

Does Brazil Need an Industrial Policy?*

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Abstract

This article discusses the convenience of adopting industrial policy in Brazil. We argue that the success of East Asian countries, usually explained by industrial policy, is mainly the result of horizontal policies. We also show that there are no theoretical or empirical foundations to most of the arguments used to justify industrial policy and that industrial policy must be motivated by market failures. We briefly discuss what market failures theoretically justify industrial policy, what the empirical relevance of these failures is and what the most adequate instruments are to be used in case of public intervention. From this perspective, we analyze the Brazilian industrial policy, such as described in Brasil (2003). Finally, we conclude that horizontal policies, besides being less subject to the influence of self-interested groups, have more potential to foster Brazilian growth.

Keywords: *Industrial Policy, Innovation, Market Failures, Brazil, Growth.*

JEL Classification: *O14, O38, O40.*

* The authors thank the participants of the weekly meetings at the *IBRE/FGV* for several suggestions, especially Afonso Arinos de Melo Franco Neto, Claudio Burian Wanderley and Guilherme Hamdan de Araújo Gontijo. Thanks also go to Filipe Lage de Souza for his thorough reading of a preliminary version and for his comments. Obviously, any remaining mistakes are the exclusive responsibility of the authors. The opinions expressed in this study do not necessarily correspond to the position held by the institutions to which the authors are affiliated.

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1. Introduction

The need to adopt some sort of industrial policy (IP) is a recurrent theme in the discussion of public interventions designed to foster growth. In this sense it is appropriate to make a distinction between sectorial (or vertical) industrial policies, which attend to only some sectors, and horizontal policies, which attend all sectors without distinction. Many authors defend sectorial policies [see Kupfer (2003), Além, Barros and Giambiagi (2002), among many] using several arguments, especially based on the observation that other countries have used such policies with success or else taking into account the need to improve our foreign accounts. An attempt will be made to show that these two arguments are not valid and that the most adequate solution would be to adopt horizontal policies.

This argument will be constructed in two parts. In the first (sections 2 and 3), it is shown that there is no evidence that the success of the East Asian countries, pointed out as models to be followed by Brazil, is due primarily to the use of industrial policy. We will also show that adopting horizontal policies played a major role in the performance displayed by Japan, South Korea and Taiwan.

In the second part (section 4), it is argued that sectorial policies make sense in the presence of market failures. In this sense, the discussion concerns which market failures could theoretically justify such policies and whether there exists any evidence that these failures are significant enough to merit some type of intervention on the part of the government. Once again, even in the cases where market failures seem to justify public intervention, the most appropriate policies are of a horizontal nature, or are more effective if accompanied by horizontal policies.

Finally, an analysis is made of Brazil's current industrial policy, consubstantiated in Brasil (2003), in the light of the discussion of sections 2, 3 and 4. Although it is a government document, the choice of Brasil (2003) has no political-partisan connotation, not least because many of the arguments and proposals contained in this document have been in some form or other used or implemented by other governments. The option to illustrate the arguments assembled throughout this paper with the analysis of Brasil (2003) was basically made on account of two criteria: (i) the document is recent; and (ii) it summarizes and systematizes many of the arguments used by those who defend using vertical industrial policy. In this sense, it shows that Brasil (2003) is right in proposing some horizontal policies, when it adopts defined timeframes for their validity and requires counterpart from the companies contemplated, and when it acknowledges the importance of innovation. It is

nonetheless argued that the proposals contained in Brasil (2003) are not adequate to meet the goal of solving the foreign constraints that the country faces, nor to generate jobs or promote regional development. Furthermore, there is no economic rationality in keeping the focus of this policy on “advanced” or “cutting-edge” strategic sectors.

2. Industrial Policy: Brazil *versus* East Asia

2.1. Industrial Policy in Brazil

For many years, Brazil employed various policies to alter its productive structure in order to increase the participation of sectors believed to have great potential to generate economic growth. Behind these initiatives lay the idea that since the terms of exchange tend over time to deteriorate as far as agricultural production is concerned, it would be appropriate for developing countries to make an effort to industrialize, principally by imposing protectionist tariffs [Prebisch (1950) & Singer (1950)].¹

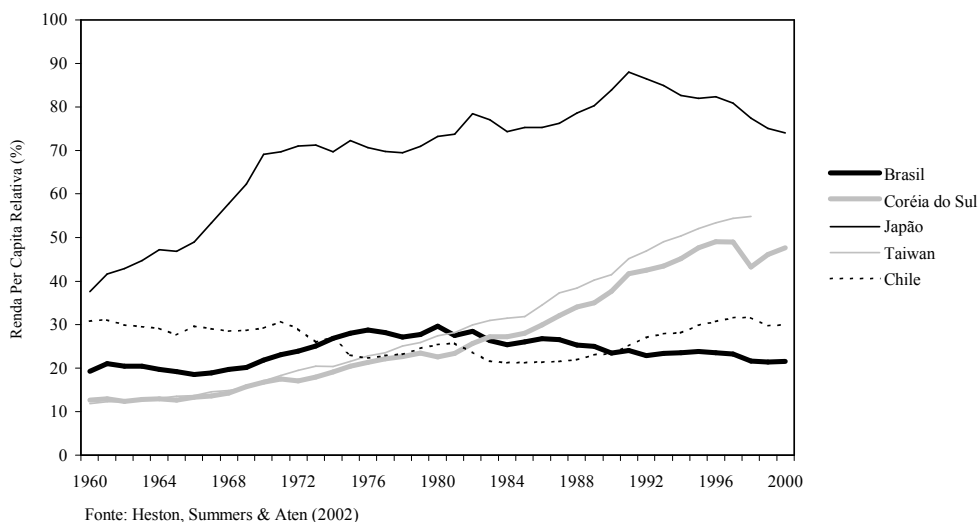
The aim here is not to present a detailed report on Brazil’s industrial policy (IP, for now on) over the last few years [for this, see Suzigan (1995), Guimarães (1996) and Bonelli, Veiga & Brito (1997), Suzigan & Furtado (2006)], but rather to describe briefly the tools used to promote industry. Between the 50s and the 80s, various types of trade protection were basically used (import taxes and non-tariff barriers such as the examination of similarity, indices of nationalization, contingency mechanisms, import licensing, preference in government procurement), along with export stimulation (favored exchange rates for exports of manufactured goods and tax exemptions) and subsidies for production in selected sectors (tax exemption and reduction and acceleration of capital depreciation).² Besides this, there was an intense flow of credit to sectors considered to be priority and the strong direct presence of the State in various productive activities. To all this, add the obstacles against adopting new technologies (the Information Technology Law (“Lei de Informática”), for example), large state investments in infrastructure (especially up to the late 70s) and expansion of higher education (principally as of the 70s).

¹ Nonetheless, it must be remembered that there is no consensus concerning deterioration of the terms of trade [see Hadass & Williamson (2001) for pertinent references]. On the other hand, Sarkar & Singer (1991) find indications that the terms of trade for exports of manufactured goods from developing countries also tend to deteriorate, which would justify the prescriptions set forth by Prebisch (1950) and Singer (1950) even in a more advanced stage of development.

² These tools were not used with the same intensity in all periods. For further details, see Suzigan (1995).

If IP appeared to be successful in changing Brazil's productive structure, there is no evidence that it managed to promote sustained growth over many years. Comparison with countries that found themselves in a similar stage of development is quite illustrative. We see that Brazil's *per capita* income in the 60s was higher than many of the countries in East Asia, but during the 80s it was surpassed by all of them. By way of illustration, in 1980 Brazil's *per capita* income was 131% of South Korea's, 40% of Japan's and 108% of Taiwan's, whereas in 2000 it had dropped to 50% of South Korea's, 28% of Japan's and 39% of Taiwan's (see Figure 1).³

Figure 1: Relative *Per Capita* Income (United States = 100%)



From the 90s on, a movement is perceived to open the economy and diminish the role of the State as entrepreneur. The impact of trade opening on industrial productivity has been widely documented [Ferreira & Rossi-Júnior (2003)], but this apparently was not translated into exceptionally high growth rates, especially if compared with previous periods (characterized by the intense use of vertical policies) or with the countries of East Asia (see Figure 1). This being so, many authors point to the performance of the Brazilian economy in the last fifteen years as evidence of the need to adopt sectorial policies [see Kupfer (2003), for example].

