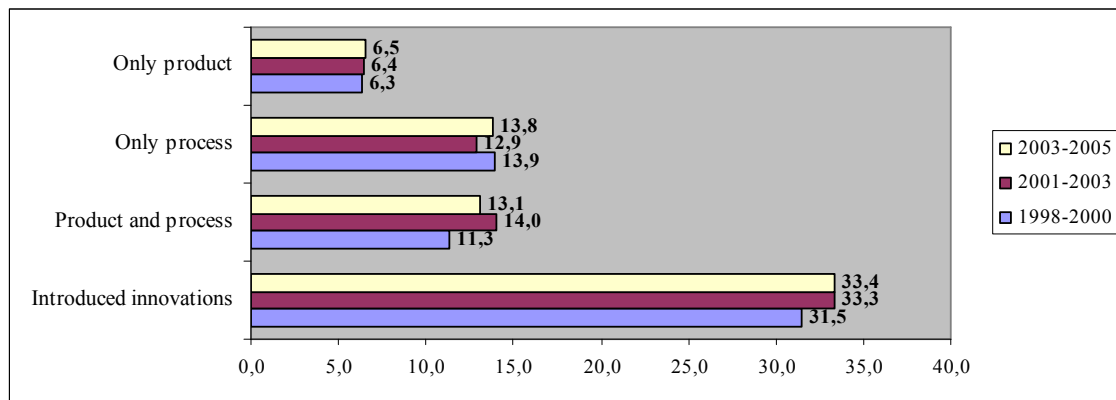
(iii) the weak results confirm the scarcity of elements in Brazil like previous existence of competencies, knowledge and efficient learning processes; and

(iv) in the macro level the imported technologies could be not much technological advanced compared with the domestic ones and consequently the impacts on the productivity were small. This last insight throw light on an open problem not treated yet. Innovation data can help to enhance the analysis.

3rd step: examination of innovation data

In Brazil, the innovation survey (PINTEC) realized by Brazilian Institute of Geography and Statistics (IBGE) started after one decade of commercial openness. So it is not possible to compare firm's performance during this period, but we can present a recent framework of firms' strategies. A first finding is the low innovation rate of brazilian manufacturing firms. During 1998-2000, only 31.5% of manufacturing firms had product or process innovation. In 2001-2003, the same was 33.4% and in 2003-2005 it was 33.4% (figure 2). But, the majority of firms concentrate their efforts in process innovation, mainly through engines and equipments acquisition. In terms of obstacles to innovate, the results points that economic issues - as higher costs, higher risk and shortages of funding – override problems and obstacles from distinct natures.

Figure 2 – Number (%) of firms that introduced innovations – Brazil, 1998-2000, 2001-2003 and 2003-2005.



Source: PINTEC/IBGE. Elaboration by the authors.

The lack of streams that leaving from of the foreign technology to productivity, the stagnated behavior of the innovation taxes and the way of this process (with focus on the imitation) denounces important nuances of fragility of the Brazilian system of innovation, in particular those relative ones to the process of technological learning and the existence of productive and innovative qualifications.

BRAZILIAN INDUSTRY: TRADE LIBERALIZATION AND ACCESS TO FOREIGN TECHNOLOGY

The model of development with focus on the domestic market and substitution of imported products suffered a great reorientation, since the 80 years, with the introduction of policies on trade liberalization and market deregulation, which sought, according to the official discourse, the modernization of the industry. In this section, the intention is to show the main features of the intensification of this opening, which took place in the 90 with emphasis on technological aspect, and their consequence to the some sector of the Brazilian industry.

3.1 The main features and opening trade

During the his government, the President Fernando Collor de Melo (1990/1992) deployed many policies aimed to liberalizing, in essence, with the following objectives: the insertion of the Brazilian economy in the global market, the macroeconomic stabilization, the modernization and restructuring of national industry and redefining the role of the state in the economy. The economic plans adopted in that period (Plano Collor I & II) had, beyond other goals, the economic stabilization and the (forced) modernization of the productive sector. These economic plans wanted, especially, to introduce structural changes for the longer term.

