

## **THE BRAZILIAN SOFTWARE INDUSTRY\***

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## **The Brazilian Software Industry**

In the course of the nineties, Brazil developed a vibrant, dynamic and large software industry. Experiencing double digit growth rates during the whole last decade, the Brazilian software market, at US\$ 7.7 billion (values for 2001), is the world's 7th larger, comparable in size to the Indian or the Chinese, with the domestic industry accounting for 98% of the total<sup>1</sup>. In the late nineties, the industry employed over 165,000 people in 10 thousand firms. Its share in the Brazilian IT market increased continuously throughout the nineties, becoming the most important segment (including related services) after 2000, surpassing hardware. In spite of recent economic turmoil in Brazil, its software industry has continued to post growth rates above the national industry average and the global software industry. Between 1991 and 2001, its share of the GDP more than tripled to 1.5%.

Although with deeper roots in earlier path-dependent trends, the current industrial pattern dates from developments in the early and mid nineties. In the previous era, an amorphous proto-software industry was characterized by extensive in-house software development activities in both user firms and hardware producers and sellers (Botelho, 1987, 1991). Domestic firms occupied niche interstices and foreign firms mainly provided system products and large applications. Following the liberalization of the Brazilian economy in the early nineties and the economic stabilization that ensued the 1994 Real Plan, reigning in the inflationary spiral and establishing currency parity to the US dollar, a sustained domestic demand for software emerged.

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<sup>1</sup> Brazil has the largest packaged software market and accounts for over a third of the total software market in Latin America.

As local businesses users facing increased foreign competition in their sector markets struggled to survive, they refocused on core business activities and, consequently, began to outsource software development rather than developing it in-house, the prevalent model until then. They also perceived that their superior knowledge of domestic market and production culture over new foreign entrants could have its competitive advantage component amplified by an efficient codification in software systems and applications. This further enhanced their interest in contracting software to an emerging software industry. At the same time, the end of the market reserve policy which framed the regulatory framework for the IT industry in the previous two decades, allowed for a decline in hardware prices that further expanded the market demand for software (Tigre 1992, 1995). In response to the new environment, strategic reorientation ensued and domestic software firms developed new capabilities.

With software exports reaching a mere US\$ 100 million in 2001, the industry's dynamic growth and the shaping of its unique structure has been grounded in the evolutionary path-dependent domestic market expansion and on its accompanying increased sophistication. Although imports have been climbing regularly to US\$ 1 billion in 2001, domestic software firms have maintained an expanding share, particularly in this critical semi-customized products as well as in services, albeit growing at a slower pace there. This reality of the Brazilian software industry stands in sharp contrast with what has been currently discussed as success cases in the context of developing and industrializing countries, the so-called three I's. India, Ireland and Israel have been establishing their international reputation among industry players and academics because of their capability to export in large values and proportions of the total output (Heeks and Nicholson, 2002). This entails a perspective that success breeds and is measured through the capability to export. The question one may pose then is whether a focus on the domestic market

is synonymous of inferior capabilities and reveals an inability to develop an internationally competitive industry, or rather an alternative strategy to prepare and structure the means to enter the more competitive international domains (Sabel and Zeitlin, 1985; Sabel and Zeitlin, 1997).

Brazil is one of the more appropriate settings to explore this question. With a large domestic market and a legacy of inward looking development policies, Brazil may once again be falling under the well-known curse of the domestic market (see, for example Das, Robert and Tybout, 2001). With the perspective of a large market, often protected by local specificities (e.g. language, size) and government policies, Brazilian firms may adopt a satisficing behavior, where their aim is solely to attain and sustain some degree of local leadership. They avoid international presence and competition and, as a result, never structure high-level technical and managerial capabilities that could propel the industry to become a driver of economic growth.

On the other hand, the local or regional market may be thought as the ideal setting to experiment products, structure competencies and test business models capable of sustaining growth and entry in international markets. This may be especially true if local clients have high levels of demand sophistication; and if there is an availability of talent, capital, as well as factor and market competition that force the creation of firm capabilities, even in a local context. Moreover, several authors (e.g. Zysman 2002; Kraemer and Dedrick, 1999, Quinn et al., 1997) have suggested that the diffusion of software use throughout a local economy may be a critical driver of overall productivity growth and an important lever for competitiveness renewal. Thus, a strong leverage in the domestic market for the development of a software industry may generate additional spillover effects in terms of overall contribution for the development of the local economy.

**This chapter looks at the Brazilian software industry under these two lenses. On the one hand, it explores how the strong reliance on the local market can have a stifling effect on the development of the industry.** The historical legacy of inward development and hardware orientation lingers on the software growth path, leaving a generation of IT user organizations and policy makers that consider software a second order concern, with organizations often retaining internal second-class development instead of first rate supply contracts, and policy makers ignoring the needs of the sector. These problems are further aggravated by an immature industrial structure, with young or renewed firms struggling to find an adequate business model and by unstable economic conditions, which led to high interest rates that limited growth. **On the other hand, it discusses how, in some areas, Brazilian software firms have been able to leverage the domestic market to build competitive positions.** The perspective explored sustains that, for the domestic market to act as an incubator of firm capabilities and a platform for international expansion, two complementary conditions must be present. First, lead client sectors for software firms, with demands close to those of leading international firms, must exist. Second, an institutional sector (Hollingsworth, 2000) with incentives mechanisms of competition and selection that force firms to structure capabilities in particular areas, must be enacted in the market. A broader objective is to understand how countries aiming to use the software industry to leverage economic growth may look at the appeal and the perils of looking internally vs. externally as the appropriate driver for the development of the industry.

The chapter is organized as follows. **First**, it reviews the emerging prescription for success in the software industry based on what are regarded as the three lead success cases, India, Ireland and Israel. **Second**, it highlights the key stages and events associated to the development of the software industry in Brazil, and positions the sector in the national industrial context.

**Third**, it elaborates on how the domestic market can act as a curse that stifles the development of the software industry, drawing on examples and cases of Brazilian firms. The **fourth** section discusses how, turning the previous argument upside-down, the domestic sector may also be seen as a driver of success in the industry, seeking to specify the conditions under which this may happen. The **fifth** briefly analyzes the early experiments of Brazilian firms in the global software market. The **sixth** and last summarizes and presents lessons for the development of the industry.

## **1. International players and emerging prescriptions for the development of a software industry**

During last few years, there has been an increasing interest in the growth of the software industry in developing nations (Schware, 1992; Heeks and Nicholson, 2002, Arora et al, 2001, Heeks, 1996; Correa, 1996; Cochran, 2001). Much of that interest has been sparked by the large exports associated to three countries, Ireland, India and Israel (see Table 1). Software is a knowledge intensive industry and, traditionally, only developed nations had significant roles in these industries. Therefore, the emergence of those nations as players in international software caused stir and interest in the business and academic communities. But while exports is certainly an important measure of success, our interest is both in whether or not the industry is playing a role as a driver of economic development in these nations and, if so, is there something to be learned for other developing nations and emerging economies aiming at the same objective.

To have an idea of the relative importance of these industries, Table 1 presents a set of key indicators for the software industry in a range of selected countries. As one could expect, the industry in large developed nations like the US, Germany or Japan, home to the top 20 largest firms in the world, is an order of magnitude larger than in the rest of the nations. Moreover, the value for the US is biased downwards because of the large number of sales done by subsidiaries

of US corporations abroad and not accounted as exports<sup>2</sup>. Nevertheless, one can also note how software has become a large industry in some developed nations, such as India and China, almost double than what is found in countries like Finland or Spain. But these absolute figures for industry revenues are masked by the underlying size of the domestic market. Therefore, a better measure for the relative importance of the industry might be its share of GDP. The results presented in the third column of Table 1 suggest that the software industry represents between 1% and 2% of the economy in most countries. Using such a metric, industries in the three large developed economies remain major leaders, but figures for Israel and Ireland immediately reveal the disproportionate of software relevance for their economies. There is then a second group with shares of GDP above 1.5%, that include countries which have a strong hardware and consumer electronics industry, where software is playing an increasing role, including Singapore, Taiwan, and Korea, as well two newcomers, Brazil and India.

In addition to market size, another variable that is likely to influence the development of the industry is the level of development of a country. Software is considered a high tech industry, which might be harder to sustain in the business environment of less developed nations, regardless of its size. Therefore, to compare the relative sizes of the software industry across countries one would want to account for such a variable, perhaps measured by GDP/Capita, a standard metric of development.

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<sup>2</sup> Existing statistics for software exports by the US are below the 1 billion USD, a number that is clearly disconnected from reality and reflects the difficulty of measuring figures in this industry

**Table 1: Software Market<sup>3</sup> in Selected Countries in 2001**

	Sales (10 <sup>6</sup> USD)	Sales / GDP	Software Industry Development Index <sup>a</sup>	Software Industry Domestic Development Index <sup>b</sup>	Exports (10 <sup>6</sup> USD)	Employees
US**	200,000	2.0%	0.5	0.5	n.a.	1,042,000
Japan*	85,000	2.0%	0.8	0.8	73	534,000
Germany	39,844	2.2%	0.9	0.9	n.a.	300,000
UK	15,000	1.0%	0.4	0.5	n.a.	n.a.
India	8,200	1.7%	<b>7.8</b>	<b>1.9</b>	6,220	350,000
Brazil	7,700	1.5%	<b>2.2</b>	<b>2.2</b>	100	158,000
Korea	7,694	1.8%	1.1	<b>1.1</b>	35	n.a.
Ireland <sup>4</sup>	7,650	7.4%	<b>3.4</b>	0.5	6,500/3,000#	25,000
China	7,400	0.6%	<b>1.8</b>	<b>1.7</b>	400	186,000
Spain*	4,330	0.7%	0.4	0.4	n.a.	20,000
Taiwan*	3,801	1.2%	0.7	0.6	349	n.a.
Israel*	3,700	3.4%	<b>1.8</b>	0.5	2,600	35,000
Finland	1,910	1.6%	0.7	0.6	185	20,000
Singapore	1,660	1.9%	0.7	0.5	476	n.a.
Argentina*	1,340	0.5%	0.4	0.4	35	15,000
Mexico	<1,000	<0.2%	0.2	0.2	n.a.	n.a.

Authors' compilation from various sources; n.a. – not available; \* 2000; \*\* 2002; # Second number excludes Microsoft exports;

<sup>a</sup> Sales divided by the size of the economy, measured by GDP, and its level of development measured through GDP/Capita

<sup>b</sup> Same as complete SIDI index, but only with domestic sales of software.

The fourth column of Table 1 is an overall Software Industry Development index that represents industry revenues divided by country GDP to control for size and then again by GDP/Capita to control for level of development (then multiplied by 10<sup>6</sup> for normalization purposes). This index attempts to measure which countries have been able to develop a software industry far and above their relative economic sizes and level of development. The results

<sup>3</sup> It is important to note that statistics on software are illusive. Depending on the data source, they might include, or not, software related services, as well as sales of foreign developed software in a particular region (e.g. Microsoft office in Ireland). Most of the sources are not very specific about what they include. Therefore, these values should be interpreted as proxies for the industry, though not definite numbers.