As a matter of fact, South Korea, Japan and Taiwan are often pointed out as examples of countries with successful industrial policies. If, as will be shown in the next subsection, Brazil used instruments similar to those used by these three countries, then what was be the

³ The information for Taiwan refers to 1998.

reason for our failure? One immediate answer would be the existence of problems in implementing Brazil's industrial policy. This theme will be taken up again in subsection 2.3.

2.2. Industrial Policy in East Asia

As in the previous subsection, the aim here is not to offer a detailed description of the IP adopted by the countries of East Asia [for references in this regard, see Noland & Pack (2002, 2003)]. A brief summary will be presented of the tools used by Japan, South Korea and Taiwan in promoting industry.

As in Brazil, Japan used direct subsidies, although the sectors benefited were precisely those that saw their participation in GDP reduced (agriculture, fishing, forest, coal mining). In addition, it employed a broad array of indirect subsidies: the Investments and Tax Loans Program, primarily addressed to investments in infrastructure, education, health and other social security policies, loans at subsidized interest rates and acceleration of depreciation. There were also programs aimed specifically at research and development, either by direct subsidy or through contracts with the government (this was the most important channel). Finally, there were exchange contingency mechanisms and allocation of reserves for strategic products (principally up to the mid-60s) and tolerance towards anti-competitive behavior.

In the 60s, South Korea used instruments such as tariff exemption for importing intermediary goods, tax incentives, preferential access to capital, accelerated depreciation of imported equipment and subsidized prices of energy and transportation. The government controlled the financial system and during almost the entire period the real interest rates were negative. In the 70s, the focus turned to heavy and chemical industry. The government intensified control of the banking system, directing lines of credit to certain sectors, projects and firms. These sectors also received substantial tax incentives and trade protection.

Finally, Taiwan also used tax incentives (reduced taxation or acceleration of depreciation and the choice of firms). The focus of these policies moved from export industries (the decade of the 60s) to capital-intensive sectors (the decade of the 70s) and later on to technology-intensive sectors (the decade of the 80s). This program was remodeled in accordance with the diagnosis that there was little relation between participating in the program and productivity gains. The focus became investing in research and development and reducing pollution, but some specific incentives were kept in the high-technology sectors. Also, different modalities of subsidized public credit were employed, especially for export

activities. As regards trade protection, the 50s was characterized by a policy of import-substitution that became milder as time passed. Although many sectors were highly protected, they had to justify that protection based on their capacity to compete with imported goods. Unlike Japan, the government played a preponderant role in financing and giving incentives to research and development activities, either by creating institutions to identify, transfer, diffuse and absorb foreign industrial technologies (the 70s and 80s), or through direct subsidies for research carried out by private firms.⁴

2.3. Some Differences concerning Implementing Industrial Policy

It became clear that the countries of East Asia used many of the policies undertaken in Brazil. However, two basic differences can be identified concerning how these policies were implemented. In the first place, the firms benefited by the government programs in East Asia were always confronted with performance goals, which had to be met or else the program was discontinued. Besides this, unlike in Brazil, subsidies and incentives were designed to be reduced over time.⁵

It should also be emphasized that Brazil's industrial policy implied a series of barriers against adopting new technologies, unlike the East Asian countries, where mechanisms were set up to facilitate this activity. In fact, some authors underscore the importance of this aspect in the development of East Asia countries [Pack (2001)].

Brazil's industrial policy underwent serious implementation problems. Many authors claim that once these problems are solved, the results achieved in the countries of East Asia could be reproduced in other countries [Wade (1990), Chang (2003)].⁶ This argument is based on the premise that industrial policy in South Korea, Japan and Taiwan was the main drive behind the growth of these countries. Nevertheless, the following sections aim to

⁴ In 1978 the government accounted for 65% of the spending on research and development, and for 40% in 2000. Besides this, spending (public and private) in this activity went from 0,8% of the GNP in 1978 to 2% in 2000 [Noland & Pack (2002, 2003)].

⁵ Another difference is the emphasis of countries like Brazil on import-substitution, whereas the East Asian countries privileged promoting exports [Westphal (1990)]. For other references, see Rodrik (1995).

⁶ Let us not forget that problems in implementing industrial policy can be seen in the East Asia too. In Noland & Pack (2002, 2003), the point is underlined that in Japan, coordination between the various agencies responsible for implementing the policies often failed and consequently paralyzed the whole process. Moreover, there are signs that the traditional sectors (based on natural resources) were the most benefited, which suggests some type of capture by organized groups. In South Korea too, there are several cases of corruption, capture and serious problems of moral hazard.

demonstrate that this is not the case: industrial policy seems to play a far less important role than many authors claim.

2.4. Growth in the Countries of East Asia: the Result of Industrial Policy?

Up to this point, the hypothesis has been accepted that there is a positive causality between growth and industrial policy in East Asian countries. However, there is no immediate relation between the presence of industrial policies and the surge of growth observed over the last few decades in those countries. Take, for instance, the analysis made by Wade (1990) in respect to the experience of Taiwan.⁷ Although he acknowledges that healthy macro-economic policies were undertaken – controlled public deficit, low inflation and relatively comfortable exchange – plus significant investments in infrastructure and education, the author attributes the good performance of this country to the sectorial policies developed by the government. A similar argument is forwarded by Chang (2003) in reference to a larger group of countries.

There is nevertheless a selection bias in this argument. For a whole variety of reasons, practically all the countries in the world introduced some type of sector policy or incentives to manufacturing. Some countries presented a good performance and are now developed countries, but the majority failed to achieve the desired results. Therefore, to select the successful cases and verify that they were all the object of some form of industrial policy is not enough to demonstrate causality between policies to promote manufacture industry and growth. The existence of failures has to be taken into account.

Indeed, Wade (1990) recognizes that other countries used the same tools as the countries of East Asia and scored trivial results. According to this author, the difference between is that in Taiwan, South Korea and Japan there was “consistent, coordinated attention to the problems and opportunities of specific industries, in the context of a long-term perspective of the evolution of the economy, plus a strong enough State not only to produce the desired effects in the economy but also the direction of those effects” [Wade (1990), p. 343]. To put it in other words, the difference in the performance across countries was due to flaws in policy implementation, which returns us to the argument developed in subsection 2.3. In this case, once the mistakes of implementation were corrected, the experiences of the countries of East Asia could be successfully reproduced by other countries.

⁷ Although the focus is on the experience of Taiwan, the conclusions drawn by Wade (1990) are extended to other Asian countries, in particular South Korea and Japan.

However, there exists a problem of identification that was not satisfactorily resolved in Wade (1990) and Chang (2003). Countries like Japan, South Korea and Taiwan employed industrial policies but also used other policies that would bear a positive effect on growth. One has to identify the impact of each type of policy on the economic performance of these countries. In this sense there is a great deal of empirical literature that investigates the impact of industrial policy (mostly trade protection and subsidies) on the growth of countries of East Asia and points towards its negative (or not very significant) impact on the productivity of labor or the total productivity of the factors [Yoo (1990), Noland (1993, 1997), Lee (1996), Beason & Weinstein (1996) and Lawrence & Weinstein (1999)].⁸ This evidence is robust to the consideration of the possibility of IP generating externalities for sectors that are not directly contemplated [Pack (2000), Pack & Lin (2001)].

3. Public Policies and Growth: What Really Matters?

If there is evidence that the impact of industrial policy on the performance of the countries of East Asia was minor, then what would explain the difference in relation to Brazil's performance? This sections shows that in addition to IP and unlike Brazil, Japan, South Korea and Taiwan systematically adopted a series of public policies that, from the theoretical and empirical point of view, tend to favor growth. In order to illustrate this difference in behavior, a compilation is made of the various indicators for Brazil, Japan, South Korea and Taiwan. Besides this, indicators of the United States and Chile were also used, that is, references to a developed country and a Latin America country with a good economic performance.

3.1. Fiscal Policy, Inflation and the Quality of Public Spending

One of the remarkable differences between Brazil and the countries of East Asia is how fiscal policy is conducted. Japan, South Korea and Taiwan have always kept an austere fiscal policy [Noland & Pack (2002, 2003)], whereas in Brazil the concern with bringing down the public deficit is very recent.