The intensification of trade opening in that period was largely supported by the diagnosis of liberal bias for the delay on production and technology of Brazilian industrial enterprises: the excessive protection of the internal market do not stimulate the business competitive conduct (such as incessant search for reduction of costs, the continuous increase of productivity and constant introduction of innovations), generating therefore management "accommodation" by the private and public administrators.

The defense of the viability of the chain 'liberalization - access to technology – productivity', discussed above, strongly supported the development and implementation, at June 1990, of a set of industrial policy known as 'General Guidelines for Industrial Policy and Foreign Trade (PICE). The intention was to follow a schedule for elimination of barriers to entry for imported products, in which one of the more significant changes was the reduction of tariffs on imports. In four years (1990/1993), the average of these was reduced from 32% to around 13% (MOREIRA & CORREA, 1997).

Linked to this tariff reduction, other important policy were introduced, such as the end of the system of previous informed consent for imports, the end of Annex C of Cacex (Agency of Portfolio of Foreign Trade), suspending the requirement for annual program to import, extinction of the market reserves and the elimination of Export Processing Zones (ZPEs). All of this non-tariff changes occurred in a very short period of time (around a year).

The Brazilians industrial companies were under pressure to reorganize their business strategies in the face of greater competition, especially from imported products and the recessive context of the time. The government itself was charged with disseminating the basic guidelines for competitive inclusion of the Brazilian industry in the global market through a "plan of modernization."

Between September 1990 and February 1991, institutional mechanisms were created that aims to process the transformation of the national productive sector through some instruments: Brazilian Program Quality and Productivity (PBQP), Program Support Training Technology

Industry (PACTI), Program of Development of Industrial Competitiveness (CIP) and the Executive Groups of Sector Policies (GEPS).

With the changes already implemented, industrial firms tend to adopt new criteria of rationality in their production strategies, which would be characterized by the search for greater productive efficiency. As Kupfer shows (2005, p. 203):

Repercutindo a tendência internacional, os anos iniciais da década de 1990 no Brasil foram marcados por uma rápida liberalização econômica, induzida por reformas institucionais simultâneas no âmbito do comércio, da inserção financeira internacional e do setor produtivo estatal. Essas reformas corresponderam a um choque no ambiente competitivo da indústria e, como não poderia deixar de ser, colocaram a estrutura industrial brasileira em movimento, inaugurando um período de intensas transformações.

Returning a little in time, it is possible to understand that, in an interval of 14 years (1981-1994), the Brazilian industry moved up quickly in the direction of greater international integration, both by the side of exports, in the 80's, as the imports, in the 90. From the 1980, the opening was very strong in all segments of the industry (BIELSCHOWSKY & STUMPO, 1996).

Chart 1 allows to understand that between the mid of 80 and until 1994, the Brazilian trade balance was surplus. From 1995 and until 1999, a trend of reversal can be perceived. This behavior reflects a very particular economic situation, following the implementation of the Real Plan, when combine strong currency appreciation, accelerated opening of imports goods and strong heating of internal demand.

It can be say that the increasing international integration of the Brazilian industry occurred since 1980, in two phases. First, during the years 80, when took place through the marked increase in the coefficient exported. In that period, the closing of imports was preserved, mainly driven by the crisis of external debt that retained imports in a very low level, forming what was known as "substitutive industrialization" In another step (the first half of the 90s), the opening led to the rapid growth in the rate of import penetration, so concomitant with the elevation of the coefficient exported.