<sup>4</sup> The fact that giants like Microsoft and Oracle use Ireland as a basis for sales for their European Union sales – because of the lowest tax rate in western Europe – significantly distorts results. For example, eliminating Microsoft exports would change share

confirm the preeminence of the three Is, but they again suggest how China and Brazil, as well as Korea, have been able to develop a relatively large sector. But of equal interest is the calculation of the same indicator restricted to sales in the domestic market, which is a proxy for relative level of development of the domestic market. It is easily seen that most countries converge in index values between 0.5 and 1, but China, India and particularly Brazil appear quite detached from the rest, with Korea being the follower of this group. Despite these figures, most research done so far in the context of the development of the software industry has been biased towards the export-oriented trio of India, Ireland and Israel. Little is known about nations such as China and Brazil, as well as Korea (Barr and Tessler, 1999).

In **India** the focus has clearly been the export market, in particular software services (Arora et al., 1999, 2001; Schware, 1992; Tschang et al., 2003). This strategy has involved both local entrepreneurs that set up companies to provide software services for multinationals, primarily in the US; as well having some foreign companies investing locally for the same purpose (today, roughly 15-20% of the exports are foreign companies in India). Most of these services have very low added value, involving activities such as data data conversion and platform migration, among others. In this process, the Indian diaspora in the US and the English language have played a key role, facilitating contact with US companies<sup>5</sup>.

To some extent, **Ireland** has also pursued a similar strategy to that of India in terms of having multinationals as 'lead clients' for the local industry. The important difference here is that, instead of contracting with firms in the US, most of the growth has been associated with

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of software sales in GDP to 4% and the industry development index to 1.9, making the overall performance of the country in the context of international software still interesting but not quite as stellar.

<sup>5</sup> This linguistic comparative advantage, relative to other developing countries, is becoming more marked as Indian firms enter the Internet-enabled services-ITES segment, where however both value added and entry barriers are even lower.

foreign investment in the country (Arora et al., 2001; Crone, 2002). These multinationals are also responsible for a disproportionate share of the industry, roughly 80% of the sales and 85% of the exports (Crone, 2002). Like the case of offshore contracting for India, these activities have involved mostly low added value tasks contracted to affiliates and clients throughout Europe. A good example is software packaging or localization for other regions of Europe. Like in India, the diaspora and the English language have been important factors. Over the past few years, the country has also witnessed an important growth of an indigenous sector, which now accounts for about half the employment but a smaller fraction of value added. Most of these firms are small niche players, with several product based and export oriented,

A third path has been pursued by **Israel**. The industry has had direct benefits from extensive investments in defense-related technologies, which has created significant capabilities in specific areas such as real time applications, avionics, communication systems, among other (Khavul, 2003; Teubal et al 2000) and a general growth of the IT sector, in particular hardware (Breznitz, 2003). Moreover, a small domestic market has quickly prompted it to look for clients abroad, which it has been able to achieve. The industry has also been able to both create a successful venture capital industry (which has become a model to several developing countries) and attract investment by some of the lead US players in the industry, which have invested in Israel with activities that may be as important as research centers.

Existing work on the I's would suggest that the path towards a successful software industry is a large export base, preferably associated with US clients or direct investment (Heeks and Nicholson, 2002). As a result, development recipes for success are increasingly tied to the common underlying characteristics of these three countries: abundance of human capital, strong links to and a diaspora in the US, the English language, the presence of multinationals and a

presumably strong entrepreneurial culture. As the standard story goes, these aspects were complemented by a careful strategy of choosing products and services offerings that complemented or at least avoided direct competition with leading firms, especially American (see Bresnahan et al., 2001, for a summary discussion of the issues). The policy issue arises when one tries to enlarge this vision to encompass countries like China or Brazil (and Korea). As seen in Table 1, the software markets for these countries are as large as any if the three I's and, correcting for size and level of development, represent markets that are as developed or more than most countries, including Spain, Finland or Mexico. One of the most striking contrasts is the gap in the development of the software industry between Brazil and Mexico or Argentina, two other Latin American nations with greater levels of development than Brazil. Mexico, in particular is also a large country, with a population of slightly over 100 million (Brazil has 176 million) and a level of development that is almost 1.5 times that of Brazil. Moreover, it is part of NAFTA, with the large and sophisticated US software market just around the corner. Yet, its performance in the software industry has been dismal, although the government is now pursuing a strong effort to revert this situation (Secretaria de Economia, 2002).

Unlike India, Ireland and Israel, very limited knowledge exists regarding the reality and prospects for Brazil or China, two of the largest nations in the developing world, who also have a very active software industry, and that have clearly been pursuing an alternative path towards its development. These are very large countries, which do not have a familiarity with English to play on their favor in the relation to the US, but which can per se have a strong local demand for the production of software. They may export little software, but their economies are heavily committed to Information and Communication Technologies (ICT). According to the World Bank (2003), in 2001, Brazil spent 8.3% of its GDP in ICT, more than the 7.9% of GDP spent in

the US, and more than double the magnitude of such expenses in India, which reached 3.9%. China also expended more than India, reaching 5.7% of GDP. Moreover, both China and Brazil have maintained for a long time inward development policies, restricting imports and fostering the use of domestic demand as a catalyst for the development of a local industry (Botelho et al., 1998). In the course of the past decade, the emphasis has been shifting. Imports of software have been liberalized and there has been an important effort to promote exports, with both countries explicitly stating exports as a key development objective.

This dramatic difference in terms of market orientation when compared to any of the three I's, raises several interesting questions. The first is whether a focus on the domestic market is a synonym of fewer capabilities for the industry. The second, regardless of the answer to the previous question, is what is the role of the domestic market and how does this inward looking path may mirror or diverge from the one of the three I's. In particular, one might be interested to understand if a large domestic market provides opportunities for doing, developing and sustaining products vis-à-vis localized customization, working as a test bed for competence structuring and product enhancement, step stones to internationalization.

The need to further investigate China and Brazil, especially the role of its domestic market, is further reinforced by noting that, apparently, some of the key underlying factors that support a software industry are as present in India as in China or in Brazil. In first place, Human Capital production in these three giants is not so different, with India and China leading the way in absolute figures, but Brazil having the upper hand on relative terms. In 2000, Brazil graduated close to 18,000 people in IT areas (Ministério da Educação do Brasil, 2003), China produced 41,000 (CSIA reported in Tschang and Xue, 2003) and India 71,000 (NASSCOM, 2003). Still, when the overall population is taken in consideration, Brazil graduates 101 persons per million

inhabitants, while India has a figure of 32 and China 69 per million. The recent effort in Brazil has resulted in about 87,000 bachelors and over 5,000 masters in IT-related areas between 1996 and 2001. Moreover, to the 18,000 bachelors that finish an IT related degree every year, there are an additional 22,000 in non-degree granting specific training courses (with more than 1,000 hours of training), as well as 340,000 graduates from short term (e.g. 40 hours) IT tools training that enter the job market every year (see Behrens and D'Ippolito, 2002). An area where the generation of human capital is still lagging is at the doctoral level, where Brazil is currently awarding less than 100 PhDs in computer science per year. A second aspect that has been discussed as relevant for the development of the industry is availability of venture capital. Here, once again, there seems to be not dramatic gap in the three nations. In 1999, at the peak of the market, Brazilian firms raised US\$ 832 million dollars of venture capital (Stratus, 2003), against 620 Million in China (AVCJ, 2001) and 500 Million (Nasscom, 2003) in India.

## **2. Evolution and current structure of the Brazilian software industry**

Like in many other countries, the Brazilian Software Industry was born together with the Hardware Industry (Mowery, 1996; Campbell-Kelly, 2003). Therefore, to understand its emergence, it is critical to look at Hardware and follow its emergence as an individual industry. At the beginning of 70's, Brazil had a military government with an import substitution model of development. As a result, in 1972, it established a principle of market reserve, which protected Brazilian firms in minicomputers (and later microcomputers) and their peripherals from foreign imports. The market reserve IT Policy implanted aimed to build up capabilities that would make local enterprises internationally competitive, but the response of internal producers vis-a-vis consumer needs was far from adequate. Government support was tepid and reluctant to reign in

the excessive fragmentation, and firms reacted accordingly by diversifying into a multitude of protected areas, failing to acquire the envisioned international competitiveness and establishing an overall regime with prices higher than those in the international market, affecting the overall pattern of IT adoption.

At the end of the eighties, the decade long economic recession and rising political instability (the transition from dictatorship to democracy) further weakened the original inward-oriented informatics policy, that eventually led to a shift in its orientation towards a much more open environment. Culminating this process, in the early 1990s, a new trade and industrial policy was launched in Brazil. This policy was based on the dominant international doctrine through which liberalization would stimulate the efficient use of market forces in order to promote the technological modernization of the Brazilian industries.

There is not an established consensus about the impact of market reserve. Some (Tigre et al., 2001) argued that the neo-liberal policy was an adequate response to the inferior market reserve regime results, which caused high prices, a delay in adoption of new technologies, and a general consumer dissatisfaction, among others. Others (Evans, 1995; Weber 1998) sustain that liberalization was the last instance of a US pressure on the Informatics Policy. But this brief reflection on the history of the Brazilian policy is not aimed to dwell on the consequences of such a policy, but rather to establish how it conditioned the creation and early evolution of the Brazilian software industry. In this regard, it can be said that:

- The focus of the early Informatics Policy was hardware development, however it indirectly launched the base for the development of the Brazilian Software Industry in the following period. It increased the number of skilled professionals, computer science degrees and related courses, etc;

- Although the Brazilian Informatics Policy was not successful in establishing a truly competitive industry, it provided the IT companies a nationwide dimension. Also provided strategic alliances between local companies and foreign firms to transfer technology to Brazil and generated some highly specialized niches, such as banking and telecommunications systems.
- The Brazilian software market had reached US\$ 1.1 billions in 1991<sup>6</sup>, a third of the total local IT industry at that time (SEPIN, 2002).

Starting in 1992, Brazil began a strong reduction in state intervention on the economy. The market reserve was replaced by a market competitiveness policy. The aim now was to preserve the market reserve-generated capacities, while preparing local firms to compete globally and reduce the trade balance constraints. The main instrument to implement these goals was the introduction of a new Informatics Law (8248/91) that came into effect in 1993. This law provided fiscal benefits to hardware companies if they manufactured their products locally and invested 5 per cent in R&D activities, 2 per cent of which needed to be in partnership with research centers or universities. From 1993 to 2001 This law benefited 428 firms and generated upwards to US\$ 1 billion in R&D activities, with 63% spent on corporate research and 33% on contracts with research centers and universities. Although, it has benefited more hardware companies (especially MNCs, including non IT), which gained direct taxes exemptions, software companies were indirectly benefited, albeit in a smaller scale, with almost of a quarter of total benefits spent on software development.

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<sup>6</sup> The true figure was probably higher because no detailed account of software services was done– the focus were products.