⁸ Compilations of this literature can be found in Noland & Pack (2002, 2003) and Pack & Saggi (2006).

Besides this, from the theoretical and empirical point of view, there are also many reasons to believe that high inflation diminishes growth [see Mansoorian & Michelis (2005)].⁹ The comparison between Brazil and some countries of East Asia illustrates this point quite well (see Table 1).

Table 1: Average Annual Rate of Inflation (Consumer Prices Index)

	1960-1969	1970-1979	1980-1989	1990-1999	2000-2005
Brazil	42,82 %	32,59 %	271,7 %	280,4 %	7,71%
South Korea	13,00 %	15,05 %	8,08 %	5,71 %	3,04%
Japan	5,35 %	8,97 %	2,51 %	1,20 %	-0,37%
Taiwan	4,77 %	8,90 %	4,44 %	2,87 %	0,78%
Chile	24,16%	130,36%	20,29%	10,28%	2,82%
United States	2,17%	6,46%	4,17%	2,46%	2,12%

Sources: IMF (2005) and Bureau of Statistics - Republic of China (2005).

There is ample evidence that fiscal policy has a significant impact on the long-term development of countries. More specifically, fiscal adjustments tend to favor the growth of *per capita* income both in rich countries [Alesina & Perotti (1995), Alesina *et alii* (2002)] and in poor [Baldacci, Hillman & Kojo (2004), Gupta *et alii* (2005)]. The channels of transmission, however, are different: in developed countries, increasing the growth rate is the result of raising private investment [Alesina *et alii* (2002)], whereas in poor countries it is mainly caused by increased productivity [Baldacci, Hillman & Kojo (2004)].¹⁰

Indeed, the results presented by Baldacci, Hillman & Kojo (2004) are indications that public spending in the poorer countries is inefficient. In this sense: (i) the quality of the fiscal adjustment is equally important, that is, cutting current expenses tends to be more advantageous than reducing investments or increasing revenue [Von Hagen & Strauch (2001) and Gupta *et alii* (2005)]; (ii) the quality of state bureaucracy and the level of corruption in the government bear a significant impact on the result of public policies [Rajkumar & Swaroop (2002)]; (iii) the efficiency of the public sector tends to be lower in countries where government spending is a higher proportion of the GNP [Herrera & Pang (2005)].

As regards item (i), although in the last few years Brazil has reduced public deficit drastically, this reduction was made at the expense of cuts in investment and increased revenue, which would indicate the need to undertake a fiscal adjustment of better quality.

⁹ In theoretical and empirical terms, there is a certain consensus regarding the negative impact of inflation on the growth rate of countries, but there is not yet any consensus as to whether this impact is just short-term, or if it is long-term.

¹⁰ Basically, the channels through which inflation diminishes growth are the same [see Fischer (1993) and Baldacci, Hillman & Kojo (2004) for further details and other channels].

With regard to item (ii), international comparison is quite unfavorable to Brazil. As shown in Table 2, in terms of corruption and quality of State bureaucracy, the indicators for Brazil are far below those of the United States, East Asia countries and Chile. Finally, item (iii) suggests that a fiscal adjustment of better quality tends in itself to improve the efficiency of public spending, which would reinforce the effect of this measure and facilitate intensifying the adjustment.

Table 2: Indicators of Corruption and Quality of State Bureaucracy (2004)

	Control of Corruption		Efficacy of the Government	
	Indicator	Ranking	Indicator	Ranking
Brazil	-0,15	95 ^o	0,02	87 ^o
South Korea	0,17	78 ^o	0,95	42 ^o
Japan	1,19	29 ^o	1,21	29 ^o
Taiwan	0,64	54 ^o	1,15	32 ^o
Chile	1,44	24 ^o	1,27	28 ^o
United States	1,83	16 ^o	1,80	14 ^o

^a This a measure of the extension of corruption, that is, exercising public power to obtain private gains.

^b Indicator that measures in conjunction the quality of the provision of public service, the quality of state bureaucracy, the competence of civil servants, the independence of public services from political pressures and the credibility of the government's commitment to public policies.

^c Can assume values between -2,5 and 2,5.

^d Out of a total of 204 countries.

^e Out of a total of 209 countries.

Source: Kauffmann, Kraay & Mastruzzi (2005).

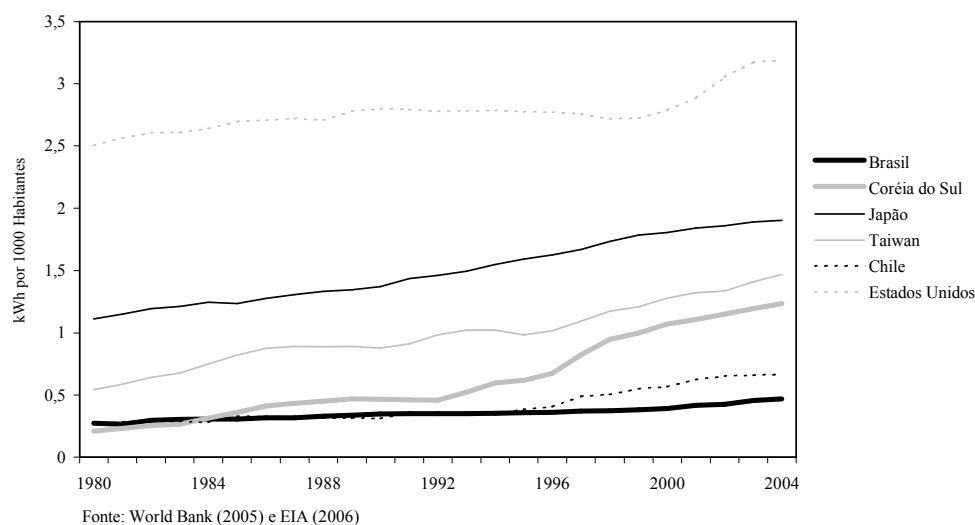
3.2. Infrastructure

From the theoretical point of view, the channel through which investment in infrastructure would contribute towards the development of countries would be to increase the productivity of the other factors of production. In this respect, there is a great deal of empirical evidence of the positive impact of the stock of infrastructure on the level and rate of growth of the *per capita* product of countries [see Calderón & Servén (2004a) for references].

In this sense, in comparison with the developed countries or those of East Asia, Brazil finds itself in an obvious position of disadvantage. Take, for example, energy generating capacity. Figure 2 shows that the stock of Brazil's *per capita* infrastructure is fairly small, even when compared with other countries of Latin America, like Chile.¹¹ Furthermore, this difference was smaller in the early 80s, but has increased over the years. Note that this still holds even when a measure of the infrastructure stock is constructed controlling for factors such as urbanization, population and territorial area [Calderón & Servén (2004b)].

¹¹ For comparisons with other sectors, see Schymura & Canêdo-Pinheiro (2006).

Figure 2: Per Capita Energy Generating Capacity
(kWh per 1000 inhabitants)



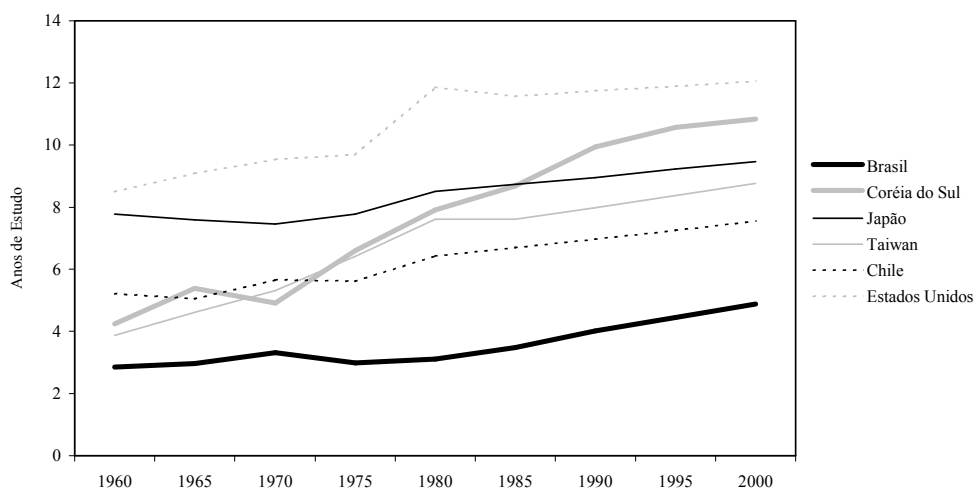
In this way, it makes sense to imagine that part of the difference in performance between the countries of East Asia and Brazil can be attributed to this factor, especially in the last thirty years. This conjecture is confirmed by empirical evidence: the deficit of Brazilian infrastructure explains about 35% of the difference in the growth rate in relation with South Korea [Calderón & Servén (2002)]. Besides this, there is strong evidence that investments in infrastructure, in particular access to treated water and sewers, play an important role in reducing inequality of income [Calderón & Servén (2004a), Calderón & Chong (2004)]. By way of illustration, the results presented by Calderón & Servén (2004a) suggest that if Brazil had South Korea's infrastructure stock, inter-personal income inequality would drop by about 15%.