The chart 2 allows a comparative analysis of the evolution of the coefficients of import penetration for the industry of transformation as a whole and for some selected sectors, which can serve as proxy of access to foreign technology in Brazil. Generally, we can say that in the decade of 90 there was a tendency of increase in the coefficient for all items observed. In the case of the industry of transformation, this tendency has remained from the beginning of 1992 to mid of 2001 (the year in which the crisis of Argentina, the terrorist attack in the United States and the "black of energy" in Brazil occurred).

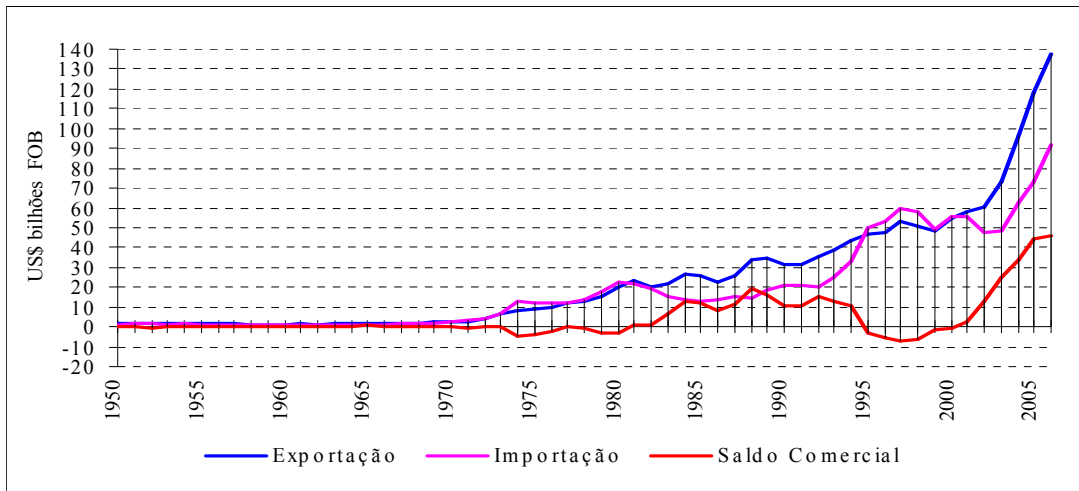


Chart 1 – Brazilian Commercial Trade Balance, 1950 – 2006 (US\$ bilhões FOB).

Source: Exterior Trade Office – SECEX. Available in: www.secex.gov.br. Access: 23 ago. 2007.

Between 1991 and the beginning of 1998, among the investigated components, the highest penetration rates were observed in the producer sector chemical elements, although their behavior shows strong seasonal influence (always peaks in the first quarter-T1). In the following decade, the sector will present a tendency of falling, and do not repeat at any time the peak of 99-T1 (47%), year of the crisis of the Real Plan. The sector of machinery and tractors, between 1991 and 1998, similarly showed strong seasonal trend (with peaks in Q4) and also reached the highest point in 1999 (T1 and T2, 36%). Since then, the trajectory is downward.

Since the second quarter of 1998, the coefficient of the segment of electronic equipment took the lead, as compared to the other, and more than this increased dramatically - reaching the mark of 82% in 2002-Q4. This situation has repeated until the present day, despite having submitted a reversal of the trajectory started from the beginning of 2003. His behavior, beyond do not show seasonality, seems to have remained immune to major turbulence in the period 1997-2002, resulting from crises such as the Asian (1997), Russian (1998), the Brazilian - followed by strong exchange rate depreciation (1999) and even not those mentioned in 2001 and the uncertainties of 2002 caused by the great possibility of win of the current Brazilian President. The same can be suggested for the total of the industry of transformation, whose was peaked in 2002-T3 (17%).