Overall, the introduction of new technologies, the economic stability in the 94 - 98 period, the fall in prices of hardware and software and the advent of the Internet propelled the evolution of a domestic software industry. On one hand, older software companies created before the 90's, often as arms of hardware producers (CPM, Scopus, Itaotec), upgraded their strategies and improved their managerial skills, in order to deal with stronger market competition. On the other hand, new firms were created with new strategic visions and concomitant technologies.

The SOFTEX Program, created in 1992 as a part of a major national project for Informatics development (the DESI project) played a role in this developmental path. The Program (initially called Softex 2000<sup>7</sup>) has built a significant support structure, implementing a wide network of agents (22 cities in 12 states), introducing entrepreneurship and business plan culture in universities, qualifying entrepreneurs and promoting national and international businesses in the area of software, mainly to small and medium sized firms (see UNDP, 2003 for an independent account of the success of the program).

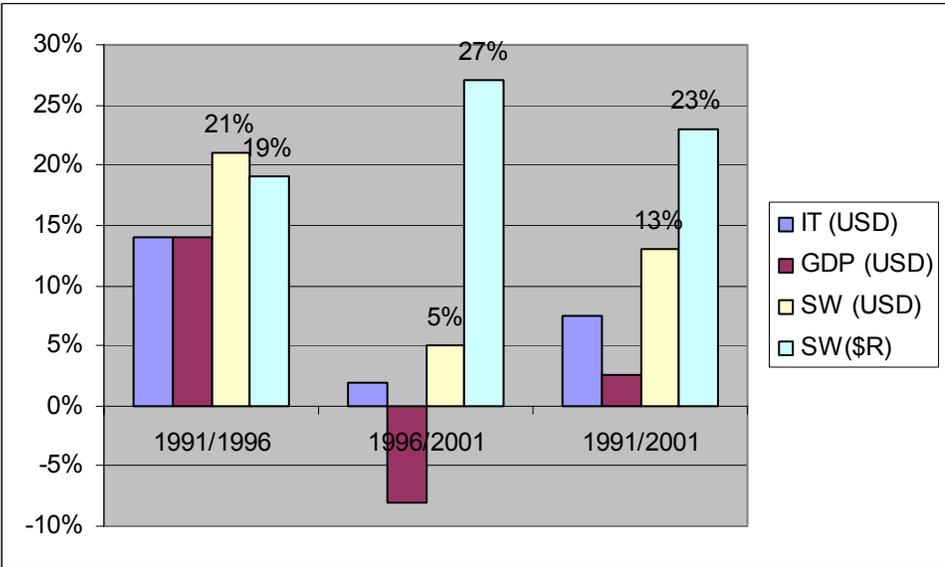
In the beginning of the decade, the Brazilian Software Market began a dramatic growth. As seen in Figure 1, from 1991 to 1996 the annual growth rate was on the order of 20%. During the second half of the decade, despite the economic turmoil that affected the country and that led to an overall decline in (US Dollar equivalent) GDP, the average annual growth was close to 30% a year, and still a positive 5% if converted to dollar equivalent sales values. Overall, during the 1991-2001 decade the share of Software in the IT market grew by 2/3 and Exports went from less than a US\$ 1 million in 1990 to US\$ 100 million on 2001. The size of the software industry sales

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<sup>7</sup> When Softex was created, its specific mandate was to promote the exports of Brazilian software to USD 1 Billion in 2000. While it felt short of its quantitative objective, it did play an important role in developing an export mindset and some of the early experiments. In many ways, the program was clearly ahead of the firms' level of capabilities. Later its mandate was broadened to include overall industry promotion, including exports and entrepreneurship.

as a percentage of in GDP grew more than threefold, from less than 0.5% to 1.5%, while the IT market as a whole went from 1.7% to 2.9% of GDP. As seen in Table 2, by 2001 the software industry in Brazil was worth 7.7 Billion Dollars. Software now represents 42% of the total IT market in Brazil, topping the hardware share of the market, with sales of products and services rather balanced<sup>8</sup>.

**Figure 1: Average Annual Growth of IT market in Brazil (Current Values)**



Source: SEPIN, 2002; Growth rate for software based only for software products (excludes services); \$R – Brazilian Real

The growth of the Brazilian software market in the course of the last decade provided a formidable expansion in the number of software development companies (program developers, data processing and database activities): from 4,300 in 1994 to 5,400 in 2000, out of a total universe of 10,700 companies with potential activities in software (against 7,000 in 1994 In the same period (1994-2000) the number of employees in the broader universe firms with potential

<sup>8</sup> Except when noted, all the figures for Brasil used throughout this document are based in data of the Secretaria de Política de Informática – MCT/SEPIN and Sociedade Brasileira para o Desenvolvimento de Software – SOFTEX, especially the presentations: SEPIN/SOFTEX, 2002 and SEPIN, 2002. See also [www.mct.gov.br/sepim/](http://www.mct.gov.br/sepim/).

activities in software went from 112 to 167 thousand. Software development firms experienced the strongest growth in the period in number of employees, 45% (SEPIN/SOFTEX, 2002).

**Table 2: Main Indicators for the Brazilian Software Industry<sup>1</sup>**

(Values in USD billions)	2000		2001	
	USD	%	USD	%
<b>Hardware</b>	7,0	40,7	7,2	40,0
<b>Services</b>	3,0	17,5	3,1	17,5
<b>Software (Products and Services)</b>	7,2	41,8	7,7	42,6
Products (Package, Custom and Embedded)	3,2	18,6	3,6	20,0
Services (Outsourcing, Development, Integration and Consultancy)	4,0	23,2	4,1	22,6
<b>Total IT Industry</b>	17,2	100,0	18,0	100,0

Source: Authors' own elaboration from data in SEPIN/SOFTEX, 2002; Revista Exame Informática-Maiores e Melhores, 2002

The slower growth in the number of employees (7% CAGR in 1994-2000) when contrasted with the industry revenue growth (27% CAGR) can be in part attributed to productivity gains as software development and system integration firms improved managerial routines and organizational structures (and in parallel by the arrival in the Brazilian market of multinational firms that possessed these traits), but it appears to be mainly due to the fact that packaged software revenues grew very fast during this period. An indirect evidence to this effect is the rise of software imports from US\$ 194 million in 1995 to US\$ 1,021 million in 2001 (SEPIN, 2003)<sup>9</sup>.

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<sup>9</sup> IDC Brazil estimates that in 2001 the packaged software market in Brazil reached 2,087 million dollars, equal the rest of Latin America. Cited in SEPIN, 2002.

As suggested by Table 3, the leading activity in the software industry in Brazil is System Integration (figures focus on services and do not account properly for sales of software products, especially sold as stand alone packages to end customers), followed by Processing Services as well as Hardware and Software Support. These top four categories represent 57% of total IT service revenues. In terms of specific markets, although no good data for expenses across areas exist, one can try to infer from firm samples. A recent survey of 147 major firms in Brazil (Gazeta Mercantil, 2003) revealed that 60% of them were investing in Customer Relation Management software, closely followed by Data warehouse, where 57% had investments occurring, Business Intelligence (53%), supply chain (41%) and e-commerce (39%).

**Table 3: Brazilian IT Services Market in 2002 (Share of revenues)**

Areas	Share (%)
Systems Integration	17
Processing services	15
Hardware support	14
Software support	11
Outsourcing Internet services	9
Application development	8
Network consultant	7
Training	7
Network/desktop outsourcing	6
Internet consultant	4
Outsourcing application	1

Source: Executivos Financeiros Magazine (2002); Excludes a substantial part of product (packaged) software sales

Software companies are mainly concentrated in the Southeast and South areas of the country (59% and 22% of total companies in 2001). The same is observed when considering marketed volume (72% and 11%) or employment creation (54% and 16%). These regional patterns can be explained, on the one hand, by the policy of the 70's and 80's decades, which privileged the south and (especially) southeast areas for the investment in R&D, and, on the

other, by the increased weight of the federal government in the software market (Brasília, the nation's capital is located in the Center West region). As a result, these areas, that were already the most industrialized of the country and also had better R&D infrastructure, reinforced their role as leaders in the development of this technology in the country. The State of São Paulo stands out, because it concentrates approximately 40% of total software market. The presence of the city of São Paulo, one of the largest and more sophisticated markets for software, including the financial sector, telecommunications, trade, etc., largely accounts for this sub-regional concentration.

**Table 4: History of firm creation in Brazil by company size (Survey of 681 firms)**

Employees:	<=10	10 to 49	50-99	100-499	500+
Creation	Micro	Small	Medium	Large	Very large
<=1980	4	4	4	20	14
1981-1990	39	85	26	33	6
1991-1995	84	106	23	8	0
1996-2001	118	87	13	7	0
Total	245	282	66	68	20

Source: SEPIN/Softex, 2002

Today's industry is composed for the most part by micro firms (82%), followed by small (14%), medium (2%) and a few large companies (2%). A recent survey on 681 existing firms (see Table 4) showed a strong and growing activity of firm creation, especially in the later half of the last decade. The table also suggests that some of these younger firms have been growing enough to move across size categories. By 2001, 36 firms created in the last decade have made it to the third largest category, and 15 to the second, though none has reached the 500 employees benchmark. A company growth trend seems to be especially prevalent among more dynamic firms. A recent survey of the 55 of the leading Brazilian software firms, representing 22% of the industry revenues and balanced distribution of sizes, showed that sales for this group in the period 1997-2001 grew by at an average annual rate of 37%, against an overall industry annual

growth of 25% (Botelho et al, 2002). This strong pattern of both firm creation and growth is important because, as noted by Bresnahan et al. (2001), success in these new industries seems to be associated with both firm creation and growth, but especially with the latter.

**Table 5: Largest Software Firms in Brazil in 2001**

<b>Company</b>	<b>Millions of USD</b>	<b>Origin</b>
<i>'Pure' non-government Software Firms</i>		
Microsoft	362	US
Computer Associates	260	US
Oracle Brazil	182	US
SAP Brazil	124	GER
Consist	77	US
Microsig	72	BR
CPQD	64	BR
Datasul	41	BR
Novell	25	US
RM Sistemas	23	US
JD Edwards	21	US
Symantec	21	US
PeopleSoft	19	US
Sybase	17	US
Eversystems	15	BR
Digitro	14	BR
Logocenter	14	BR
Adobe Systems	12	US
Baan	12	UK
Network Associates	10	US
<i>Consulting / Software Services Firms</i>		
EDS	240	US
Accenture	194	US
DBA	62	BR
CTIS Informatica	57	BR
Proceda	52	BR

Sources: Exame Informatica, 2002 (software); Gazeta Mercantil, 2002 (consulting)

But Table 4 also shows that the young (90's) and middle-aged (80's) firms have not yet grown enough to acquire dimension to become significant players in the international context. Furthermore, as seen in Table 5, the 10 larger national companies have average sales of below US\$ 100 millions when internationally equivalent ones are on the order of US\$ billions. Even India, a benchmark country in terms of active participation in the industry, has the top 10 national

firms selling at least USD 100 Million. Table 5 also shows the importance of foreign players in the sector. Since liberalization and until its world crisis in 2001, the IT sector has been on the top 3 destination sectors for foreign direct investment in Brazil. Attracted by the strong growth in market demand, a number of software product and service companies have been installing rather large operation in the country. These have been commercial businesses, as well as software development units, especially in more recent years. This strong inflow of foreign firms has quickly brought new technologies and familiarity with the more up-to date software tools to Brazil, erasing the backwardness induced by the previous period of autarky in the country. In several areas, these multinationals are developing technology and sophisticated products and services in the country.

