The Telecommunications Restructuring Process in the 90s: A comparative study of the impacts on the Brazilian and Spanish innovation system

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1 - Introduction

The national innovation system (NIS) approach brings an alternative to the traditional view of innovation as a process of radical change in frontier sectors. The NIS approach offers a conceptual instrumental extremely useful for the understanding of the innovation dynamics at local, regional and national levels. However, as emphasized by Cassiolato and Lastres (2000), there are some specificities in the less developed world that should be taken into account if we want to use the concept of NSI in the context of these economies. The instability of the macroeconomic, political, institutional and financial environment, the different historical institutional development and the very systemic and structural relationships between developed and developing economies are among these specificities[2].

The macroeconomic environment in developing countries has proved to be an important constraint to technological development in these countries. In the last decades, most of the firm's technological strategies in developing countries have

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[2] The discussion about the specificities found in the less developed countries regarding the use of the NSI concept can be found in Lastres, Cassiolato and Maciel (2003), Cassiolato and Lastres (2000) and Arocena and Sutz (2000).

been more affected by macroeconomic policies than by specific innovation policies (Cassiolato, 1992).

Also important is the instability of institutional frameworks supporting the innovative activities in developing countries. An important part of the innovative efforts in developing countries comprises a lack of interaction between the actors of the systems of innovation at different levels (local, regional or national).

This paper is part of a D.Phil thesis, which aims precisely at examining the idea of National Innovation System in the context of a developing country, namely Brazil. In particular, the study aims at comparing the transformations brought by the institutional and regulatory changes in Brazil and in Spain during the 1990s to their telecommunications innovation system. The specific objective of the paper is to analyse the impacts of these restructuring processes on the national innovative and productive building capabilities in telecommunications.

There are two reasons why this comparison between Brazil and Spain is done. Firstly, is the fact that Telefonica is actually one of the main fixed and mobile services suppliers in Brazil. Also important is that this firm, during the Telebrás[3] privatisation process, bought the fixed services concession area of São Paulo, the major state of Brazil and where the telecom innovation system was concentrated. The second reason that influenced this comparison is that, in the end of the eights, the two countries had similar situations in the telecommunications sector. This means that both of them faced investment

[3] Telebrás was the Brazilian state owned holding for telecommunications services supply and was privatised in 1998.

constraints in the network and a significant part of demand was not satisfied by the national services supplier.

The next section will briefly discuss the main aspects regarding the theoretical framework used in the PhD Thesis. Section three analyses the development of the telecommunications innovation system in Brazil, the main results achieved by this system and the impacts that came with the restructuring process. Section four discusses the liberalization processes implemented in Spain, the internationalization of Telefonica and its impacts on the Spanish innovation system. Finally, section five presets the preliminary conclusions of the paper.

2 - Theoretical Framework

The D.Phil thesis draws on two major theoretical approaches found in the neo-Schumpeterian literature in order to analyse the impacts of the recent technological and regulatory transformations of the telecommunications sector.

Firstly, the paper makes use of the NIS concept (Freeman, 1987; Lundvall, 1992; Nelson, 1993), and applies this concept to understand the impacts of the recent transformations of the telecommunications sector on two specific national innovation systems: Brazil and Spain.

The second approach used in the paper is related to the analysis of the recent transformations in the telecommunications industry, particularly as stressed by Martin Fransman (2002). The departing point for this approach relates to structural changes in the telecom industry, resulting from both the globalisation process and technical change. These changes begun when the first measures

towards liberalisation of the telecom services markets were implemented in US, UK and Japan. The technological dimension of these changes is related to the new set of influences based on Internet technologies, which brought about fundamental transformation that further altered the telecommunications industry. The new global structure of the telecom industry, which resulted from these technological and regulatory transformations, has some essential differences regarding the previous one[4].

However, the globalisation did not modify significantly the organisation of the innovative activities of the telecommunications industry. The R&D activities of the incumbents and of the equipment suppliers are still concentrated in their home countries. Some of the incumbents from the developed countries have been establishing small laboratories outside their home countries, but none of which plays a significant role in the company's overall R&D (Fransman, 2002).