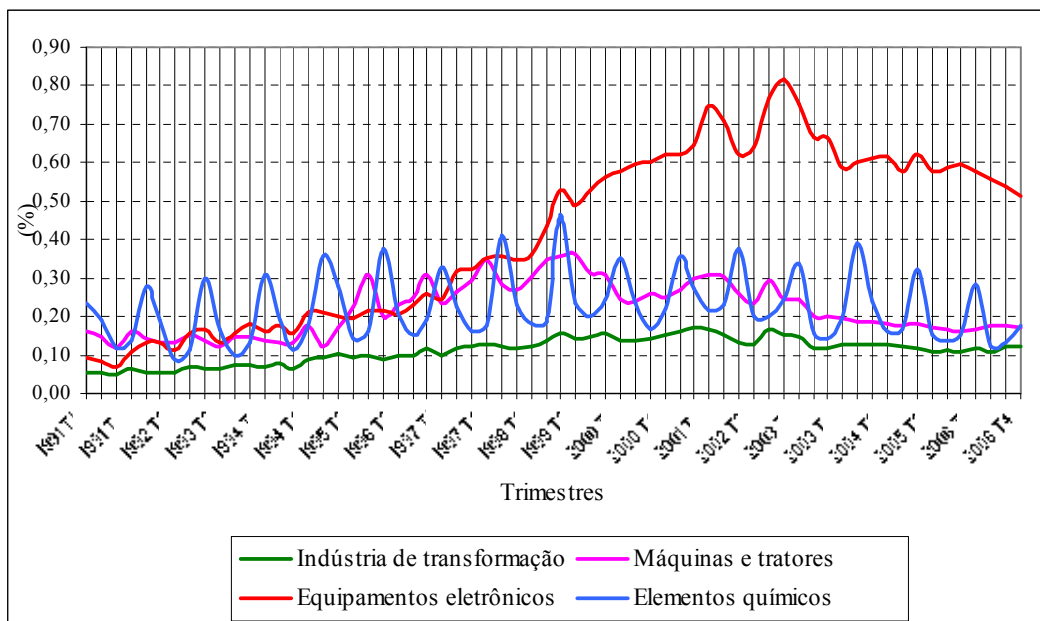


Chart 2 – Comparative analysis of the coefficient import penetration evolution – Industry of transformation and selected sectors – Brazil, 1991 – 2006.

Source: Elaborated by the author with data from IPEADATA. Available in: www.ipeadata.gov.br. Access: 23 ago. 2007.

Using the coefficient of variation (CV), as a criterion to examine the instability of the degree of import penetration, it can suggest that for all segments, the decade of 90 was more turbulent, especially in the sectors of electronic equipment (CV = 54.92%) and chemical sector (CV = 41.93%), conform Table 1.

Table 1 – Descriptive statistic of the coefficient of import penetration of the industrial sector – Brazil, 1991-99 and 2000-06.

Statistics	I. Processing			Machinery / tractors			Electronics equipments			Chemical elements		
	1991-99	2000-06	Tot	1991-99	2000-06	Tot	1991-99	2000-06	Tot	1991-99	2000-06	Tot
Average	0,09	0,13	0,11	0,22	0,22	0,22	0,24	0,63	0,41	0,21	0,23	0,22
DP	0,03	0,02	0,03	0,08	0,05	0,07	0,13	0,07	0,22	0,09	0,08	0,09
CV(%)	34,68	14,50	30,32	38,08	21,88	31,69	54,92	11,44	53,81	41,93	12,87	38,99

Source: Elaborated by the Author with data from Ipeadata. Available in: www.ipeadata.gov.br. Access: 23 ago. 2007.

Clearly, by comparing the average of factors between the two phases, the penetration of imports was expanded in the current decade, especially for electronic equipment. Only the sector of machinery and tractors presented stability of the average coefficient (22%). One aspect draws attention: the average of coefficients for the total of the industry of transformation was significantly lower than that observed for each of the segments investigated. This leads to the belief that, in recent years, the supply of internal demand by domestic industrial production has been expanding into segments of lower technological content, i.e. in the sector of less technology content and with lower aggregation value.