Top software firms in Brazil have a particular set of origins. A recent report (Botelho et al., 2002) that surveyed a sample of leading companies in the country – the group grew 1.5 times as much as the overall software sector in the 1997-2001 period – showed that the overwhelming majority of these were established from existing firms (See Table 6). Some were established as a true spin-off, in the sense that the ‘mother’ company starts – and often has a stake in - the new firm (among others, Trópico results from the commercialization of a technology developed by CPQD and Itaotec became a separate office automation arm of ITAÚ bank). But the majority of those are separate companies created by employees of the ‘mother’ firm that spotted a particular opportunity on the course of their work and decide to create a new firm, often without no direct support or even in competition with the ‘mother’ (IBM and Siemens are among the most prolific ‘nests’ for these entrepreneurs). The large number of spin-offs from existing firms contrasts with the low number of university spin-offs, indicating that most entrepreneurs have some firm experience before deciding to create their own firm.

**Table 6: Dates of Firm Creation for Sample of Leading Companies**

<b>Creation Date</b>	<b>Firm Origin</b>					<b>Total</b>
	<b>Government</b>	<b>Multinational</b>	<b>Firm Spin off</b>	<b>University Spin off</b>	<b>Start up</b>	
Before 1980	5	4	4	1	4	18
1980 - 1989	0	1	12	0	6	19
1990 - 1995	0	0	6	0	2	8
1996 - 2002	0	2	5	0	3	10
Total Global	5	7	27	1	15	55

Source: Botelho et al., 2002

Another important characteristic of the industry in what concerns major players is the prevalence of strong government software firms. These date from before the eighties, and are powerhouses in the country. The largest of all, SERPRO, employs close to 9000 people and had revenues totaling USD 372 million in 2001. The figure presented in Table 6 also highlights how several multinationals have a long and established presence in the country, dating from the market reserve period, while a new wave of recent entrants is trying to ride the growth and liberalization of the domestic market. Finally, as in most other nations with a vibrant software sector, there are a large number of start-ups, created by the conjunction of interests and opportunities of talented entrepreneurs. These are very diverse players, ranging from software factories, to e-commerce, component developers or management software, among others.

Making sense of the relative economic importance of the Brazilian Software industry also entails placing it in the broader national industrial and economic context. Table 7 presents a comparison of key competitiveness statistics in the overall Brazilian industry and the Software sector. As it can be readily observed, the differences are quite significant on every level. The software sector is growing at an order of magnitude faster than the overall industry. The same is true for job creation. While software has added 55,000 jobs, the industry as a whole, as well as all

individual industry sectors at the SIC level 2, have also lost jobs in the 1994-1999 period. The software industry has also a higher value added per worker, both in comparison to the overall industry figures as well as to the high tech subgroup, suggesting that the growth in the software industry is sustained by an underlying stronger competitiveness when compared to most other industrial sectors in the country.

**Table 7: Comparing Software with the overall Brazilian Industry**

	<b>Software</b>	<b>Total Industry</b>
Sales Growth (CAGR % - 1995-2000 Current Values)	24%	2%
Growth in Number of Workers (CAGR %)	7% (94-00)	-1% (94-99)
VA / Employee (10 <sup>3</sup> R\$ - 1999)	97	26 / 60 (Hi Tech*)

Source: Own calculations and data of Ministry of Economics, IBQP-PR and IBGE for Industry; SEPIN, 2002 and Botelho et al, 2002 for software; \* High Tech is an average of 9 sectors that range from pharmaceuticals, to electronics and aircraft manuf.

Although policy makers have begun to recognize the size, dynamics and potential of the software industry in Brazil, the policy instruments in place to support the industry are still quite narrow, mostly some timid financial incentives. One of the prevailing instruments is the SOFTEX Program, already mentioned above. In 1997, Softex in partnership with the National Banks for Social and Economic Development (BNDES) launched a pilot credit program for software firms: PROSOFT. The program, expected to end at the end of 2003, has USD 35 million budgeted for investment. Its funding analysis takes into account the risky nature of the software business and thus it is managed in logic of portfolio. It provides loans up to USD 2 million to software firms with gross revenues under R\$ 100 million (about USD 30 million) and then collects returns as a function of firm results. By the end of 2002, it had invested half of the budget in 29 firms.

More recently, a policy emphasis has been placed on the development of export consortia and on open source software. For example, in Congress, the House of Representatives has chosen not to renew its MS Office software licenses. An inter-governmental committee (composed of ministries and state companies, including SERPRO and the country's two largest financial

institutions, Banco do Brasil and Caixa Econômica Federal) has been set up to develop a government policy and action plan for the implementation of free software in Brazil in 2004. In Brazil's southernmost state, Rio Grande do Sul, free software has advanced further, mostly in schools and small municipalities, and continues to expand to include even the municipality of Porto Alegre, the state capital.

Another recent development is the development of an institution to organize and coordinate venture capital in Brazil. In 2000, the Brazilian Association for Venture capital – ABCR was created, with government agencies such as FINEP<sup>10</sup> taking an important role in its creation. In the period 2000-2002, 183 firms received roughly USD 2.8 billion in venture capital, with the greatest value in 2000 and subsequent year experiencing a sharp decline due to world and Brazilian economic conditions (ABCR, 2003). Although firms with computer related activities, communications and media represent 46% of the total invested, only 23 firms corresponding to USD 30 million are in 'pure' software & services, a very small share of the total. This suggests that software firms are either using other financing mechanisms or that they are associated with particular applications and thus would be labeled in another computer related category (e.g. all Internet firms are labeled under a separate category than software).

The brief history and context of the Brazilian Software Industry described above, portrays a relatively young sector but with a significant size and a substantial growth pattern. But it is also inward oriented, regionally fragmented and mostly composed of small players. These contrasts

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<sup>10</sup> FINEP is the arm of the Ministry of Science and Technology whose mission is to fund research, development and innovation projects that can contribute to the economic development of Brazil. Its broad mandate enables it to be present in a large number of initiatives, from pure research to venture capital. It also manages the sector funds, among which the one for IT mentioned before.

require further understanding of the nature of the local companies, their capabilities and their interactions with the market.

### **3. The curse of the domestic market**

The potentially large size of the Brazilian market indelibly marked the country's postwar import substitution development strategy. Despite the model's revealed exhaustion by the late seventies, its long lasting influence was repeatedly reinvented in the closing decades of the last century, particularly in the IT sector (Tigre, 1992). Initially, coupled to a drive towards selective technological autonomy, it was transfigured into a hardware market reserve policy that held back the diffusion of IT throughout the economy with high prices and limited product choices (Botelho 1991; Tigre 1995). In recent times, the explosive growth of trade deficits in electronic components continued to entice policy makers<sup>11</sup> into envisioning a deepening of the development of IT industry in the direction of microelectronics. More importantly, however, to our argument is the impact this general pattern of IT development had on the timing and structuring of the software industry in Brazil.

The relative lateness in the emergence of a domestic software industry out of a previously amorphous set of software related activities, which took place mainly from the mid-nineties, is deeply conditioned by several dimensions of this historical legacy. As discussed before, liberalization in the nineties led to an explosive growth in Brazilian software industry. As a result, one would expect the large and fast growing market to lead to a healthy mix of mostly local or regional custom development service firms, together with national general purpose

(packaged) software, as well as specialized firms in both vertical (industry) segments and horizontal niches (e.g. components). In fact, as explained below, smaller unfocused regional players, with thin competence sets and limited ambitions, have dominated the sector. Only in certain sectors and more recently, has this pattern begun to change with the emergence of national more specialized firms, an aspect explored in the next section.

In the decades preceding the nineties, IT users perceived software development as an essentially auxiliary activity performed in-house by both IT user organizations and hardware producers. Private and public (at all government levels) organizations alike, the former strategically driven by a protected market and the latter by state-ownership bias, had few incentives to discipline their disorganization in the process of producing software. That is, software production activity did not have either a corporate or industrial identity, and was considered as an afterthought, marginal activity within firms. With costs considerations taking the back seat and amidst a generally soft labor market for human capital in the sector, there were no drivers for the emergence of a market-based software industry until the event of economic liberalization. Nor there were drivers for the appearance of an organizational culture oriented towards the acquisition of efficiency-driven and business model sensitive managerial capabilities.

The slow decline in the high costs of hardware (thanks to hardware import liberalization starting in 1992 and in spite the maintenance of a mix of tariffs and taxes that kept prices higher than in the international market) and the low cost of software personnel made IT end user firms to increasingly rely on software to meet the competitive challenge posed by the growing entry of

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<sup>11</sup> Domestic businessmen having falling for it in an earlier technological autonomy format without having captured any significant economic returns, were now overly cautious to embrace the government's grandiose industrial dreams in microelectronics

foreign competitors in the Brazilian market starting in 1990. As the software industry finally came into being, the emerging firms, many of them spin offs of former hardware producers and of large software users, inherited their organizational and culture legacies of disorganized production, lack of cost consciousness and non-cooperative behavior. In addition, they inherited from their original host organizations a culture of vertical integration, bundling HW and SW, as well as the development of in-house full software development capabilities that hindered, with a few notable exceptions, the development of collaborative strategies among firms and the development of subcontracting networks. On the other hand, the latecomer status of end user organizations – new ones and with disorganized patterns of software use -- towards the specification of software demands turned them into purveyors of an unsophisticated demand, with a few notable exceptions in the banking and telecom sectors, earlier, and federal government sector, later<sup>12</sup>. At that early point in the evolutionary path of the Brazilian software industry, this seemed to provide a good fit with the basic and generic skill set that the emerging software providers had.

This unsophisticated nature of the firms, both users and developers, worked within an expanding domestic market, with a perceived inexhaustibility, and a strong regional fragmentation. In addition, there was a rapid and massive increase in software imports, which accompanied the similarly rapid deepening of the internationalization of the Brazilian economy in the nineties. The result was a context that privileged strong customization to individual customers and growth through diversification in particular regional markets over any type of

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<sup>12</sup> However, these leading user sectors maintained a high-level of in-house software development capabilities. See further discussion of this point later.

specialization or general purpose products for the national market. Thus, it is not surprising to find the persistence of a large number of small regional firms, with the lack of strategic focus.