The diagnosis for the Brazilian case (and many countries in Latin America) is that the government reduced its investments in infrastructure but failed to attract a sufficient volume of private investments [Calderón & Servén (2004b)]. In this way, although the solution also entails increasing public investments in infrastructure (which depends on a fiscal adjustment of quality), it is patent that there is a need for the private sector to participate in this process. This being so, it is indispensable for a legal and regulatory framework to be built that makes private investment an attractive proposition in some sectors.

3.3. Investing in Human Capital

One of the main differences between the countries of East Asia and Brazil is the emphasis placed on human capital accumulation. Figure 3 illustrates this affirmation well. In 1960, the average schooling of the Brazilian population above 15 years of age was about 3 years of study, while in Taiwan and Korea it was around 4 years. In 2000, Brazil had advanced only as far as 4,88 years of study, while Taiwan and Korea reached levels close to 9 and 11 years of study, respectively.

Figure 3: Average Schooling of the Population above 15 Years Old



Fonte: Barro & Lee (2000)

In theoretical terms, the accumulation of human capital is desirable because it increases the productivity of other factors of production, besides contributing to lowering inequality of income. Many empirical studies find a positive element between the average level of schooling and growth [Benhabib & Spiegel (1994) and Sala-i-Martin (1997)]. Similar evidence is found in respect to the quality of education and growth [Hanushek & Kimko (2000)]. In fact, when one takes into consideration not only years of schooling but also the quality of education, one sees that, contrary to what is suggested in Bils & Klenow (2000), accumulating human capital generates growth.

Moreover, the relation found is between education and growth, not necessarily between spending on education and growth. Accordingly, educational policies must be designed to ensure that public spending in this area is effectively transformed into human capital. Furthermore, there is evidence that externalities exist associated with education [see

Moretti (2004) for references], which would reinforce the importance of some type of public policy in this area.

No developed country in the world has Brazil's educational indices. As a matter of fact, not even developing countries with similar income levels. Table 3 presents the portion of the difference between product per worker in Brazil and various countries that could be explained by the difference in education and illustrates the cost of having a poorly educated population.¹² Note that these are conservative estimates, since they do not take into account the externalities associated with education and the difference in quality between school systems.

Table 3: Difference in *Per Capita* Income in Relation to Brazil Due to Education

Difference in <i>Per Capita</i> Income Explained by Education	
South Korea	76%
Japan	66%
Taiwan	77%
Chile	89%
United States	35%

Source: Pessoa (2006) and the authors' calculation using the same methodology (see appendix)

3.4. Savings and Social Security

What about the incentives to capital accumulation? East Asia countries and Chile (more recently) made considerable savings efforts, while for the last forty years the rate of domestic savings in Brazil remained slightly above that of the United States, a country that is already in a balanced growth path, so that one would expect lower saving rates (see

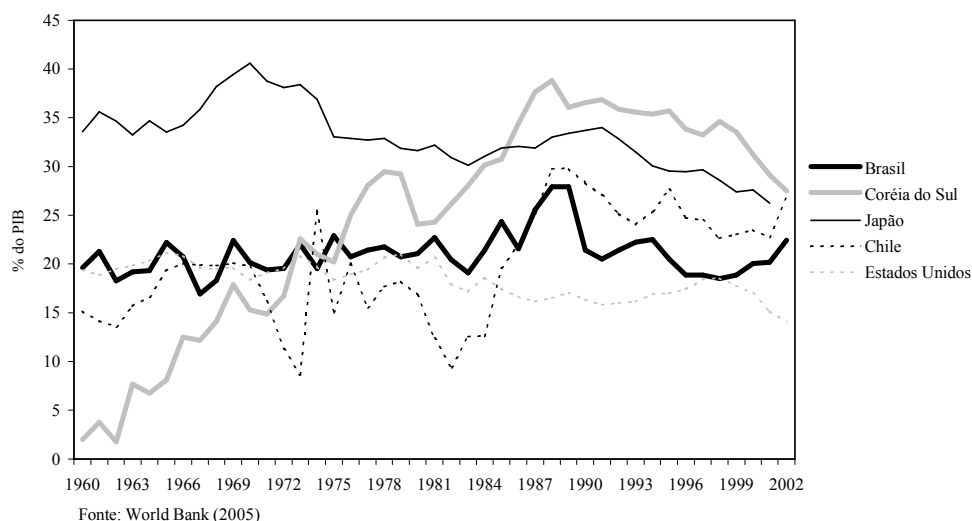
Figure 4).

It is not within the scope of this paper to discuss the Brazilian strategy in detail in comparison with these countries, but it is certain that the construction of adequate incentives for savings involves a savings effort on the part of the public sector and a reformulation of the social security system. Social security and pensions system in Asian countries are very inexpensive in comparative terms. Practically all social security is fully funded, as indeed happens today in Chile. Brazil spends 13% of its GNP on social security, while South Korea spends only 1,9%, Chile 8,5% and the United States 5,4% [World Bank (2005)]. It should be

¹² See appendix for methodology and data.

borne in mind that the portion of elderly citizens in the Brazilian population is far smaller than in most of these countries (5,3% as against 7,2% in South Korea, 7,3% in Chile and 12,4% in the United States). In addition, although government experienced sizable primary surplus in the last years, taxation as proportion of GDP is today 38% of GDP and increasing. However, public investment is today at its historical lower level, so that most revenues goes to current expenditures and interest payment.

Figure 4: Domestic Savings (% of GNP)



3.5. Conclusion

To sum up, for many years some countries of East Asia have followed (and still follow) a group of horizontal policies that have proven to contribute towards development: austere fiscal policy, fiscal adjustment of quality, inflation control, incentives to savings, investment in human capital and infrastructure. The Brazilian case is markedly different.

In view of this, it is appropriate to wonder what might be the main causes of the difference between the performance of Brazil (and many other Latin American countries) and that of countries that have managed to draw closer to the developed countries (especially those of East Asia). In this sense, even those who advocate using sectorial policies cannot ignore the important role of horizontal economic policies in the growth of countries like South Korea, Japan and Taiwan [De Gregorio & Lee (2003)]. Indeed, the Chilean experience is a fine illustration of this point. Unlike most Latin American countries, for many years it has pursued several of the economic policies described in this section. Could the difference

between Chile's performance and that of most Latin American countries (including Brazil) in the last few decades be some coincidence?

This argument can even be adapted to developed countries such as the United States and Germany. Besides being 'examples' of successful industrial policy, which seems to be far from true, they were very successful in other dimensions that modern economic theory considers essential for long-term growth. The early development of North-American industry was mainly based on comparative advantages, in other words, on transforming non-reproducible natural resources [Wright (1990)]. Furthermore, evidence shows that, although the implantation of some industries was brought forward a few years, North-American protectionism had a negative impact on welfare (see section 4.1).

Finally, the levels of schooling (reading and writing) for free men in the United States at the end of the 18th century stood at 90% in New England and 70% in Virginia and Pennsylvania [Galenson (1996)]. Furthermore, the United States led the process of universalized secondary schooling [Goldin (2001)]. In Germany, the period of industrial flourishing coincided with low rates of trade protection and investments in infrastructure, education and incentives technology acquisition [Chang (2003), p.65-68]. Different from Germany and in a way closer to the United States, Latin America was one of the regions of the world that presented the highest import tariffs [Bértola & Williamson (2006)] and, especially in the case of Brazil, extreme lower levels of schooling.