The index of quantum is another interesting form to observe the behavior of imports. Chart 3 shows a comparison between capital equipment and intermediate goods. There is a big jump in imports of the two groups since the second half of the nineties, especially in the case of capital equipment. These two sectors seem to have felt the influence of exchange rate

depreciation in the 1999, when passing to present downward trajectory, but greater than the levels seen in the pre-Real Plan period.

Thus the information shows a strong increase of the degree access to foreign technology for the industry of transformation, since the early 90. The next step is trying to ascertain how this was related to productivity.

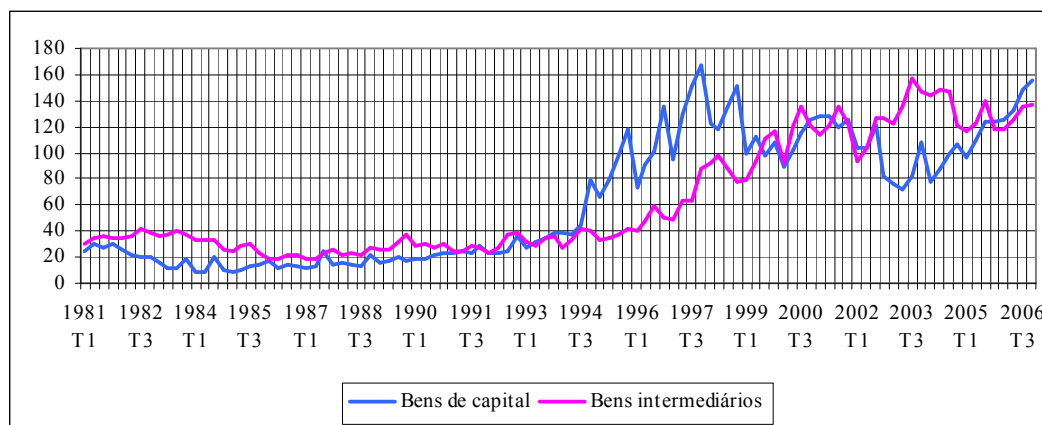


Chart – Index of quantum of import of capital equipment and intermediate goods (1996 = 100).

Source: Elaborated by the author with data by Ipeadata. Available in: www.ipeadata.gov.br. Access: 23 ago. 2007.

3.2 Causality between foreign technology access and productivity: the application of Granger test

When discussing the direction of causality, in the context of trade liberalization, the debate usually revolves around the exports and productivity variables (the second chain ‘liberalization trade - exports – productivity’, indicated in the second section). Paus *et al* (2003), reviewing the literature on the subject, show that the results are not conclusive since there may also be plausible to imagine that companies with greater productivity rates would be better able to compete in the international market, exporting.

Despite this controversy, it is understood here that doubts can be raised about the direction of causality between access to technology and productivity. The test of Granger Causality (GRANGER, 1969) can help clarify this matter, although close lesser degree of sophistication. Through this instrument, you can check if a variable helps explain the occurrence of another variable (in order of precedence).

Granger (1969) defined a concept of causation that, under certain conditions, it is very easy to be operationalized. The argument here is that a cause can not come after an effect. Thus, if the variable ‘z’ affects the variable ‘y’ then the variable ‘z’ should help improve the forecasting of variable ‘y’. In other words, wants to know whether the coefficients of variable ‘z’ are statistically significant in anticipation of variable ‘y’.

The basic way to determine the Granger causality is considering if contemporary and time lag variable should incorporate, or not, an equation. Having identified the optimal number of time

lag, the next step is to define the significance of the parameters that define the causality. Be the model:

$$z_t = \sum_{i=1}^p a_i z_{t-i} + \sum_{j=0}^p b_j y_{t-j} + \varepsilon_{zt} \quad (1)$$

$$y_t = \sum_{i=0}^p c_i y_{t-i} + \sum_{j=1}^p d_j z_{t-j} + \varepsilon_{yt} \quad (2)$$

To determine if y_t cause z_t and if z_t cause y_t , it should use the test F to examine the restrictions with the following null hypotheses: $b_j = 0$ and $d_j = 0$. In a model with p time lag, y_t not cause z_t if and only if all coefficients b_j are zero. Thus if y_t does not provide good explanation for z_t , then y_t do not cause z_t in the Granger sense (Enders, 1995).