The counter-specialization bias was further reinforced by the sticky persistence of significantly large captive in-house software markets in most areas, ranging from Banking to Government IT Services. In 1999, the banking sector in-house expenditures with software development were almost 50% higher than external purchases<sup>13</sup>. From 1995 to 2002, government IT expenditures rose from R\$ 808 million to R\$ 2.5 billion (about US\$ 800 million), a growth of 214%. During the same period, expenditures with external software acquisition and licensing grew only 13% and 133%, respectively, jointly accounting for a mere 1.3% of the total IT expenditures. However, total government expenditures (internal – paid to state-owned developers-- and external suppliers) with professional technical services in the area, grew a whopping 305% in the same time, reaching 24% of total national IT expenditures (versus 18% in 1995 - Queiroz, 2002). Throughout the nineties the share of these markets in the overall national software sector remained largely unchanged, despite the general strong growth of the market.

Two additional issues aggravated the negative effect of these captive markets on software specialization. First, large state-owned software firms are self-contained and largely opaque to the transfer of their unique process capabilities and expertise, obtained in the course of the development of large automation and e-government projects, to external firms. Second, as most large organization, often themselves large software clients, became free of domestic IT purchasing constraints, they quickly moved into the opposite extreme. Aggressive strategies of adoption of international software solutions were favored as a means to catch up to international

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<sup>13</sup> In that year, total software expenditures reached R\$ 874 million or about US\$ 300 million dollars (Cotias, 2002).

competitors entering the local market with the onset of liberalization, leaving to local developers smaller and diverse customization projects, with limited technical depth or business role.

A structure of disincentives to specialization was also fueled on both the human and financial capital sides of the business. Existing social and labor regulations dramatically increased the cost of direct employment, discouraging service-oriented software firms to invest in organizational and managerial capabilities oriented to skill improvement and business model innovation<sup>14</sup>. With the high-end tier of the market closed to them, due to the excessive reliance of large users on either in-house capabilities or large providers with established reputation, often international firms, the budding domestic software firms competed mostly on a low cost model that pushed them to high levels of labor outsourcing and high turnover. This market context was coupled to persistently high barriers to growth finance – interest rates that could reach the double digit level per month and collateral requirements impossible in the context of software — which dampened the appetite for external growth financing that would be necessary for competence deepening, as well as national and international market development.

The market trap generated by the set of conditions described above was also not perceived or dealt with through appropriate policy measures. As a backlash of an overture context in the early nineties, policymakers perceived the international market as the only sufficiently relevant to render any specific support policies. This feeling was further aggravated by the government's dogged effort to eliminate a mounting balance of payment deficits and the fiscal restraint required by the macro economic policy in the post-Real Plan years (1995 onwards). This business environment thrust policy efforts towards a blind “export at any cost” race, neglecting any

potential leverage that a strong and large domestic software market could play on the short term, even with the international market as the ultimate objective. In addition, while a general policy emphasis on exports existed, the relatively small size, newness and geographic dispersion of an emerging Brazilian software industry meant that it did not possess the political clout relative to other industrial sectors to obtain differentiated financing for exports (it is important to remember that mineral and agricultural products and related account for almost 2/3 of Brazilian exports).

This lack of, or negative perception of the potential and importance of the domestic market as a driver of the competitive growth for domestic firms was expressed in the very limited national policy efforts towards the software industry deployed in the nineties, with Softex and Prosoft standing as the two timid policy mechanisms in place. Moreover, these few policy instruments that did exist were governed by a nationalistic bias that regarded the development of software products as the only activity that merited support, dismissing service-oriented firms and initiatives. The problem, though, is that these products were often developed (and financed) to become 'toy products' for pet regional clients, without a clear perception of whether or not a real market potential existed, and no serious effort to sell nationally, let alone internationally. An expanding regional and local government software demand businesses fueled this trend, as officials favored, first local state software firms, and second local private firms.

Finally, the informal nature of a large segment of Brazilian economic activity coupled to the large geographic size and fragmented structure of the domestic market for software invites the growth of piracy, particularly in the packaged software segment geared to small business. Weak distribution channels and geographic dispersion make it hard to enforce anti-piracy policies. The

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<sup>14</sup> Other relevant factors include the structural gap between academic research and industry and the historical pattern of

PC market is dominated by gray market producers, which usually bundle pirated software aggravating the problem. The final outcome is particularly damaging to domestic software product development firms, which are largely geared to the SME segment.

The ultimate impact of the curse of the large domestic market is to be found in the immature and distorted industrial structure of the domestic software industry and in the weakness of its attendant institutions. First, there is a dearth of large firms capable of playing the role of leaders and serving as exemplars of growth rewards. In 2001, most top domestic firms exhibited modest revenues in the \$ 50-100 million range. A good example of this situation is the segment of ERP for small and medium firms, where three small to middle-size firms have evolved offering somewhat similar solutions in their individual regional markets. Although they have experienced reasonable growth, they've arrived at the beginning of the 21<sup>st</sup> century with relative small size that put them at disadvantage to compete with foreign firms moving into their market. Second, cooperation efforts, key in the context of software and Internet product development (MacCormack and Iansiti, 1997), including strategic alliances, joint marketing agreements and product development partnerships, are low among firms (Botelho et al, 2002). This lack of proximity between firms is ultimately reflected in the small number of mergers and acquisitions, although the trend began to change in the beginning after 2000. Third, the industry lacks a unified voice, being torn beyond regional pulls by different expectations of SMEs against large firms and product development against software services-oriented firms. A reflection of this is the fact that there are two different industry associations, none of which seen as highly representative of the sector, a contrast with the role of NASSCOM in India.

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consumption of imported technologies.

The opening of the economy at the beginning of the nineties fostered the introduction of new technologies throughout the economy, creating an enormous potential for IT and software in the country. But, perverted market and strategic incentives, the lack of a priority-oriented policy and a low profile in the State's procurement power, shaped a uneven regional sector, populated by a growing number of small and medium firms whose competencies reflect the limited requirements and knowledge of their narrow client base. As a result, the market evolved rapidly to a large size, but firm maturity evolved slowly and more fragmented, especially when compared with India and other developing countries emerging in the international software market.

#### **4. The promise of the domestic market**

Developed nations, as the US or Germany, often nurture industrial capabilities by leveraging their strong, sophisticated and large domestic markets. Because of their general backwardness, developing nations often cannot follow the same path. As described in the previous section, when the context evolves from an historical environment of inward development strategies, a focus on the domestic market can even induce a number of behaviors that can stifle the development of an industry, in particular one like software.

The question, nevertheless, is whether there may be conditions under which the domestic market can act as an incubator of firm capabilities and as platform for further affirmation in the international market. The perspective that will be explored is that, for such possibility to materialize, two complementary conditions must exist. The first is the existence of lead client sectors for software firms, whose demands are close to those of leading international firms, providing opportunities for learning and competence deepening. The second dimension is the presence of competition and selection mechanisms that force firms to structure capabilities in

particular areas. In addition, when one joins these two dimensions to a third, a strong entrepreneurial culture, it will be argued that it may result in a healthy experimentation in the vertical software product market space, which can be the generator of entrepreneurial growth firms capable of leveraging the international market.

### **Leveraging leading sectors**

While Brazil is a developing economy in most dimensions, there are relevant differences across areas of the economy. Several industries and functions of the domestic economy are particularly well developed, even by international standards. Some of these are avid clients of software and, as a result, they have been the anchors for the development of a vibrant Brazilian software industry.

One of the areas where the local industry is extremely sophisticated is banking. The financial turmoil under which Brazil lived for a long time, its large and complex market, as well as the aggressive policies to establish currency and capital markets stability has generated very high performing institutions, even at international level. This was already true before liberalization (Lisfield and Montes-Negret, 1996; Botelho 1998), and their strength has been confirmed throughout the liberalization process initiated in 1994. A recent study analyzing the impact of foreign bank entry in Brazil since liberalization (Vasconcelos and Fucidji, 2002) showed that, contrary to what is usually found in most developing nations, foreign entrants did not exhibit better operational indicators upon entry, and had not shown better evolution after entry when compared to domestic players.

Another area where local industry is extremely sophisticated is telecommunications. Since the late 70s and until early nineties, Brazil had a strong policy supporting the establishment of an

indigenous industry in this area. As a result, and much at the expense of the final consumer, significant technological capabilities in telecommunications have been created, including a relatively developed cluster around the city of Campinas, which involved CPqD, the R&D centre for Telebrás (the former government telecom monopolist), universities and other research institutions, as well as equipment suppliers and the operating companies (Evans, 1995). Initially most players were locally owned firms. But, since deregulation started in the early nineties, foreign firms have since bought most of them. During the same period, a range of other foreign firms invested in Brazil, both for manufacturing as well as telecom service provision. As a result, the sector is now a blend of some local and mostly foreign players, but with highly competitive rates and well-established capabilities. Moreover, these companies have access to a law that provides strong fiscal incentives for R&D spending, which has guaranteed a continuing investment in their technological capabilities in Brazil. The high level of international competitiveness in the Financial and Telecom sectors is evident from the degree foreign direct investment (FDI) in the two areas. In 2000 and 2001, they represented 52% and 30% of total FDI, respectively, a preeminent role they have occupied since the liberalization process in mid nineties.

The importance of these two sectors is the fact that they are sophisticated clients and strong developers of software systems. According to Banco Hoje (2002), the Brazilian banking system is the largest single investor in IT in Brazil, accounting for 30% of total expenditures. Moreover, the success and competitive ability of firms in these areas depends greatly and increasingly on the ability to deploy advanced software. In most hardware telecom products, software already represents 50% of the cost of the product, and its relative importance is likely to increase over the next few years.

Table 8 presents key indicators in research and software development gathered in a recent study of 55 of the leading Brazilian companies (Botelho et al, 2002). As it can be seen, figures for Telecom and Banking software stand out from the rest. Telecom has virtually all indicators of knowledge intensity clearly above the average. In Banking, the ratio of expenses and human resources in knowledge activities to the total is low. But the high ratios of expenses to software sales and expenses per human resource in R&D suggest that these firms are bundling a focused work with very high level knowledge, with a number of other activities that are clearly below the threshold in terms of knowledge and that bring some of the general indicators down.

**Table 8: Research and Development performance in leading sectors vs. average**

	<b>Telecom</b>	<b>Banking Software</b>	<b>Average</b>
R&D/ Software Sales	17%	47%	13%
R&D/ Total Sales	11%	5%	6%
R&D Expenses / Human Resources in R&D	32,238	182,178	52,092
R&D Expenses / Human Resources	16,599	1,043	8,742
R&D Human Resources/ Human Resources	60%	32%	41%
Human Resources with Graduate Level /Hum. Res(2)	15%	5%	11%
Share of Direct Software Revenues	38%	45%	71%

Source: Botelho et al., 2002; The R&D activities should be interpreted as involving the software development process

Particular cases are illustrative of how lead sectors and local idiosyncrasies can spur the development of an indigenous software industry. In the banking sector, the establishment of the Brazilian Payment System (SPB) is a particular good example. In 1999, the Brazilian central bank decided that, by 2002, Brazil should have installed an advanced payment system, in accordance with the most up-to-date Internet technology recommended by the Bank for International Settlements. With SPB, funds clearance would be immediate and, as a result, the central bank can control bank reserve accounts in real time, not allowing overdrafts, thus increasing dramatically overall system reliability and trust. This highly complex system entailed

the installation of a dedicated backbone structure for the system, as well as the provision of a software system for the central bank, clearing houses and each bank in the system to link them together in a reliable and secure way. On aggregate, banks spent over R\$ 1,7 billion (over US\$ 800 million dollars) in the adaptation of their technology infrastructures to the requirements of the SPB (Gazeta Mercantil, 2002). Microsoft named the establishment of the SPB as the biggest IT project ever in the Latin America banking sector and placed over 200 dedicated professionals working in the project with their local partners (Gazeta Mercantil, 2001).