4. Industrial Policy and Market Failures

The previous sections made it clear that Brazil's industrial policy failed to attain satisfactory results and that even in the East Asian countries there are signs that such policies yielded limited results. Besides this, there is ample evidence (theoretical and empirical) to sustain the use of horizontal policies rather than sectorial or vertical ones.

Do these results mean that developing countries, especially Brazil, should give up any type of industrial policy? The answer to that question is not obvious. In fact, when understood as selective sectorial interventions, industrial policies only possess economic rationality if they aim to correct some type of market failure [Grossman (1990)]. Defining the scope of government interventions, therefore, first passes through identifying these failures. The next sections offer a brief summary of the literature in this respect, identifying the main market failures that in theory would justify public policies, evaluating empirically whether

there is evidence that these distortions are big enough to warrant the government's attention and, if so, what type of instrument is the most appropriate.

4.1. Externalities in Learning

Many authors have emphasized the need for IP in environments where some sectors present dynamic learning, that is, when each firm's marginal cost of production diminishes with the volume produced by all the firms over time (learning-by-doing).¹³ This being so, since the pioneer firms do not internalize the reduction of costs that their production will allow the other firms in the future, the possibility exists that if the initial cost of production is high enough and without any government intervention, the economy will not produce that good. In this case, providing subsidies to the sector that presents dynamic learning will be optimal if the learning is fast enough and if the degree of substitution between the domestic and the imported good is small enough [Melitz (2005)]. It should be remembered that even when subsidizing is the optimal option, this should be chosen in such a way that it can be reduced over time [Melitz (2005) and Miravete (2003)].

In a context of general equilibrium with open economies, Redding (1999) also finds that some type of subsidy to sectors characterized by externalities in learning can be optimal, although he admits that in practice the selection of the sectors that should receive it is quite difficult, especially on account of the amount of necessary information. This argument of a practical nature becomes all the more relevant when one considers that the government does not know the firms' learning curve. Dinopoulos, Lewis & Sappington (1995) show that under asymmetry of information with relation to the learning curve, public intervention does not prove optimal in many case in which intervention would be justified if the information were symmetrical. Expressed differently, the asymmetry of information lowers the scope of government action to increase welfare in the presence of learning-by-doing.

Still concerning the practical implementation of government intervention, it should be stressed that this is only justified if the learning implies externalities between firms. Otherwise there is no justification for public policies. In this sense, Head (1994) calculates the impact of trade protection on the North-American industry of railroad tracks. The impact

¹³ More precisely, $c_t = c(Q_t)$, where $Q_t = \int_0^t q_s ds$, q_t and c_t are domestic production and cost at instant t .

on the consumers was negative in the short and long run, and the effect on welfare, though positive, was small. Enormous effects of learning were found, but the result presented by Head (1994) is based on the hypotheses that the spillover of knowledge within domestic industry is perfect and that no such externality exists among North-American and British firms. The latter hypothesis, in addition to biasing the result to validate the hypothesis of the presence of externalities among domestic firms, is quite questionable in that, as underscored by Irwin (1998), a considerable part of the workers in the North-American steel industry gained knowledge and experience in British industries.

In Irwin (1998), a probabilistic model is developed in which the decision on entry and exit of firms is endogenous. The application of this model to the North-American tinplate industry in the early 19th century shows that the import tariffs instituted in 1890 anticipated the implantation of this sector in the United States by about ten years. Despite this, trade protection presented negative effects in terms of welfare. Ohashi (2004) shows that learning in the Japanese steel industry was quite fast, but that spillovers were not observed in the sector and the impact of export subsidies was of little significance to the growth of the industry.

With regard to the semiconductor industry, Irwin & Klenow (1994) keep the focus on DRAM (Dynamic Random Access Memory)-type chips and find evidence that learning is far more intra-firm. Besides that, the externalities of learning occur both among firms of the same country and those of other countries, which would not justify a policy to promote the domestic industry. Similar results are to be found in Gruber (1998) for EPROM (Erasable Programmable Read Only Memory)-type chips. Moreover, there is evidence that a small part of the learning is transferred from one generation of products to another, at least as far as DRAM-type chips are concerned¹⁴. Given the short duration of the product cycle, the gains from policies for this industry tend to be short-lasting.

Finally, Thornton & Thompson (2001) produce evidence that the externalities resulting from learning were small in the military ship-building industry in the United States during the Second World War.

IN summary: empirical evidence seems to indicate that there are no significant externalities associated with learning in firms, which would de-authorize the government's

¹⁴ Gruber (1998) finds the opposite evidence for EPROM-type chips.

use of industrial policy. Even if that was not so, the implementation of such policies would be very problematic.

4.2. Informational Externalities

Another type of market failure associated with learning was raised by Hoff (1997) and Hausmann & Rodrik (2003). The local use of technologies or activities already undertaken in other countries is not immediate and needs adaptations. Put in other words, the function of certain goods is not the same in all countries, since much of the technology is tacit or else depends on the economic and institutional environment in which it is inserted. In this way, there is uncertainty if a given activity is liable to be produced locally, that is, if the firms involved in the new activity will prove to be productive enough. So, if this learning only takes place after the investment and the return on this investment is not entirely appropriated, then there is room for the government to intervene.

This problem is similar to that faced by the firms that invest in innovation, but in this case the return on the investment can be protected by patent and intellectual property laws. Hausmann & Rodrik (2003) call the process of discovering that activities are domestically lucrative “self-discovery” and Rodrik (2004) calls the distortion associated with this process “informational externality”.¹⁵

Hausmann & Rodrik (2003) develop a model in which local entrepreneurs do not know the cost associated with local implementation of new products and activities. Once an activity has been implemented and proved to be productive, the entrepreneur enjoys extraordinary profit for some time, until other entrepreneurs also begin to dedicate themselves to the same activity and this profit becomes eroded. In this sense, market equilibrium leads to two types of inefficiency: (i) sub-investment in non-traditional activities, since the pioneer entrepreneurs do not internalize the gains they generate for the other entrepreneurs; (ii) excessive diversification of non-traditional activities, to the extent that the extraordinary profit enables not very productive activities to survive.

In this case, Hausmann & Rodrik (2003) and Rodrik (2004) suggest an industrial policy that in general lines should lend incentive to investing in new activities *ex ante* and

¹⁵ This type of market failure is all the more relevant when one takes into account that for the less developed countries there is evidence that imitating already existing technologies plays a more important role than developing domestic technology for the growth of *per capita* income [Connolly (2003)].

eliminating not very productive activities *ex post*. Obviously the incentive should be given only to the pioneer firm rather than to the imitators. Trade protection and subsidies to exports would not be very adequate, as it is not possible to distinguish between pioneers and imitators. Loans and guarantees on the part of the government, although they benefit the firms discriminately, undergo serious problems associated with political influence in directing resources, corruption and moral hazard. In fact, the Brazilian experience with this type of policy corroborates this affirmation.¹⁶

Furthermore, it should be emphasized that this type of model adjusts better to economies in the early stages of development. Hausmann & Rodrik (2003) recognize this fact and point out that in more advanced stages of development, innovation activities are more important for guaranteeing growth. This indeed would seem to be the international evidence: Imbs & Wacziarg (2003) claim that the growth pattern of countries tends to be characterized by an early phase of diversification of activities, preceded by a phase of specialization when a certain level of development is reached (measured by *per capita* income).

In this sense, Rodriguez-Clare (2004a) analyze the experience of Costa Rica and evaluate that in that country's present stage of development, policies focused in sectors in which comparative advantages have been revealed are more appropriate than policies aimed at expanding the scope of activities, as advocated by Hausmann & Rodrik (2003). The same prescription is probably valid for Brazil.

For different reasons, Hausmann, Rodrik and Velasco (2004) also do not recommend policies to induce self-discovery in the case of Brazil. Here the argument is based on the diagnosis that Brazil is a country with a high return on investment but whose growth is restrained by the domestic and international credit market. In this sense it would be more appropriate to introduce policies that increase domestic financial intermediation and international credit for the country (principally through austere fiscal policy).