Note that the test captures only the direct effect between the variables that constitute the model. To formalize the idea, suppose Ω_t as a matrix that captures a group of information containing all relevant information available in the period t . Since $z_t(h|\Omega_t)$ be the optimal predictor **h-step ahead** (MINIMUM-MEAN-SQUARE-ERROR), the z_t process was built based on information Ω_t . If z_t can be more efficiently prevail with the information contained in Ω_t and knowing that y_t is inside the matrix Ω_t then y_t cause z_t , to Granger sense (LÜTKEPOHL, 1993).

The problem in the choice of Ω_t is that not all relevant information is available to the predictor. Hence, the term causality indicates the cause and effect relationship between only certain variables available.

The variables used here were:

- i) Labor productivity in the industry of transformation (PRODUTINDTRF), measured by the ratio between the index of industrial production and the number of persons employed in the industry of transformation;
- ii) Coefficients of import penetration, designed as proxies for access to technology for the sector: industry of transformation (CPINDTRF), machinery and tractors (CPMAQTRAT), electronic equipment (CPELETRON) and chemical elements (CPEQUIM).

The quarterly series were obtained at <http://www.ipeadata.gov.br> and selected period (1991:01 to 2002:04) made up by the availability of data and the fact that include the phase of intensification of trade opening (Collor government) and its consequences, including the following governments.

In the transfer functions, the variables productivity, coefficient of imports industry machinery and tractors and electronic equipment sector were included in first differences in order that, according to the test unit root - Augmented Dickey-Fuller (ADF) - the two sets are included in level of order one, $I(1)$ (table 2). Because of working quarterly information, has chosen itself, as a measure of caution, to work with all seasonally adjusted series.

Table 2 – Result of ADF test

Variável	Teste ADF		Modo de entrada no sistema
	I(1)?	Especificação	
PRODUTINDTRF	Sim	-	D(PRODUTINFTRF_SA)
CPINDTRF	Não	Intercepto e tendência	CPINDTRF_SA
CPMAQTRAT	Sim	-	D(CPMAQTRAT_SA)
CPELETRON	Sim	-	D(CPELETRON_SA)
CPEQUIM	Não	Intercepto e tendência	CPEQUIM_SA

Source: elaborated by the author with *EViews* 5.0. SA = *seasonal adjustment*.

The intention was to verify the existence of causality in the particular confrontations between productivity each coefficient of penetration. It began the exercise using 5, 4, 3, 2 and 1 time lag, by which it was determined that, in any simulation, productivity showed to be endogenous regarding any of the coefficients. In contrast, this shows that the productivity caused the coefficient of the total imports for the industry of transformation and the industry machinery and tractors (Table 3). In relations productivity vis-à-vis imports of electronics sector and productivity vis-à-vis imports of the chemical elements sector there was no causality in any direction.

TABLE 3 – Results of Granger Tests

Direção da causalidade (Granger)		Defasagens	Erro	
D(PRODUTINFTRF_SA)	➡	CPINDTRF_SA	3 e 2	5% e 9%, respectivamente.
D(PRODUTINFTRF_SA)	➡	D(CPMAQTRAT_SA)	5, 4, 3 e 1	1%, 1%, 6% e 7%, respectivamente
D(PRODUTINFTRF_SA)	Nenhuma	D(CPELETRON_SA)	-	-
D(PRODUTINFTRF_SA)	Nenhuma	CPEQUIM_SA	-	-

Source: elaborated by the author - *EViews* 5.0.