Therefore, there is no doubt that the roles of the main agents of the telecommunications industry have changed as far as the organisation of the sector has been deeply altered by the liberalisation and privatisation processes at the international level. Nevertheless, and given the strategic character of the telecommunications sector for the competitiveness of the economy, the national dimension of the investment in innovative activities of the equipment suppliers and the incumbents was maintained, even during and after the restructuring process of this industry (Szapiro and Cassiolato, 2003).

[4] Of special interest for this paper is the fact that the R&D intensive activities have moved from the incumbent telecom operator to the specialist telecommunications suppliers, particularly to the equipment suppliers. This shift implies that the incumbent operators have been diminishing their R&D effort and also that the new carries (the so called new entrants) do not need to have internal R&D and innovation capabilities to supply services in the telecom industry (Fransman, 2002).

Moreover, on the one hand, most of the developed countries still maintain the promotion of telecom productive and innovative capability building in their policy agenda. On the other hand, for the larger Latin America countries, that do not have anymore neither a nationally owned carrier providing services nor a nationally owned equipment producer (they are now mostly MNCs subsidiaries), the impacts of the structural reforms on the telecom productive and innovative capability building process have been harmful.

In this context, the next two sections will briefly analyses the main aspects regarding the telecom-restructuring strategies adopted by Brazil and Spain and will discuss its principal impacts on the two innovation systems.

3 - Development of the Telecommunications Innovation System in Brazil and Impacts of the Restructuring Process

The Brazilian telecommunications innovation system was originated in the early 1970's and was mostly concentrated in Campinas, a medium-sized city in the state of São Paulo. The system was the result of a set of federal government policies aiming at deploying in Brazil a technological and industrial structure for high technology areas[5].

As a result of these policies, throughout the 1980s industrial structure producing telecom goods was developed. This was remarkable since the 1980s was a period when the overall performance of the Brazilian economy was very poor.

[5] Cassiolato et alli, 2001, Doria et alli, 2000 and Szapiro, 1999 provide more detailed analysis and information on the origins of this system.

Government policies stimulated the increase in locally added value. Assemblage activities with imported inputs gave way gradually to local production. At the end of the 1980s, 90% of added value was produced locally (Pessini, 1993). In some cases, this was achieved by technologies developed locally in co-operation with other Brazilian institutions, like CPqD and university centres.

By the end of the 1980s, a telecommunications innovation system was established in Brazil. R&D Centre of Telebrás (CPqD) represented the cornerstone of the system. Local universities played an important part. Almost all big telecom multinational subsidiaries had facilities within the country. More than 40 locally-owned firms were established in less than a decade. These firms were deeply engaged in technology development.

At the central stage of the system was CPqD. It was set up in 1976 in Campinas, as part of a larger movement, which intended to transform that region in a high technology centre. CPqD's main objective was to develop strategic expertise and capabilities for the Brazilian telecommunications system, in conjunction with local universities, telecommunications equipment producers and carriers.

One of the most important results of these processes was the establishment of a large network of local suppliers. In 1982 there were approximately 120 local firms, responsible for approximately 17% of the market (Hobday, 1984). Although the most important technology effort of the sector was at CPqD, local firms engaged in joint collaborative technological development with CPqD, universities and other firms.

The development of the innovation system brought many benefits for the telecom sector. The share of locally developed products in the total market for electronic

equipment steadily increased, from an average of 4% during the 1980s to 14% in 1996. As pointed out by Hobday (1990) 'CPqD has developed virtually from scratch a range of digital exchange systems designed not only to suit Brazil's tropical climate, but also the particular types of telephone traffic conditions found in the various regions. CPqD's close relationship with industry has enabled technology transfer and joint development with local firms in exchange, transmission and peripheral telecom technology' (p. 19) and 'there can be little doubt that in the areas of industrial and technological progress in digital telecom Brazil was, in the 1980s, leading the Third World, mostly as a result of the policies adopted after 1974' (p. 19-20).