4.3. Flaws in Coordinating Investments and Clusters

Decisions as to production and investment in an industry are interdependent, and when taken in a decentralized manner they can lead to learning-intensive industries not developing, even

¹⁶ It should be remembered that for many years in Brazil, loans from government agencies were granted to some companies provided that proof was available of the non-existence of another domestic firm engaged in producing the same good, exactly in the spirit of the model offered by Hausmann & Rodrik (2003).

when there exists available stock of human capital. Rodrik (1996) develops a model in which the economy is comprised of two sectors: the traditional and the learning-intensive. The inputs for the latter are produced with growing returns of scale and cannot be imported. In this way, in order for the learning-intensive sector to develop, a large enough variety of input materials has to be produced domestically. If none of these inputs are produced locally, there is little incentive for any firm to produce them, since there will be no demand. The same can be said with regard to the final (learning-intensive) good. In such cases, there is room for the government to coordinate the productive investments.

Nevertheless, this type of model assumes a relatively large endowment of human capital. Rodrik (1996) acknowledges that his model adjusts better to economies with well educated labor force, especially countries of East Europe and East Asia.¹⁷ In the case of Brazil, this model could be applied to sectors in which there exists a reasonable stock of human capital, but taking into account that government intervention only makes sense if the economies of scale in the domestic production of the input materials are significant and if it is not possible to use imported inputs.

Anyway, contrary to what is presented in Rodrik (1996), intervention by the government does not necessarily involve granting. The logic of coordination flaws means that, once all the investments are made simultaneously, all of them become lucrative. In this way, none of the investors would need to be subsidized *ex post*, some type of *ex ante* guarantee would suffice [Rodrik (2004)]. Moreover, this type of policy allows for abuse and problems of a moral hazard nature.

Note that the idea forwarded by Rodrik (1996) is related to the presence of externalities of a local nature and specific to a certain industry. As underlined in Rodriguez-Clare (2004a, b), this type of externality usually generates industrial agglomeration, what is known as clusters. As a matter of fact, there is wide evidence of the existence of such externalities, and they are mostly associated with learning spillovers: all things being equal, learning-intensive industries (with big spending on research and development or significant use of skilled labor) tend to be geographically more concentrated [Rosenthal & Strange (2004)]. To put it differently, spillovers that lead to the formation of clusters are generally associated with learning and innovation. This evidence is confirmed by Raut (1995) in

¹⁷ For an analysis of the role of the government in the success of East Asia countries from the perspective of coordination of investments, see Rodrik (1995).

relation to the presence of externalities, and by Branstetter (2001) in relation to its eminently local nature.

Nevertheless, it is worth noting that: (i) all sectors have some potential to form clusters; and (ii) all sectors can exist with or without clusters. Thus, the model presented by Rodrik (1996) is based on a premise that is not valid, namely that the modern (learning-intensive) sector is bound to develop only with the formation of clusters. If we take into account that the modern sector can develop using lagged technologies or old organization of production, it is clear that policies that distort prices in order to stimulate this sector do not necessarily lead to externalities and the formation of clusters.¹⁸

So, instead of focusing on new sectors, government intervention should keep the focus on sectors that are already developed and possess the potential to be benefited by the formation of clusters [Rodriguez-Clare (2004a)]. Moreover, even in the presence of externalities, policies that distort relative prices such as export-promotion or trade protection lead to less welfare [Puga & Venables (1999) and Rodriguez-Clare (2004b)].¹⁹ Preference should therefore be given to policies that consist in fixed subsidies, investment in infrastructure and legal reforms that facilitate exploring the externalities associated with innovation.

So, rather than a policy of indiscriminately stimulating innovation, it is more productive to lend support to research and development in sectors where the country has already shown some comparative advantage. Natural candidates are those that present good exporting performance. In addition, it should be noted that there is evidence that the research and development activities carried out in universities and public laboratories have greater potential to generate externalities [Audretsch & Feldman (2004)]. It therefore makes more sense to support chiefly research and development in these institutions, rather than subsidizing activity in the private sector [Rodriguez-Clare (2004a)].

Note that the prescriptions set forth in this subsection run contrary to the common-sense notion that industrial policy should promote sectors characterized by some degree of ever more sophisticated technologies. Indeed, no evidence exists that the process of development is associated with a shift towards progressively more learning-intensive industries [Hunt & Tybout (1998)]. There are many developed countries not intensive in

¹⁸ Brazil is rich in examples of sectors that received incentives from the government to develop and failed to generate any type of agglomeration or positive externality.

¹⁹ As a matter of fact, it should be remembered that most of such policies were forbidden by the World Trade Organization (WTO). One of the exceptions is precisely subsidies to research and development activities.

advanced technologies (New Zealand and Italy are two examples), while others master cutting-edge technologies without being developed (Russia, for instance).²⁰

An argument that is often heard is that a big country like Brazil is incapable of generating development if it does not have a diversified industry and presence in the more “advanced” sectors. The economic logic of such an argument is not clear, but obviously we are not suggesting that Brazil should revert to being an exporting monoculture economy: the countries mentioned above possess a highly diversified list of exports. Our point is that having a diversified export list is not the same as mastering technologically more advanced sectors.

4.4. Barriers to Entry and Externalities in the Export Activity

It may be argued that there are barriers against the entry of domestic firms in foreign markets. Besides tariff barriers, import quotas and sanitary specifications, some barriers are associated with establishing trade contacts, knowledge of the foreign market and the existence of asymmetry of information as regards the quality of the exported good. For example, Raff & Kim (1999) present a model in which consumers pay a price to try out new products. As they already know the quality of the local product, but are unfamiliar with the quality of the imported one, this cost becomes a barrier against the entry of exports of other countries. In this case, as a policy prescription, some type of exports subsidy is recommended when the difference between the high-quality and the low-quality good is significant, when the difference in the production cost of the two goods is low, and when the degree of differentiation between the exported good and that produced by the foreign country and the import tariff is high. The subsidy should be lowered over time as the problem of asymmetry is gradually resolved.

Some authors also argue that some externalities are associated with exporting. Once a company manages to export to a certain country, the other firms of the same country benefit from this transaction, that is to say, the barriers to entry are lowered for all the firms. In this case, the need for some sort of public policy would be made all the stronger. In Aitken,

²⁰ New Zealand’s export list is quite illustrative in this respect. According to official data for 2004, at least 75% of the exported value consisted of commodities, agricultural produce or small transformations of the latter. Dairy products, meats, leathers and skins, fruits, fish, woods, wool and vegetables accounted for about 53% of the value of exports. Nevertheless, New Zealand’s *per capita* income is almost three times that of Brazil [IMF (2006)]. For references and a brief analysis of the Italian experience with industrial policy, see Ferreira (2005).

Hanson & Harrison (1997), micro-data from Mexican firms are used and evidence found that the likelihood of a firm to export is greater if it is located in the vicinity of a multinational corporation, but remains unchanged in the vicinity of a domestic export firm. This result seems to indicate that the externalities are not related to the exporting activity itself but rather to some other aspect of the activity of multinational corporations.²¹ This conjecture is corroborated by Greenaway, Sousa & Wakelin (2004), who examine British firms and find evidence that the main channel through which foreign direct investments enhances exports is by increasing competition. Along the same lines, Bernard & Jensen (2001) and Barrios, Görg & Strobl (2003) come upon no significant evidence of externalities in the exporting activity of Spanish and North-American firms, respectively.

Be that as it may, the presence of barriers against entry, even in the absence of externalities, would justify some type of public policy. However, instead of subsidies, it would be more appropriate for measures that reduce directly asymmetry of information. For example, marketing promoting the country as a producer of quality goods and invest in certifying our products.

4.5. Externalities of Foreign Direct Investment

Many countries have made use of policies to attract foreign direct investment with the justification that there exist externalities associated with this type of activity. Basically, multinational firms could generate spillovers to domestic firms through three channels: (i) generating externalities in the export activity; (ii) increasing competition in the local market; and (iii) transferring technology and organizational methods.²² The first channel was evaluated in the subsection above, and the evidence does not favor it. The second channel has not been the object of theoretical or empirical studies, with the exception of Greenaway, Sousa & Wakelin (2004) [see preceding subsection]. Anyway, other instruments exist that are

²¹ Aitken, Hanson & Harrison (1997) interpret their result as evidence of spillovers in the exporting activity of the multinationals. However, the fact that proximity with multinationals increases the likelihood of exporting does not necessarily mean that there exist externalities associated with the exporting activity in itself, but rather that the presence of the multinationals generates some type of externality that indirectly facilitates exporting by domestic firms. This externality can be generated, for example, by increasing the productivity of the domestic firms by means of transferring technologies and more modern organizational models.