The results of the Granger (GRANGER, 1969) suggest that, at least in the short term, the industry of transformation in Brazil not reaped benefits in terms of increases in productivity from the import of foreign technology post-1990. This makes weight gain the arguments that the industrial restructuring at the beginning of the decade was a very passive character and increases in productivity recorded since then (whose levels are relatively higher when compared to the 80 - Chart 3) were fruit of strategies geared primarily to the rationalization of costs, especially that influence on the workforce (deployment, outsourcing, contracting of work partial and / or temporary, reduction of wages, among others). Moreover, the lack of systemic conditions, structural and institutional support to carry out innovative efforts and investments in new productive capacity leads to a process of regressive specialization of the industry, or concentration of imports in sectors with greater technological content and greater elasticity - income and exports in traditional sectors of industry, with low technological content (KUPFER, 2005).

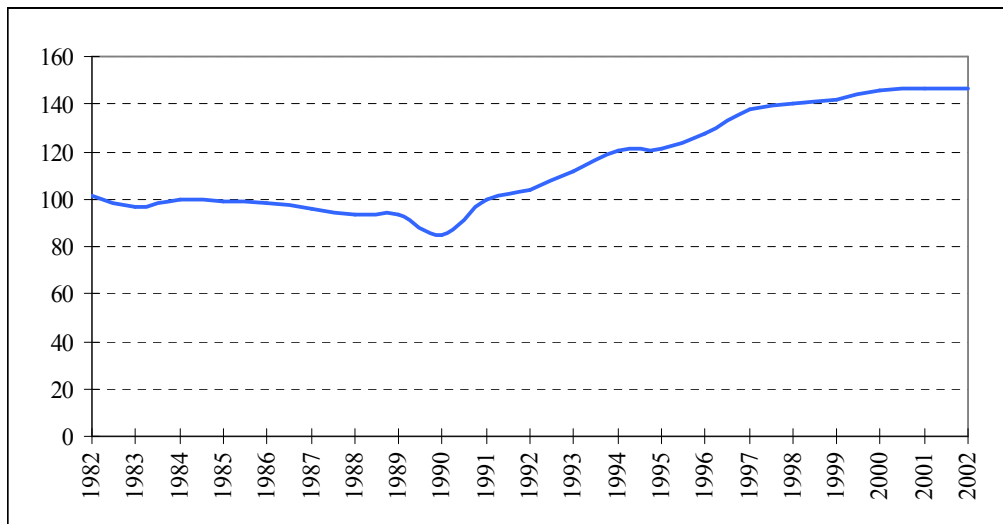


Chart 4 – Index of productivity – Industry of transformation – Brazil – 1982/2002.

Source: Ipeadata. Available: www.ipeadata.gov.br. Access: 23 ago. 2007.

From the results presented, four lessons seem reasonable:

- i) Certain businesses (especially those of large) that had previously achieved higher productivity levels, in face, for example, they have had an opportunity to develop processes of learning technology, and create and deploy innovative and productive capacity (in some cases with the possibility of use of mechanisms of spurious competition) created conditions for technology and greater capacity to invest. These internal advantages created in the past allowed, with the liberalization, access to foreign technologies to lower cost and / or better quality.
- ii) With the intensification of liberalization, survived mainly industrial companies that had been successful in the use of mechanisms for streamlining costs. The increases in productivity derived allow the generation capacity of investment, including in imported technologies;
- iii) New technologies, to operate effects on productivity in the short and medium term, require some conditionality that Brazil has not yet been able to generate, such as the existence of a prior stock of knowledge and skills productive and innovative, whose creation does not can give a long process of learning; and
- iv) In aggregation terms, the imported technology may not have closed high degree of novelty on the existing internally; it is also because its impacts on productivity were irrelevant.

The latter insight casts light on an issue still open and that are crucial: there is no subsidies so far to say that imports of products and technologies involved process significantly different from those already on the internal plane. The deepening of the analysis, by introducing reflections on the process of technological innovation, can help in clarifying this issue.

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