While several banks of the 170 in the Brazilian system used their internal resources to develop a solution, a significant number hired outside firms for development, creating an immense market opportunity for local and foreign software firms alike. The development of the system and maintenance fees could generate significant and sustained additional revenues, and could also be the foundation for the production of subsequent products and services. Several dozen software Brazilian and international firms and consortia bid for the development of software products for the SPB. Of these, only 2 foreign firms (besides Microsoft and IBM which provided base software technologies to most SPB projects), Getronics and Unysis won contracts, and 5 other Brazilian software providers established partnerships with foreign suppliers such as Microsoft and Computer Associates. But the majority of the contracts went to Brazilian firms. More interestingly, several leading foreign banks in Brazil, including BankBoston, UBS Warburg, JP Morgan and Bank of America, among others opted for pure domestic solutions. This example illustrates well the level of competence that domestic software firms working for the banking sector have achieved (Gazeta Mercantil, 2001 and 2002, several editions; personal communication, 2002a).

In Telecoms the first set of interesting pockets of competence relevant to the software industry is associated to embedded software. One of the leading examples among foreign players is Siemens. The company entered in Brazil in the seventies and is now the largest company in the electronics and electrical engineering sector in the country, employing roughly 8,900 people in 12 production facilities and 13 sales offices nationwide. The presence of Siemens in Brazil includes also a Telecommunications Technology Research and Development Center with over a hundred full time researchers and an additional several hundred other affiliated through university grants and contracts. The research laboratory is a world competence Center for four product lines, including low end private branch exchange switches (“PBXs”) and is planning to add a Competence Center for GSM in the short term. This means that the unit has global full cycle product responsibilities, including research, development and manufacturing for these lines. Like Siemens, Ericsson has close to 500 people in its Brazilian research unit, all devoted to research and development in software. Among others, the Brazilian Unit is responsible worldwide for full cycle development of software for several systems in its fixed and mobile telephony. It is also worldwide competence center for the development of the TDMA telephony system. Others, such as Alcatel and Motorola, also have a number of local and global competence centers and extensive development programmes in the country.

A second example is CPqD, the former government research lab now turned into a company after market liberalization. The firm is a leader in terms of research and development in software – much because of remaining subsidies by the government - and has consistently been responsible for several key products and spin-offs in the industry. Among several products, perhaps the most interesting case has been Trópico, the fixed commuter terminal system developed originally by CPqD and now sold by a spin-off company holding the same name. Of

the 42 million fixed network terminals currently installed in Brazil, 8.5 million are Trópico (personal communication, 2002b). Initially, the sale of such systems was protected by the strong protective mechanisms of the government. But since the telecom privatization process in late nineties, the company had to compete in the open market for contracts, battling with the other international giants in the industry such as Siemens, Ericsson, Lucent and Nortel. The firm has been able to withstand competition, having roughly 20% of local sales nowadays. Currently, the like most other telecom firms, the company has been battling to survive in very adverse market conditions, but is claiming excellent development prospects for its more recent terminals, both in Brazil and abroad, especially other developing countries.

Yet a third area of interest in the telecom business are start-ups, that are using the creativity and flexibility of the Brazilian professionals to create software that caters to the growing demand for communications in the country, in particular cell phones. Demand for cell phones has grown at a double-digit rate for the past few years, reaching 33 million active phones by the end of 2002, a trend that is expected to continue in the future. As a result, a number of very innovative local firms have jumped into the development of games and applications for cell phones. Recently, CESAR, a development team based in Recife geared towards the development of software games was one of the 5 winners of the 1st Asia Java Mobile Challenge and placed another game in the top 20 of the same contest. This was a global competition organized jointly by the six leading Asian cell phone operators that involved over a thousand participants from 23 countries around the world. The group is now negotiating a license to placing the winning games with the operators that promoted the contest. Recently, it also secured a USD \$1 Million grant from Motorola to develop cell phone games. This is only one of a growing number of examples of software start-ups that are seen as critical for the future of the industry. They also represent a

growing view that Brazil is a country of entrepreneurs. According to the Global Entrepreneurship Monitor published by Babson College, Brazil has often led and always ranked among the top 5 more entrepreneurial countries in the world.

Not only the private sector has played an important role in the development of the software industry. The public administration can also be considered a lead sector and an anchor for the development of the industry, although still too isolated from the rest of the market. The Brazilian Government is a very large and complex machine, with sophisticated needs and requirements in terms of information processing. To attend these needs, the strategy has been to create public firms that supply software and IT services across states and sometimes the entire country. These companies have more than 10,000 employees and have developed a rich pool of competences, complemented with an aggressive government push towards the adoption of e-government tools. This effort has made Brazil one of the leading countries in this area, with important flagship projects such as electronic voting and electronic tax declarations. In the last presidential election, all the voting was done electronically. This meant over 90 million citizens voted in the world's largest electronic election. This massive popular participation in e-government is present in other areas as well, as can be readily understood by the impressive amount of information about Brazil and its government available on-line. One of the major projects has been electronic tax collection that, in 2002, had assured that 96% of all the people filing annual tax returns did so electronically (Ministry of Finance in [www.fazenda.com.br](http://www.fazenda.com.br)).

Another software area where the Brazilian Government is a world leader is the adoption of 'free' software such as Linux. At least eleven Brazilian cities -- have passed laws giving preference to or requiring the use of "software livre", and a number of other municipalities, states and the national government have mulled at similar legislation. (CNET, 2001; Estadão, 2002).

This important push towards this technology is important because of the growing presence of this technology as an alternative to proprietary software. IDC estimates that around a third of the computers in Latin America will run Linux in 2003.

This increasing government interest in open source software in Brazil has been one of the drivers towards pre-eminence of local firms in this area at a global level. The Brazilian company Conectiva, which sells in all Latin America has quickly evolved towards the status of a major player in the international free software world. Recently, it signed an agreement with four other major international players in the field to create United Linux, a standard Linux platform to be commercialized across the world. The company is also a key player in the technical side. In 2001, Marcelo Tosatti, a Conectiva employee was chosen to take over maintenance of the current "stable" Linux kernel, taking over from Alan Cox, a major figure in the Linux community and long-time maintainer.

From the discussion above, one can understand how lead sectors play a very important role in structuring software industry capabilities. As software producers fully aware of their role in the broader international context, even if for strategy or market reasons focusing on Brazil, they will work in projects with broader relevance, such as low end PBX units in the case of telephones, or the Java based games for GSM examples. The size and increasing sophistication of lead sectors as clients also have an important impact in software supply chain. They can steer the work and provide enough of an opportunity for suppliers to focus their competence and invest in general and ever more complex products and services, escaping the low value added customization trap discussed in section 3. The banking sector is a good example for this role.

## Structuring Competencies

But, while the demand for sophisticated software products drives the technical acumen of the local firms, that might not be enough for them to establish a sound business model, and learn the importance of nurturing structured capabilities in particular domains. The driver for the firms to begin consolidating competencies in particular areas requires from two key complementary factors: international competition in the product and input markets, as well as the development of the capital markets.

Increasing liberalization of the Brazilian market and the perspective of strong and continued economic growth emerging from a stable currency began attracting international developers of software to invest in the local market. Domestic companies that used to have virtually captive clients soon began to feel the international competitive pressure. By looking at the list of the top 20 software firms present in Brazil nowadays (see Table 5), it is easy to recognize the presence of familiar international names. At the service level, high-level systems analysis and software development firms such as EDS and Accenture have grown over the past few years at double-digit rates and are now larger in sales than any local private software firm<sup>15</sup>. Domestic software service providers such as DBA from Rio and CPM from São Paulo, two of the leading firms, are in active competition with these foreigners and still growing at a very fast pace. A similar context exists in more specialized service suppliers for vertical segments, as described in the examples of banking and telecoms noted in the previous section. Product firms have been feeling similar competitive pressure. A good example is the ERP segment. Until mid nineties, Microsiga and Datasul, two of the largest Brazilian software firms had the market for themselves.

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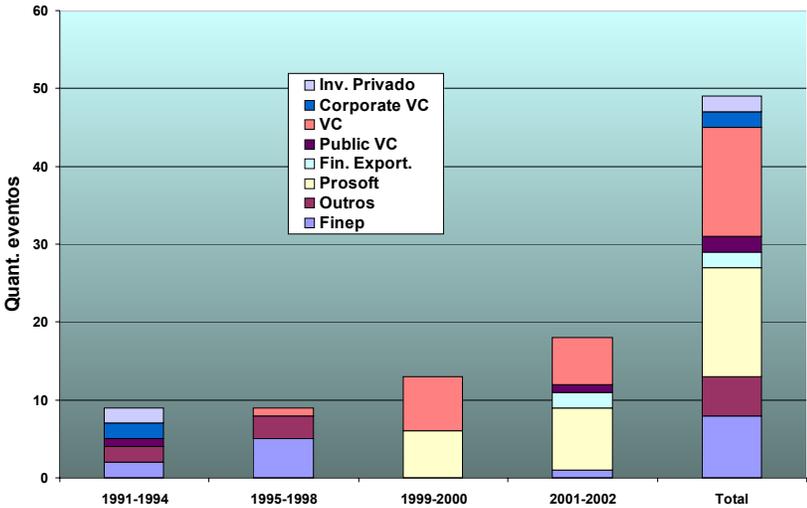
<sup>15</sup> Although their sales are not only software related. Some public firms, such as SERPRO are larger than these

But liberalization attracted giants such as SAP and BAAN, which realized the immense business opportunity that the Brazilian market represented. While these global producers quickly took over the large firm market (mostly from internal development, as this segment was never been the major target of local developers), the battle now is on ERP systems tailored to cater medium sized companies. SAP is now attacking this market through a version of its system, but local producers claim that they are not losing market, but rather competing on a growing business. They have also begun an internationalization process towards Latin America and even the US.

Liberalization, acted as a competitive shock on local firms, leading them to reshape their strategy and hone their business model. It had a cascading effect. First, larger local firms in both products and service areas felt the brunt of the competitive pressure brought about by the entry of foreign players and the rising imports. This, in turn created both new constraints and opportunities. On the one hand, imports required adaptation to local specificities (e.g. tax code), integration to existing systems and new automation for organizational routines, areas in which local firms knowledge of domestic markets idiosyncrasies and local corporate organizational culture had an upper competitive hand, which balanced international technical and service prowess. On the other, foreign entrants market focus on large corporations enticed local firms to explore in greater depth and commitment the huge SME market. Given the fragmented and uninformed nature of this demand, local firms had to dramatically shape up their organization and service skills. Second, they became organizationally leaner and strategically meaner, that is to say they restructured into more flexible organizations. Software service local firms, for example, began experimenting with flexible models of software factory coupled to cooperation with vertical (and sub-regional) market knowledgeable smaller firms.