The results were also significant in terms of price reduction of key products. Prices of installed terminals which averaged US$ 800 in 1987 fell to approximately US$ 200 in 1993 (Szapiro, 1999). It resulted in a significant reduction in the investment costs of building a telecommunications network in a large country (Mytelka, 1999). In the early 1980s, before CPqD was developing local technologies, the costs of setting up such a network in Brazil would have been exorbitant since the smallest exchanges being built internationally could accommodate many more lines than the needs of small towns and rural areas; they would certainly be under-utilised. As Mytelka (1999) pointed out, 'given the debt crisis and the decline in import capacity that this engendered from the mid-1980s on, there was little likelihood that Brazil could have significantly increased the speed with which its network was expanded and digitalized in the absence of the TDX programme that provided cheaper, more appropriate and technology intensive, digital products' (p. 145). In this sense, CPqD was seen as one

exception in terms of successful laboratories in developing countries (Hobday, 1990).

From the 1990s on the Brazilian policy agenda was substantially altered (as in the case of most Latin American countries). Many structural changes were implemented in the Brazilian economy and this affected the telecommunications innovation system. The changes involved mainly trade liberalization, break up of the state monopoly and the privatization of Telebrás.

It is important to highlight that, in general, the telecom structural reforms were implemented mainly with the implicit idea that the entrance of foreign direct investment (FDI) brought by multinational subsidiaries, would promote the necessary investment in the modernisation of the equipment industry and the services supply[6].

The preliminary evidence in Brazil shows that the privatisation process[7] and the absence of sectoral policies made a great pressure on the increase of telecom equipment imports until 2001 (when the international crisis in the telecommunications sector became stronger in Brazil) and, therefore, on the deterioration of the trade balance. The process of denationalisation of the telecom equipment industry, which resulted from the privatization process also contributed to the aggravation of the problem of the trade balance. The market share of the nationally owned firms decreased from 41,5% in 1997 (one year before privatisation) to 8,7% in 2000 (Oliva 2002) as can be seen in the table 1.

[6] A more detailed analysis of the liberalisation and privatisation of the Brazilian telecommunications sector and its impacts can be found in Szapiro, 1999; Cassiolato et alli., 2002; and Szapiro, 2003.

[7] The privatisation of Telebrás was in 1998. Nevertheless, the process of preparation for the privatisation of Telebrás began in 1995. At this moment, the holding Telebrás invested a huge amount of resources in the

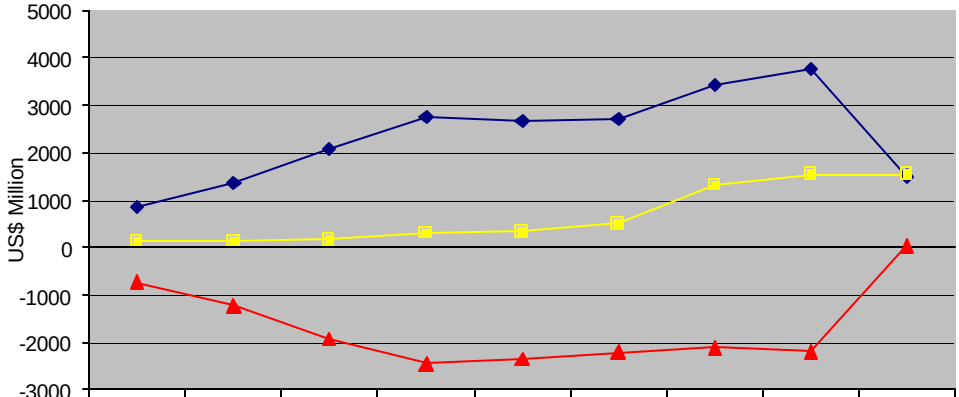
Table 1: Market Share of the main suppliers of telecom equipment in the Brazilian market, by origin of capital (*)

Year	1988	1997	2000
Market share of the nationally owned firms	77%	41,5%	8,7%
Market share of the foreign firms	23%	58,5%	91,3%

Source: Oliva, 2002 .
(*)The concept of nationally owned and foreign firms is based on the control of voting capital criterion.

The outcome of these processes can be seen in figure 1.