²² Another argument used by different governments to justify promoting foreign direct investment is the creation of jobs. As pointed out by Rodriguez-Clare (2004a), if this is the case, it makes no sense to discriminate between foreign and domestic investment. Furthermore, there are more adequate policies to deal with the unemployment problem (see section 5.1).

more appropriate than promoting foreign direct investment to guarantee and strengthen competition in the domestic market, especially a policy of opening the economy to international products.

The third channel deserves more attention. From the theoretical point of view, several authors stress that externalities are only appropriated by domestic firms under certain conditions. The model presented in Rodriguez-Clare (1996) emphasizes spillovers generated by the domestic suppliers and clients of the multinationals. In this case, externalities are greater when intermediary inputs are employed intensively and when the cost of communicating between the plant and headquarters of the multinational is substantial. Furthermore, the more developed the country that receives the foreign direct investment, the greater the effect. Nonetheless, as in Rodrik (1996), it is assumed that intermediary inputs cannot be obtained in other countries. In a framework in which these inputs can be bought abroad, the externalities created by the multinationals tend to be smaller. In this way, any eventual policy to promote foreign direct investment should be kept focused on sectors in which it is more difficult to import these inputs.

The model in Alfaro, Chanda, Kalemli-Özcan & Sayek (2003) derives that the spillovers of the multinationals are put to greatest advantage in the presence of a market with developed domestic credit. This is corroborated by the empirical evidence provided by the same authors. Thus, should it be the government's intention to stimulate foreign direct investment, this policy should be matched with interventions that increase financial intermediation in the domestic sphere.

Note that the empirical evidence indicates that foreign direct investment increases the productivity of domestic firms only if the stock of human capital is big enough [Borensztein, De Gregorio & Lee (1997) and Xu (2000)]. In this case, industrial policy to promote foreign direct investment can be combined with investing in education and training or with keeping the focus on sectors in which there already exists a reasonable number of skilled workers.

Nevertheless, as pointed out in Alfaro & Rodriguez-Clare (2004), the evidence of the existence of externalities of the activity of multinationals in relation to their domestic rivals (horizontal externalities) is not very conclusive. On the other hand, the signs of the presence of externalities in relation to domestic suppliers (vertical externalities) are stronger. However, as they use the model presented by Rodriguez-Clare (1996) as their basis and as many of their premises cannot be taken into account with the data used, the authors themselves view the results with a certain skepticism. In this sense, rather than suggesting policies to stimulate foreign direct investment, policies are put forward that are designed to do away with the

barriers that prevent domestic firms from building relationships with the multinationals, improving access to inputs of better quality, credit and technology. Furthermore, given the obstacles to direct investment (both foreign and domestic), it makes more sense to introduce policies to diminish them than some kind of subsidy.

5. Assessment of Brazil's Current Industrial Policy

It is clear that any vertical policy should be related to some market failure, and empirical evidence suggests that some types of market failure are more relevant than others. On the one hand there is no evidence of the existence of externalities related to the learning of firms. Nor do distortions associated with self-discovery seem relevant to a country in Brazil's stage of development. On the other hand, the externalities resulting from innovation, foreign direct investment and, with many qualifications, those related to industrial agglomeration (clusters) do seem relevant. Although it remains unclear whether there exist externalities in exporting activities, the existence of barriers against entry is *per se* a justification of some sort of policy.

This being so, the next step is to identify which policy is most adequate to correct each type of market failure. In this aspect, the preceding sections provide some important lessons. Firstly, government intervention should be of a temporary nature and cease once the distortion that caused the policy has been eliminated. As a matter of fact, the Brazilian experience with industrial policy is quite illustrative in this respect (see subsection 2.3). In this aspect, the industrial policy currently in place in Brazil [Brasil (2003)] appears to be on the right path, insofar as it proposes the adoption of temporary limits to government intervention and performance goals for the firms and sectors contemplated.

Secondly, policies that distort relative prices in the intention of reallocating resources to certain sectors are not recommended in most cases. It makes more sense to get rid of the distortion directly. For example, if there are barriers against entry in the export activity, these should be mitigated using policies that reduce the initial cost of exporting rather than by subsidizing exports. Once again, the industrial policy pursued by the present government does the right thing in proposing measures of external insertion in keeping with this guideline: simplifying procedures, seeking markets, stimulating the creation of distribution centers of Brazilian companies abroad and their internationalization, and supporting the consolidation of the image of Brazil and Brazilian trademarks overseas [Brasil (2003), p. 13].

Thirdly, the role of the activity of innovation is extremely important. Investment in research and development generates spillovers and evidence shows that the activities that benefit from externalities associated with industrial agglomeration are precisely those in which innovation and knowledge are important. It does not follow, however, that industrial policy must necessarily be geared to new sectors with high technological content. Instead of looking for new opportunities for investment in “advanced” sectors, it would make more sense to incentive industrial agglomeration in sectors where the country has already shown comparative advantage [Rodriguez-Clare (2004b)].

Note also that these externalities are likely to be greater if the research and development activity is carried out by universities and public research centers, always with a market orientation. In this regard, Embrapa fits the prescription perfectly: a public enterprise engaged in research directed towards sectors in which Brazil possesses comparative advantage. Also worthy of praise is Law 10.973 (Law of Innovation), which among other things facilitates coordination between universities, research institutes and private companies, enabling these agents to set up partnerships to create new products and processes.

On the other hand, the choice of strategic sectors by Brazil’s current industrial policy seems to be based precisely on criteria of technological content, without any very solid economic justification [see Brasil (2003), p. 17-22]. This theme will be taken up again in subsection 5.2.

5.1. Goals and Objectives

Brasil (2003) identifies the goals and objectives of industrial policy: (i) generation of employment; (ii) expansion of exports; (iii) regional development; (iv) improvement of efficiency of production and capacity of innovation. Brief comments will now be offered on each of these objectives.

With regard to generating employment, it should be remembered that unemployment has a cyclical component related to economic activity. In this case, industrial policy is hardly adequate, inasmuch as its focus is long-term [Ferreira & Hamdan (2003)]. Hence, the question of employment should be treated with measures that increase the degree of formalization in the economy (changes to labor legislation and reforms to the credit market, for example) and the productivity of labor (education and training, for example).

Besides this, the strategic sectors (see subsection 5.2) are precisely those that are little labor-intensive, which would have a small impact on employment. Indeed, “traditional” sectors not contemplated in Brasil (2003), such as agriculture and cattle-raising and services provided to families, feature among those with greatest potential to generate jobs [Najberg & Pereira (2004)]. One possible beneficial effect of keeping the focus on human capital-intensive sectors would be to raise the remuneration of this factor of production by increasing stimulation of skilled labor. Nonetheless, Brazil already presents very high return rates on investments in education [Holanda-Filho & Pessoa (2006)]. Low investment is the result of deficiencies in the public school system and flaws in the credit market, which are not dealt with in Brasil (2003). Finally, it must be remembered that the use of employment –generating goals can lead to industrial policy benefiting inefficient companies for the simple reason that they generate a certain number of jobs.

As regards using industrial policy to combat foreign restrictions on the Brazilian economy, it is worth remembering that, as pointed out in Amadeo (2002), the literature does not highlight obtaining trade surpluses as one of the objectives of industrial policy. Furthermore, if there are no market failures or significant macro-economic problems, the exchange rate tends to send the correct signal concerning the need for foreign currency, that is, the correct signal about the social benefits of exports. In this way, export-subsidizing policies, even though they increase the inflow of foreign currency, tend to generate a smaller allocation of resources and social security losses [Rodriguez-Clare (2004a)]. In respect to this, there are signs that in the case of Brazil the volume of foreign trade is quite sensitive to the exchange [see Ferreira (2005) for references], which indicates that there is no reason for public interventions.²³

As for the use of industrial policy to resolve regional differences, here too it does not seem to be the most appropriate option. There is evidence that the differences in *per capita* income between the Brazilian regions are mainly due to educational disparities [Duarte, Ferreira & Salvato (2004)]. Based on this diagnosis, it therefore does not make much sense to use industrial policy to promote regional development: public policies directed towards education would be more fitting. In fact, if there is a concern to use local externalities that enable the formation of clusters, there is no reason to stimulate innovation in firms located in remote or isolated regions [Rodriguez-Clare (2004a)].