This strong competitive stimulus has been a major force towards inducing companies to better structure their competencies and devise clear market and technical strategies. But perhaps as important as market competition, was the disciplining role of the capital markets. In early stages of the industry, virtually all firm's growth was achieved through reinvested earnings. On the one hand, the dramatic growth of the industry meant that firms had the minimum cash to finance their activities and, at least, a moderate growth. On the other hand, inexistence of a venture capital market and the extreme national financial instability created a strong bias against external financing, with sky rocketing interest rates that firms perceived as taking over any potential value that the external cash might bring.

**Figure 2: Growth of external financing in a sample of lead Brazilian software firms**



Source: Botelho et al., 2002

In mid to late nineties, local financial stabilization and an international appetite for technology based firms, in particular software and the Internet, created a completely different scenario. Figure 2 shows the results of a recent survey (Botelho et al, 2002) of the leading firms in the Brazil on how they accessed finance. As it can be seen, there has been a very important

growth in access to venture capital or special funds toward product development. Of the 50 firms surveyed, 16 had accessed some form private venture capital (mostly international) and 20 had received funds from a competitive government fund to finance software firms. Together with cash, came a new discipline in terms of business, management and even technology.

Firms interviewed (Botelho et. al. 2002) reported that the prospect for the entry of external private capital provided an important impetus towards firm development along two major directions. The first is in the definition of a clear business model, usually providing a sounder basis along which to structure their competences. To access external funds, firms had to prepare detailed business plans and explain how they expected to become and stay competitive in the local and international markets. This effort, often helped by external consultants, forced companies that had often treated strategic planning, budgeting and marketing as side tasks to seriously grapple these issues and place them coherently in an integrated plan. The second area where external capital is having a major influence is in the management structure and competencies. Most firms in the industry had sound technical expertise, but technical people with limited management experience and skills also handled the management. The entry of capital forced a major change in this dimension, either supplying management talent to enter the company or forcing the firm to secure such competencies to be able to access capital.

Access to subsidized government funds, provided a similar influence, albeit with a less direct role at the level of the management. In 1997, the BNDES and Softex created the Prosoft initiative described in Section 2. Because, unlike traditional venture capital, this line of credit did not require giving up capital, it has been very popular among companies, albeit also extremely competitive. Similar to a potential Venture Capitalist investment, firms interested in receiving Prosoft had to prepare a business plan to demonstrate the merit of the project and viability of the

company. Short of specific technical and business competencies in the area of software, BNDES, the Brazilian Development bank established an agreement with Softex to analyze the merit of the applications before granting financing, making the process extremely demanding. These two aspects are transforming the industry, making firms much more aggressive, focused and overall more competitive.

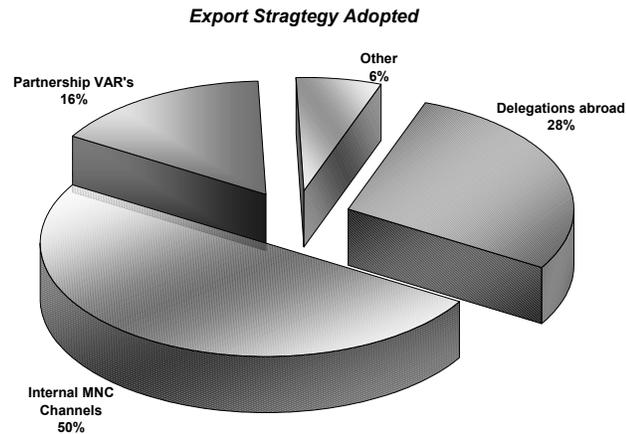
## **5. Going Abroad**

The fact that Brazilian companies have mostly relied on the domestic market to develop themselves doesn't mean that they are not aware of the importance of internationalization. Virtually every leading local company is trying or has planned going abroad. In a recent survey involving 55 of the leading software firms in Brazil, 60% of them reported to have export activities (Botelho et al, 2002). Still, a lot of them are still timid, often in early stages or trial modes and not as part of an aggressive development campaign: the average share of sales devoted to the external market of those that exported in the sample was only 12%.

Firms have been using an array of internationalization strategies. As seen in Figure 3, half of the firms surveyed uses internal multinational channels as a main export channel. This includes firms that are themselves multinationals operating in Brazil, as is the case of Siemens or Ericsson. It also includes having a branch of a multinational present in Brazil adopting software developed locally and then selling it to operations abroad. Examples of this are the sale of banking software by Software Design to Goldman Sachs in New York, or the sale of Tropic PBX devices and related software to Telefonica across Latin America. The reason for why this category prevails is the local strength in vertical specialized software (products and services). The previous section explained how areas like Telecoms and Banking have been associated to the

creation of strong competencies in domestic producers, that in turn use their clients, especially when they have an international presence, as the major channel to access foreign markets.

**Figure 3: Export Strategies for sample of 55 leading Software firms**



Source: Botelho et al., 2002

Then, there are more traditional international expansion modes and some emergent experiences. Sales through delegations and VARs to expand to foreign markets is being explored in areas such as ERP and niche products, which use the Latin American market as the natural extension path to the growth across domestic regions. For example, Eversystem has exported its financial management application packages to Argentina and Mexico, where it has established offices. CPqD, which had already exported its telecommunication management application systems (Promus, Flexflow, Sagre, Terus, SGE e dotIP) to the United States (it maintains an Office in Silicon Valley), Italy, Bolivia and China, in recent times launched an aggressive export strategy based on partnerships with Brazilian and local firms to sell its solutions in Chile, Venezuela, Colombia, Uruguay, Peru and Argentina.

Some companies are more aggressive and have jumped directly to the US market. Eversystems, one of the leading Brazilian software firms and an internationalization success case has more than a third of its sales out of its Miami office, which represented over USD 32 Million

in 2002. This example is expected to become the norm in a few years, as most of the top firms interviewed in Botelho et al. (2002) showed clear and aggressive international expansion plans over the next few years. More recently, the earlier local experimentation with software factories has turned into a bush fire, with firms aggressively entering the international outsourcing market based on their vertical markets superior knowledge and labor relative low cost. This trend is being fueled both by domestic factors such as currency devaluation, growth in second phase ERP integration review tasks in large firms and early successes of existing factories, as well as generic factors such as firms' renewed focus on their core business activities –outsourcing even system analysis and specification together with development – and the diffusion of multi level architectures, which allows firms to outsource to multiple suppliers, avoiding dependence on a single firm (Cesar, 2003).

The emerging experiments that are seen by many in the industry as a path that has been clearly under explored so far, but that may represent an important source of market growth for domestic producers and international firms to be located in Brazil is precisely export services, the bread and butter of the Indian industry. A number of recent examples by international firms clearly signal that Brazil is being seen as destination for localizing development, including recent announcements by giants like Dell and Microsoft to create or expand software development platforms by hundreds of people. It also encompasses smaller firms, such as development arms for European retailers and new agreements by local software factories to begin producing to clients in the US and Europe. Finally, Brazil is attracting interest of the leading Indian services firms, with Tata Consulting Services, one of the top five Indian software firms, announcing a joint venture with TBA, a local firm, to create a software development operation that they expect will grow to 3000 professionals in 5 years (Pressconsult, 2002).

These examples are a good indication of the positive prospects for the internationalization of the Brazilian Software industry over the next few years. Strong business models, mature technologies and deep domain knowledge in key vertical areas may propel the industry to an interesting growing level of internationalization both in Products and Services. For the latter, one might expect them to be specialized vertical off-shore work, rather than customization, platform porting and on-site development.

## **6. Discussion, Conclusions and Future Prospects – From Laggard to Second Mover?**

The evolutionary path-dependent trajectory followed by the Brazilian software industry over the past decade reveals that the curse of the domestic market could be turned into a blessing with appropriate institutions and incentives<sup>16</sup>. Starting in the beginning of the nineties, a growing and increasingly open Brazilian economy spurred an enormous development of the IT and software sectors in the country: Released from the constraints on access to foreign technology that prevailed throughout the eighties, firms across the economy rushed to invest in IT, and software in particular, creating a strong and fast growing domestic demand for the nascent software industry. But the market and policy contexts created a set of incentives that drove software firms towards serving an increasing number of clients, most with limited needs and simple technical requirements, looking for customization of existing solutions. Alternative strategies such as developing innovative products for the national market, or even pursuing internationalization, were set aside by the high risk against an uncertain return and the impossibility to access external capital at feasible costs. As a result, the maturity of the Brazilian

companies evolved slowly and more fragmented, especially when compared with India and other developing countries emerging in the international market of software.

The perspective becomes different when at least two conditions co-exist. First, lead client sectors for software firms, with demands close to those of leading international firms, must exist. These provide opportunities for learning and competence deepening similar to what exports to a foreign player by subcontracted domestic firms would provide. The examples of Banking and Telecom explored in section 4 illustrate this dynamic. But opportunity may not be enough. The second dimension observed in Brazil is the presence of competition and selection mechanisms that discipline firms to structure capabilities. In the case of Brazil, international competition, as well as private and public venture capital has played a significant role in structuring business models and shaping competence building. When one joins these two dimensions to a third, a strong entrepreneurial culture, a healthy experimentation in the product market space also emerges, which can be the generator of entrepreneurial growth firms capable of leveraging the international market. These observations are critical, not only to understand the dynamics of the industry in Brazil, but especially because they show that there are alternative paths to the ones of India, Ireland and Israel in the acquisition of competences in the software industry.

A focus on the domestic market may have yet another important advantage worthwhile noting –multiplying effects. While the software industry can, per se, be important for economic performance, its impact in the economy has the potential to be much greater. Software is a critical leverage for innovation across virtually every area of activity (Schware, 1992; Quinn et al. 1997, chapter 2), and plays a major role at the level of intra and inter organizational learning (Quinn et

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<sup>16</sup> Conversely, Ireland has strived to reverse the curse of the export market, by stimulating the growth of a domestic software

al., 1997, chapter 2). In fact, recent empirical studies at the company and country levels have shown that information technology is positively related to corporate and national economic performance (Kraemer and Dedrick, 1999; Mckinsey, 2002; Gordon, 2003). The fact that investment in IT use can lead to economic payoffs means that countries should focus on promoting IT production as well as IT use, in particular software. This will be particularly important for sectors that Kraemer and Dedrick (1999) refer to as "production close to use", whose IT use is very close or overlapping with production. According to Kraemer and Dedrick (1999), in these areas, not only the potential multiplying effects are the largest, but they also offer significant opportunities for developing local IT industries. The pattern of development of the local software industry in Brazil supports much of these prescriptions. Therefore, one might argue that this pattern of development maximizes impact in the domestic economy as a lever of economic development (Mokyr, 1990).