Figure 1: Trade Balance of Telecommunications Equipment Industry



	94	95	96	97	98	99	2000	2001	2002
Import	855	1360	2088	2753	2682	2711	3435	3753	1511
Export	124	130	154	288	330	494	1311	1552	1547
Trade Balance	(730)	(1.230)	(1.933)	(2.464)	(2.353)	(2.217)	(2.124)	(2.201)	37

Source: Elaborated by the author based on data from BNDES.

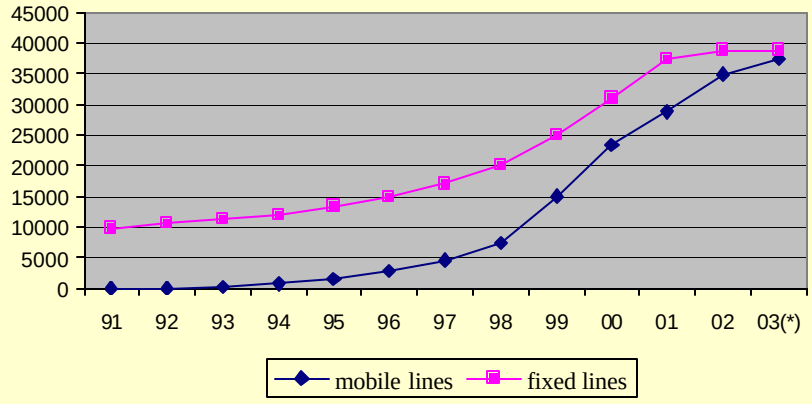
In addition to this, the Brazilian multinational subsidiaries have been changing their role and are concentrating in doing product adaptations to local market and in the development of local products (Galina, 2003). This is especially harmful if one takes into account what Hobday emphasised in his works (Hobday, 1984 and 1990). He observes that one of the most interesting achievements of the

expansion and modernisation of Brazilian telecommunications sector. This movement put a great pressure on the growth of telecom equipment import, which was aggravated by the privatisation.

telecommunications innovation system in Brazil during its development had been the gradual involvement of MNCs subsidiaries, which started to interact and cooperate with CPqD, the university system and local firms.

It is worth to note that, from the point of view of the services supply, the privatisation resulted in a significant increase in the number of mobile and fixed lines, as can be seen in figure 2.

Figure 2: Evolution of fixed and mobile lines in Brazil
(in thousands)



(*) until may 2003
Source: Anatel (The National Regulatory Telecommunications Agency – www.anatel.gov.br)

4 - Internationalization and Privatization Processes of Telefonica and its impacts on the Spanish Innovation System

The internationalization process of Telefonica began in the end of the eights. The main objective of Telefonica was to become a global carrier. At that time, a group of Telefonica's managers noticed that the telecommunications liberalization process that began in the US, UK and Japan would spread all over the world. In this sense, Telefonica's monopoly would be broken and it would have to compete with other carriers in the Spanish market. The incorporation of Spain in the European Union (EU) put more pressure on the internationalization effort of the company, given that, after liberalization, it would have also to compete with strong European monopolies in the European market.

All this process was happening exactly at the same time that the privatization processes in Latina America were being implemented (the liberalization of the telecommunications market in Chile and Argentina began in the early nineties). The privatization of state telecommunications monopolies in Latin America represented great opportunities for the Telefonica's internationalization strategy.

The telecommunications liberalization process in Spain began in the mid eights, when Spain was incorporated in the EU, and when Telefonica was in the beginning of its internationalization strategy. In fact, the main liberalization measures in the equipment industry and in the services supply were implemented in the beginning of the nineties.

It is worth to mention that at the time of privatisation, Telefonica was not anymore a public enterprise. In this sense, Telefonica holds some differences regarding other state telecommunications monopoly. It was never directly dependent upon the government budgets, but before the privatization the Spanish government had 31,86% of the capital of Telefonica. In this sense, Telefonica could be characterised as a "state run" monopoly, as opposed to a "state owned" monopoly (Rama et alli, 2002). Nevertheless, until 1995, the Spanish government had a great influence on the strategies adopted and decisions taken by Telefonica, and also used to choose Telefonica's president.