²³ For a suggestion on the use of IP to overcome the problem of external restraints, see Além, Barros & Giambiagi (2002).

Finally, concerning the increase of efficiency of production and capacity for innovation, the preceding sections indicate that these are objectives to be pursued to the extent that they are related to increases of productivity of the economy. Nevertheless, this calls for some comments. From the businessman's point of view, it is always optimal to use the best techniques from the economic point of view. If there is a technique that raises the firm's productivity but has not been chosen, this is because from the point of view of the expected profitability the investment is not attractive. The exception to this is when there is some restriction on credit. In this case the most appropriate thing would be to correct the distortions of this market. This seems to be part of the diagnosis presented in Brasil (2003), especially with regard to small and medium companies facing restriction of capacity and technological lagging. However, it is appropriate to wonder if a greater impact on the credit market, for example, would not be achieved by reducing the need for government financing instead of approving "legal instruments to facilitate obtaining financing through business consortiums and the like" [Brasil (2003), p. 16].

Once again, it is worth recalling that the emphasis on innovation does not necessarily mean keeping the focus on "cutting-edge" sectors, but rather increasing the productivity of sectors in which we have comparative advantages.

5.2. Strategic Sectors

In addition to more general prescriptions, Brasil (2003) selects strategic sectors on which industrial policy efforts should concentrate. The sectors selected are: semiconductors, software, pharmaceuticals and medications and capital goods. These sectors were chosen because: (i) they present growing and sustainable dynamism; (ii) they are responsible for expressive portions of international investments in research and development; (iii) they open new business opportunities; (iv) they are directly related to innovation of processes, products and forms of use; (v) they promote "intensification of the productive fabric"; (vi) they are important for the country's future and they present the potential for developing dynamic comparative advantages. Comments are offered below on each item.

Concerning item (i), at no moment is it made clear what makes a sector more or less dynamic, nor what the term means. As regards item (ii), the fact that other countries invest in research and development in these sectors does not mean that Brazil should do so. The developed countries probably invest more in these sectors precisely because they are human-

capital intensive, in other words because of their comparative advantages. As pointed out in the preceding sections, Brazilian comparative advantages recommend investments in sectors that are intensive in other factors of production. In this sense it comes as no surprise that the example of success mentioned in Brasil (2003) is precisely the case of Embrapa, where investments in innovation are closely related to agribusiness, a sector in which we possess comparative advantage.

Furthermore, let it not be forgotten that the choice of strategic sectors that are human-capital intensive, a scarce factor of production, tends to raise the salary of skilled workers, thereby increasing even more the already high inequality of Brazilian incomes [Ferreira & Hamdan (2003)].

With regard to item (iii), it remains unclear why these sectors open up more business opportunities than others. Would the production of soy and other activities in which Brazil has an acknowledged comparative advantage not open up new business opportunities?

In item (iv), there is obvious confusion between the emphasis on innovation and the focus on “advanced” sectors. The fact that there is theoretical and empirical evidence that investments in research and development should be the object of some type of public policy does not mean that industrial policy should privilege “cutting-edge” sectors. As pointed out in section 4, it is more appropriate to contemplate sectors in which the country has shown that it possesses comparative advantages, which is not the case of the strategic sectors listed in Brasil (2003).

As in item (i), in item (v) it is not clear what precisely is understood by “intensification of the productive fabric”, nor why such sectors promote more intensification than others, or why such intensification is desirable. But if intensification means producing locally most of the input materials in a productive chain, one wonders whether there is any economic rationality in doing so. Inasmuch as these inputs have different compositions and intensities of factors, Brazil would hardly enjoy comparative advantage in producing all of them [Ferreira (2005)]. So, would it not be more reasonable to buy part of these input materials from countries that are able to produce them more efficiently? This argument becomes all the more appealing when one takes into account the diagnosis that Brazil does not need policies to stimulate self-discovery and diversification, but rather to increase productivity in sectors where comparative advantages have already been revealed [subsection 4.2 and Rodriguez-Clare (2004a)].

Finally, item (vi) offers two criteria of choice. The first of them is that sectors are important for the country. The statement calls for some justification in that it fails to explain

what makes one sector more or less important than any other. The second is that these sectors create dynamic comparative advantages. Dynamic comparative advantages are associated with the learning of companies, which enables the cost of production to decrease over time. However, even in this case, public intervention is only justified in the presence of externalities related to this learning, that is to say, if the firms benefit from the learning of the others (see subsection 4.1). Moreover, an assessment has to be made as to whether the cost of such an intervention exceeds the benefits. At no moment is evidence presented in this respect. Indeed, in the semiconductors sector, international empirical evidence points to the non-existence of externalities.

6. Final Considerations

In view of the discussion in the previous sections, what lessons can be drawn in respect to industrial policy in Brazil? In the first place, the argument that Brazil should introduce sectorial industrial policies because other countries have done so and met with success is wrong. Recurrently mentioned examples are the countries of East Asia. Nevertheless, it is worth remembering that several other countries have had experiences with IP with disastrous results. Furthermore, besides sectorial interventions, countries such as Japan, South Korea and Taiwan have also used horizontal policies so that one cannot ignore their important role in the development of those countries.

So the question remains: if various countries of East Asia used industrial policy but also kept inflation under control and public accounts healthy and invested in education and infrastructure, then why credit the performance of these countries to sectorial interventions rather than to horizontal policies? Why should the solution to Brazil's poor economic growth have to include vertical policies - the efficacy of which is not confirmed by empirical evidence even for countries held to be examples of the success of the use of IP - when the experience of other countries supports the use of horizontal policies?

Secondly, sectorial policies have to be motivated by some sort of market failure. In this case, one basic premise of vertical industrial policy is to identify and measure these failures so that more appropriate policies can be elaborated. In fact, authors such as Moreira (1994) attribute the failure of Brazil's IP to precisely the inability to identify and correct such flaws. Although it has some positive points, Brasil (2003) often errs exactly because it repeats this mistake. Moreover, even when such market failures actually exist, in most cases

the most indicated instruments are horizontal policies: investments in infrastructure, definition of the proper legal framework, certification of products, reforms to the credit market and investments in education. Indeed, in the Brazilian case, this diagnosis is shared even by authors who in general defend some form of industrial policy [see Hausmann, Rodrik & Velasco (2004), for example].

Note that the problems concerning government failures and capture in implementing sectorial policies were not even emphasized. To what extent is the government able to choose correctly the sectors contemplated by the IP?²⁴ Even if it is capable, what is there to guarantee that this choice is not motivated by pressures from organized sectors? Brazil's history in IP (and even in other types of policy) is not very heartening in this respect. As a matter of fact, even in the countries mentioned as being successful in implementing industrial policies, various problems of corruption and capture on the part of the government have been documented [Nolland & Pack (2003)]. Hence, although there may be (theoretically) room for some type of sector intervention, the emphasis in Brazil should be put on horizontal policies. Besides being less vulnerable to problems of capture, these tend to yield bigger gains in terms of productivity and growth.

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²⁴ See Pack & Saggi (2006) for a discussion about the enormous informational requirements necessary for the correct implementation of industrial policy by governments.

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Appendix

Supposing a Mincerian specification for education, product per worker may be written as:

$$y = Ak^\alpha (e^{\beta h})^{1-\alpha},$$

where α is participation of labor in income and β the Mincer coefficient associated with average years of schooling of the labor force.

Let κ be the capital-product ratio. It is possible to write the aggregate long-term function as $y = Ae^{\beta h} \kappa^{\frac{\alpha}{1-\alpha}}$. Consequently, the income differential between two countries attributed to the education differential is given by $e^{\beta h}$. In the exercise, the conservative value of 0,07 is supposed for the Mincer aggregate rate of return [see Topel (1999) and Krueger & Lindahl (2001)]. All the data are for 2000. The average years of schooling of the labor force (h) were obtained from Barro & Lee (2000). The data on product per worker are from Heston, Summers & Aten (2002). Table 3 reports the statistics $100 \frac{e^{\beta(h-h_{BR})}}{y / y_{BR}}$, in which the subscript BR indicates values relating to Brazil.