A related potential advantage driven by the path-dependent nature of the industry development in Brazil is the important role of verticals, or software developed around the needs of particular industries or segments. The increasing commoditization of the international software services market expressed in the continued high growth of the outsourcing market is accompanied by a restructuring of the demand for outsourcing towards increased customization and local / vertical market knowledge, thus putting pressure on current exporting firms and nations to either explore additional markets beyond that of the US or seek to move upwards in the value-added ladder (CNET, 2003). Vertical markets software is widely perceived as a promising step in this direction. Leading firms in the Brazilian software industry hold unique competences

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industry capable of adding greater value. Regional Technology Strategies, Inc. 2001; Crone 2002.

in this environment, as they have been evolving a flexible specialization model of software production, both in services, products and quasi-products coupled to services (e.g. components, middleware, etc.). As it happened in the past with traditional industries, when shifts in market demand towards increasing customization could no longer be fully met by the Fordist production models based on wage costs, in the international software industry today it is the structural changes in the composition of market demand (e.g. fragmentation and upscaling of business processing outsourcing into vertical and horizontal segments), rather than the expansion in volume, that is increasingly requiring suppliers to adopt an alternative production model<sup>17</sup>.

Helper, MacDuffie and Sabel (2000)<sup>18</sup> suggest learning-by-monitoring firms present an alternative organizational form outside the markets and hierarchies menu, in which pragmatic collaboration allows for more continuous and adaptable innovation. They further suggest that the development of a series of collaborative routine interactions with suppliers (“pragmatic collaborations”) by vertically integrated firms -- in the case of the automotive industry studied by them these being benchmarking, simultaneous engineering and ‘root cause’ error detection and correction—facilitates the establishment of “‘learning by monitoring’- a relationship in which firms and their collaborators continuously improve their joint products and processes without the need for a clear division of property rights”. Software work in vertical markets requires a high degree of trust between the user and the supplier. The user detains critical information about the particular market, which is intimately tied up to its strategy. The user, by outsourcing the

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<sup>17</sup> This perspective diverges from a view on the transformation of the international software industry which structures the software market strategic space in a dichotomy of major product and niche markets or complementary activities (Breshnahan, Gambardella and Saxenian, 2001). This view, in a way, mimics similar earlier views of the markets for traditional industrial products, in which only marginal markets (here niche markets) or subsidiary dependent relations with large vertically integrated firms were believed to be available for SMEs, thus dead end to growth based on productivity increases and innovation. See Sabel and Zeitlin, 1985; 1997, as well as Piore and Sabel, 1984.

<sup>18</sup> For a full elaboration of the learning by monitoring concept see Sabel, 1993.

software development of this critical strategy-specific activity, risks losing its competitive advantage. But, market conditions require it to lower cost and increase the quality of its products and services. In this situation, cooperation has to be valued by the actors (user and supplier) “as an end in itself “ (Helper et. al., 2000, p. 476). In the Brazilian software industry, software developers have been developing these pragmatic collaborations with users for a long time. That is to say, the seeds of learning by monitoring have been sown.

Take the case of the financial sector. Here, banks cooperate with suppliers to develop specific applications which requires the supplier to fully understand the characteristics and dynamics of the market segment being served by the financial institution and, conversely, requires that the bank reveal as much of its strategic take on this segment, to insure that the final product fulfill the user’s expectations. Several Brazilian financial software firms (Eversystem, Logocenter) have developed ‘generic’ market software products out of pilot projects— joint product development or continuous service – with financial institution users. They possess the cooperative know-how necessary to jointly develop vertical market software. Similarly, ERP providers to SMEs, have adopted different strategies to turn cooperation into a need to final users. Some make use of intermediary local organizations (affiliated firms), which establish and manage this bond, with the ERP developer acting as a clearinghouse. The quick response time afforded by this system bring users back for more cooperation. Others make extensive use of call centers to establish this cooperative bond with software users as well as to add vertical market knowledge to the product, as required by the user. Either way, the ERP developer is able to closely monitor shifting demands at lower costs, generating a learning process for all parties involved. Whereas the sector’s institutions (Hollingsworth 2000; Owen-Smith et al., 2003) seem to be in place in the financial segment, an appropriate institutional arrangements and incentives

structure may be missing or underdeveloped in other main segments of the Brazilian software industry.

In fact, there remain several important challenges for Brazil to successfully migrate its set of domestic competencies to the international market. First, it is important to distinguish between product and service firms, despite the increased blurred of the boundaries between the two. With the current scenario of Indian dominance on the international service and related-system integration arena, entry requires competitive cost, low technological ability, but an ability to signal process capability. This is done either through reputation or investment in process certification schemes, such as CMM. Both are difficult to justify in an environment of strong growth in domestic demand but low client sophistication in most cases. As a result, firms have been slow in gearing up to the international services market. With the strong devaluation of the Real and an anticipated decline in local demand we will perhaps see a reversal of this trend. Yet, these aspects may not help growth in the international product arena. Early stages of product testing are often done in the domestic market, which sometimes pays enough return on the investment (Branscomb and Auerswald, 2001). But the full potential exists in the international market. As firms move to later growth stages beyond the local environment, product marketing costs and knowledge outstrip the financial resources of software developers, requiring a renewed financial and strategic structure, some of which seems to have begun. For both areas, another area of major concern is the atomistic structure of the software development industry coupled with ever the fiercer competition from foreign software firms, particularly in the high-end segments of the market. This suggests the design of policies aimed at promoting increase in scale and scope, direct and indirect, through Mergers and Acquisitions and collaborative alliances. A number of somewhat larger size firms is necessary to anchor needed networks for shared and

complementary innovation and marketing activities characteristic of flexible production systems, particularly in the international market.

Second, domestic software firms, both products and services, excel in their vertical market knowledge and capacity to structure low cost solutions. But the increasing competitive pressure of foreign firms on their niche vertical markets puts them in a bind, which may risk the domestic market that locals have used to establish themselves and are banking on as a stronghold for internationalization. Large users tend to adopt a risk averse purchasing attitude that favors the selection of established foreign suppliers, whereas SMEs are not willing to pay a premium for the domestic firms' unique knowledge. The trick is to stay ahead of the foreign competitors by constantly entering new growth market segments, large enough to generate margins to finance the development of component-like products which could assist them in facing up foreign competitors when these niche markets mature into full blown markets and to be able to provide a superior service and semi-customized products at low cost to an expanding number of SMEs, especially in areas where these are also growing to become larger and more competitive, perhaps with international ambitions. The policy track to be pursued here is to subsidize early users in the adoption of new products and provide incentives for research centers to assist firms in turning their vertical service experience into component-like products. Complementary, local support to the establishment training organizations for the production of labor for software factories in low cost areas can contribute to the firms' capacity to sustain a low-cost strategy which allows them to focus their managerial and technological energies on higher value-activities.

The still missing institutional link here is the state. Amsden and Chu (2003) have suggested that the strategy available to latecomers willing to acquire second mover advantage in the service sector –lack of cutting edge skills in national firms, mature foreign technology,

important economies of scale and wherein national firms are put in direct competition with foreign firms in the national domestic market -- lies in the state-led networking. This requires the state to influence firm size, structure, and degree of specialization substituting for the personal trust that shapes and strengthens networks in classic producer sectors and producing firms with large enough capital and project management capabilities to face foreign competition. These large firms will have the expertise and the capability to seize the opportunity to enter foreign markets and diversify into “newer” mature service lines. Be it in Taiwan, where the state plays the role of networker be it in Ireland where it becomes a flexible developmental state (O’Riain 2000, 2004), in both cases its ultimate goal, together with large capital enterprises, is to act as seamless enabler second move advantage. As Amsden and Chu aptly put it: “... a latecomer network contains no internal, organic mechanism to drive it because it lacks technology at the world frontier. The role of driver must be assumed by big business and the developmental and regulatory arms of latecomer state.” (2003: 18)

In the end, the success of the deepening of the alternative evolutionary path of the Brazilian software industry hinges on the firms’ ability not only to react to current organizational and competitive constraints. But rather they ought to actively shape their institutional environment, preferably in a collective fashion, so that they economize on transaction costs and, conversely, maximize their strategic learning. Therein lies their competitive trump card. In the careful monitoring of the evolutionary course of the domestic market, particularly its learning components (Wolfe and Gertler 2002; Wolfe 2002), lies the key to turn the curse into a lever of competitiveness.

To conclude, this chapter has argued that the curse of the domestic market may be turned upside down to promote development in the software industry that is more sustainable and fine-

tuned to the emerging vertical market outsourcing software demands. It has also argued that software is a critical component in economy-wide productivity enhancement, and more importantly in organizational learning. In this regard, it has shown that the Brazilian software industry is well poised to take advantage of these emerging trends due to its evolutionary path that has generated learning drivers and pragmatist mechanisms, inducers of learning by monitoring relational knowledge. On the policy front, there is a requirement for the Brazilian state to become more of a flexible developmental state (O'Rian, 2000) in the path of self-discovery of a policy framework that promotes the economies of specialization at the industry level, by supporting small firms acquisition of learning capabilities and economies of scope by assisting the implementation of monitoring institutions. Challenges remain, but the prospects are bright.

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<sup>1</sup> The calculations and sources for the values aim to reach a value that is in line with the values considered by India and Ireland, that account software outsourcing and packaging services in the total values. So, the values for 2001 are obtained as described:

- The 2001 values were converted using the annual average exchange rate 1US\$ = R\$ 2.3504
- Hardware sales values are directly obtained from SEPIN statistics
- For services, estimated software services sales are subtracted from total IT services sales reported by SEPIN
- Software Products correspond to software sales data reported by SEPIN – a narrow criteria for defining software
- Software Services. We verified that the reported SEPIN services were mostly associated with hardware, making it difficult to compare with other international statistics. Using data from INFO Exame (2002) we estimated a conservative value for software services in 2001. Data for software is thus calculated as follows: Revenues for the top 20 in the Outsourcing segment is US\$ 1.2 billion. The segment Providers adds another US\$ 500 million. And Development and Integration adds a further US\$ 1.1 billion. Consulting (top 10) accounts for US\$ 260 million. Totaling these four segments into a software Services category, we reach US\$ 4.06 billion. In the same source (INFO Exame 2000), the top 20 software sellers reported revenues in 2001 are US\$ 1.6 billion, far below the reported SEPIN value for Products revenues of US\$ 3.6 billion. The difference is probably accounted for the other more than 3.000 SMEs that make up the bulk of the highly fragmented Brazilian software industry.
- Adding SEPIN's Products value of US\$ 3.6 billion to our estimated US\$ 4.06 billion for Software Services, we come up to a total value for the industry of US\$ 7.66 billion.
- The calculus of the Software revenues for 2000 was made according to the following methodology. First, we calculated the percentage value of Services in 2001(Reais equivalent) over the total for IT, as reported by SEPIN (21.36%). Next, we calculated, based on this share the value of the Services segment (R\$ 5.5 billion). Finally, we subtracted from the SEPIN reported value of (IT) Services this value, to arrive at the value for Software Services in 2000, R\$ 7.31 billion. These values were then converted using the annual average exchange rate 1US\$ = R\$ 1.8302.

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