The privatisation of Telefonica began in 1995, when the government sold 10,7% of the capital. In 1997, the government sold the other 21,16% of the capital, but remained with the Golden Share for the ten years after (until 2007). According to López (2003), the government still decides who will be company president and approves any mergers that may take place.

In fact, the main impacts of the recent restructuring process in Spain on the innovation system are related to the internationalization of Telefonica.

According to López and Molero (2004), the internationalization of Telefonica stimulated the internationalization of some small and medium Spanish equipment suppliers. This internationalization took place both through increases in exports and through foreign direct investment in some Latin America countries.

In a sample of five Spanish equipment suppliers and three multinational subsidiaries[8], López and Molero (2004) found that in 2000 almost 40% of the production of the Spanish firms was exported.

It is worth to mention the case of the internationalization of Amper, a Spanish medium telecom equipment supplier that acquired a Brazilian firm, Medidata, which has been working on the telecommunications sector in Brazil for more than twenty years.

In fact, Telefonica is the key agent of this innovation system and has been playing a fundamental role and influencing the innovation process in the telecommunications and electronics sector[9].

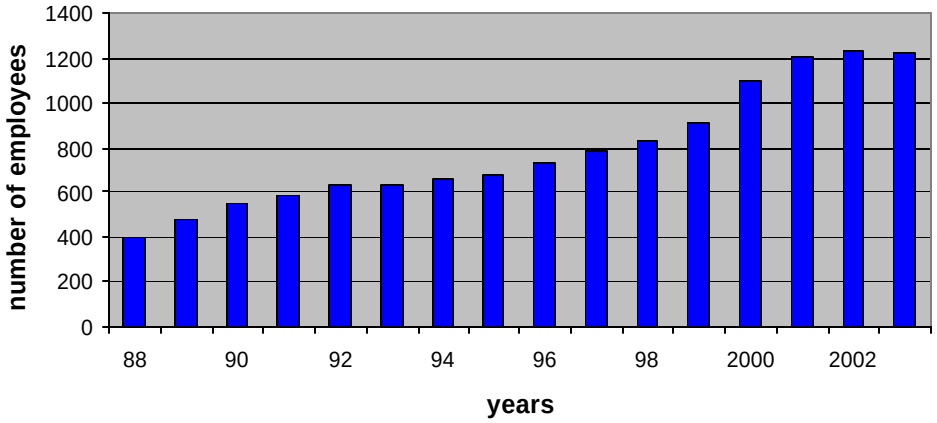
Also important is the role played by Telefonica I+D (Investigación y Desarrollo), which is one of the biggest Spanish R&D firm. It makes part of Telefonica's group, and also works as a "client" for the Spanish components and equipment firms.

[8] The Spanish firms are: Teldat, Mier, Eliop, Amper and Telefonica I+D. The multinational subsidiaries are Siemens-Elasa, Lucent Technologies and Alcatel.

[9] During the 70s and 80s Telefonica created an industrial group, composed by many national and international equipment suppliers. Telefonica held approximately 50% of the capital of firms like Telettra, Marconi and Ericsson, among others. During this period, Telefonica was the "state run monopoly" carrier and used to have a great influence on the innovation process of the telecommunications sector. That is why some authors classified Telefonica's policy as an "active industrial policy".

Telefonica I+D has been deeply affected by Telefonica's internationalization process, which can be seen in the figure 3 that shows the increase in the number of employees of Telefonica I+D.

Figure 3: Growth of Telefonica I+D



Source: Field research (Telefonica I+D).

Most of the innovation effort of Telefonica I+D is determined by the Telefonica expansion strategy, which affects indirectly especially the Spanish equipment firms. When Telefonica acquires a national operator, Telefonica I+D supplies some of the technological demands of Telefonica. The Spanish firms supply many software systems to be applied in the new network and some equipment[10] demanded to be used in the new operator.

In this sense, the Spanish firms join Telefonica's expansion strategy, supplying specific components and services to the national market where Telefonica begins operating. Telefonica establishes the export base and facilitates or negotiates the services and products of the Spanish firms which would like to operate in overseas markets (López and Molero, 2004).

The internationalization process of Telefonica has also affected the multinational subsidiaries, but in a different way from that of the Spanish firms. The innovation strategy of the multinational subsidiaries does not depend on Telefonica's

[10] López and Molero (2004) gives some examples of these equipment, related to public telephony and small switching systems developed by Spanish firms with national technology.

expansion strategy. It depends on each group strategy and also on the global operators' demand, in which group Telefonica is included. The Spanish subsidiaries' activities are inserted in a global strategy and the innovation effort is part of the group's global effort.

Nevertheless, it is important to observe that the Spanish subsidiaries acquired a strategic role in their groups due to Telefonica's expansion. In this sense, it is the Spanish subsidiary that coordinates the sales of the group to Telefonica and to its Latin American subsidiaries. They negotiate the equipment sales for many countries directly with Telefonica from Spain. The sales of the multinational groups may be done by a local subsidiary (installed in the country in which Telefonica operates) or globally, but it is coordinated by the Spanish subsidiary. This gives them an important role in their groups and may beneficiate the Spanish innovation system through subcontracting relations and other interactions with the local network of firms and institutions.

5 – Preliminary Results

From the preliminary findings on the Spanish restructuring process it can be noticed that the liberalization process and, most important, the internationalization of Telefonica produced positive impacts on the Spanish innovation system. The growth of Telefonica I+D and the increase in exports of the Spanish SME are examples of these impacts. Also important is the fact that the internationalization of Telefonica encouraged the development of new innovative activities in Spain (Rama et alli, 2002)[11].

Although it was the internationalization of Telefonica which stimulated this improvement in the innovation system, there are some industrial, technological

[11] This could be observed throughout the expansion R&D facilities of the multinational subsidiaries in Madrid (for example, Ericsson and Lucent) and also throughout the increase in the number of researchers in

and innovation policies that have been implemented by the Spanish government which gave the necessary support for the Spanish firms to internationalise. Of special interest were the instruments directly related to the internationalization of Spanish SME[12].

In Brazil, the telecom structural reforms were implemented mainly with the objective of maximising the entrance of foreign direct investment in order to promote the modernization of the national firms and the increase the competitiveness of the economy. Although there have been increases in investment and in number of fixed and mobile lines, the impacts of those changes on the innovation system have been harmful. There has been a strong process of acquisition of dynamic nationally owned firms by multinational subsidiaries and an aggravation of the trade balance deficit. The main telecommunications R&D laboratory had reduced its innovation activities and has been facing a long period of uncertainty.

The preliminary conclusion of the paper shows that the different strategies adopted by the two countries (Brazil and Spain) produced different results for their innovation systems. In Brazil, although there has been a significant increase in the number of mobile and fixed lines, the privatisation and liberalisation processes of the telecommunications services weakened the innovation system, while in Spain the innovation system has been strengthened by those changes.

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the Telefonica R&D centre (Telefonica I+D). According to Rama et alli. (2002), the staff of Telefonica I+D grew from 300 researches in 1988 to 1208 in 2001.

[12] It is important to study the influence of the Spanish industrial, technological and innovative policies and also the European support programmes on the strengthening of the Spanish innovation system. It is one aspect that will be deeply analysed in the PhD thesis. Nevertheless, from the field work it could be observed that those policies have had a significant impact on the internationalization of the Spanish firms and on the increase of their innovative investment.

A comparison between the strategies adopted in Brazil and Spain may also confirm that the policy agenda behind the structural reforms in the telecommunications sector influences enormously the impacts over innovative strategies. Rather, the experience of Spain shows that the adoption of specific policies aiming at strengthening the telecom innovation system and at promoting productive and innovative capabilities building proves to be more effective. On the opposite side, the main findings in Brazil demonstrate that, in the absence of sectoral policies, FDI and the multinational subsidiaries by themselves were not sufficient to foster the increase of competitiveness.

One of the most important aspects of the telecommunications structural reforms implemented in Spain was the strengthening of the Spanish telecommunications innovation system.

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