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Brazilian Software: the Quest for an Export-Oriented Business Strategy

By
Alfredo Behrens

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Brazil, IT figures at a glance

Demography	**Population (millions, October 2002)**	**175.2**
	Number of households (millions, 2000)	**44.7**
	Urban households (2000)	**83.7%**
	Rural households (2000)	**16.3%**
Macroeconomic	**GDP in USD$ billions in 2001($1,309bn at PPP)**	**$503bn**
	World ranking in HDI (2000)[1]	**74**
	Current account balance (as % of GDP, 2002)	**-2.5%**
	Inflation (last twelve months, September 2002)	**7 %**
Business	**Ranking as per Transparency international (2002)**[2]	**45, of 102**
	Business environment ranking (2000 to 2004)	**61.8% of USA grade**
	EIU e-business readiness in 2002[3]	**Rank 34 63% of USA**
Internet	**Number of active Internet users (millions, 2001)**[4]	**6**
	Households with PC (2000)	**10.6%**
	Households with TV (millions in 2000)	**38.9**
	Households with telephone (millions in 2000)	**17.8**
Investment in IT	**IT services, USD$ billion (2002)**	**$4.7**
Software	**Packaged software market USD$ billion (2002)**	**$2**
Hardware	**Computers, servers, etc. USD$ billion (2002)**	**$5.2**
	Networking and communications equipment in USD$ billion (2002)	**$1.1**
Telephones	**Fixed phone lines (millions, 2000)**[5]	**38.3**
	Cellular (millions, August 2002)	**31.6**
	Households with Cable TV, millions (2001)[6]	**2.1**
Credit and debit cards	**All credit cards in 2001 (million)**	**35.3**
	Cash cards in 2001 (million)	**119**
	Number of all credit card transactions 2001 (million)	**1.027,8**
	Value of credit card transactions in 2001 (USD billion)	**27.35**
Banking information[7]	**Number of current accounts in 2001 (millions)**	**63,2**
	Number of savings accounts in 2001 (millions)	**14.872**
	Number of active ATMs	**14.872**
	Branches, ATMs and others in 2001	**42.043**

[1] IDH, UNDP
[2] Transparency International

How we got here

The origins of the Brazilian IT sector

There is always a beginning, but the most likely one to start a history of Brazilian software is during the military regime that took over Brazil in 1964.[8] Until then, foreign companies led much of the development in Brazilian IT. During the early sixties these companies brought with them the first computers. Then, the mainframe was king. Some networks operating dumb terminals could be seen by the late sixties and early seventies.

Foreign companies contributed decisively to the training in manpower, both in-house as well as through short courses and also to the shaping of university curricula. Besides, they created a market for specialized labour.[9]

The penetration of IT devices and methods coincided with a political regime that had constrained the activities of political parties; much of the political energy was channelled through professional associations. The latter, comprising mostly young and highly trained staff, increasingly advocated the internalisation of know-how on the production of IT material.[10]

The nationalist stance of the professional IT associations was greeted by a military administration sensitive to national security and independence on strategic issues.[11] It was this teaming-up of otherwise unlikely bedfellows which brought about the framing of Brazil's IT policy.[12] The latter was strongly focused on IT hardware. [13]

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[3] Introducing the EIU's e-business-readiness rankings
[4] Nielsen Netratings, ABRANET claims 9 million, the Ministry of Telecommunications claims 23 million.
[5] Ministry of Communications estimates that 49.4 million fixed lines were in operation in August 2002, when 98% of the lines were digital lines.
[6] ABTA, Brazil
[7] http://www.febraban.com.br/dados1.asp
[8] Government policy explicitly invited local manufacturing of computers since the fifties. For a comprehensive review of players and intentions in the framing and development of the Brazilian IT policy see Tapia, Jorge Ruben Biton: "A trajetória da política de informática brasileira (1977-1991) atores, instituições e estratégias;" PhD dissertation, University of Campinas, November 1993.
[9] The Pontifical Catholic University of Rio de Janeiro (PUC-RJ) is acknowledged to be the first university to house a mainframe computer in Latin America. PUC-RJ teaches software courses since 1961 and still by the mid seventies it was attracting students to its Master's degree from as far as Chile and Mexico.
[10] Adler, E. The power of ideology: the quest for technological autonomy in Argentine and Brazil. Berkeley, California University Press, 1987, page 8.
[11] The Brazilian Navy was keenest in securing technological independence in computing capacity, but the Brazilian Foreign Office was also involved in achieving independence in this area in order to ensure reliability and confidentiality in its international communications with its own embassies.
[12] This was the high time for the Brazilian IT acronyms such as Sucesu; the veteran association representing those active in the IT sector was founded as early as 1968. CAPRE (Portuguese acronym for Coordinating Commission for Electronic Processing Activities, created in 1972)

This pro-local manufacturing stance had a long history of support of an economic logic, of sorts: make locally products whose imports were on the rise. The military's concern regarding acquisition of know-how in the manufacture of computing devices was paramount. Besides, the new technological elite wished to secure a niche for themselves in Brazilian manufacturing. However, the import substitution policy in the IT field was partly triggered by trade imbalances, particularly after the first oil shock (1973) and sought to stem the outflows of scarce hard currency.

Thus, the drive for local manufacturing of IT equipment managed to garner a somewhat broader support base than just the military and the highly skilled workers: the country's managerial technocracy supported the alliance while a modernizing cadre of entrepreneurs also saw in the import substitution a lucrative business opportunity.[14] Local operations initially concentrated on the repair of equipment. Encouraged by the familiarity gained with the servicing of peripheral IT equipment, a local industry cropped up, initially around the production of video terminals, but later expanded under a host of tax incentives. This led to a bitter dispute, never quite resolved, in which foreign companies refused to become junior partners in companies to whom they would have to release proprietary technology. Annoyed by IBM, Brazil sought the collaboration of a variety of then lesser-known computer manufacturers, i.e. Italian Olivetti, British Ferranti and German Nixdorf; and went along with a policy of manufacturing locally IT products, which were rapidly being superseded abroad.

Brazilian development and funding agencies like BNDES and FINEP also became instruments for supporting the local manufacturing of IT products, as well as the local development of technology.

Digibrás (Brazilian Digital Company, a holding company, created in 1974) and SEI (Special Secretariat for Informatics, created in 1979) the latter reporting to the National Security Council and with oversight over the process of regulating and consolidating the transfer of digital technology to Brazil.

[13] Schwartzman characterizes this phase as one of "bureaucratic insulation" in which science policy decisions were made with little observation of formal peer review processes. Schwartzman, Simon, "High Technology vs Self Reliance: Brazil enters the computer age" MIT Symposium on "The Computer Question in Brazil", Cambridge, Mass. April 18, 1985.

[14] The eccentric alliance of military, IT pioneers and managerial technocracy yielded a surprisingly innovative cadre of public employees. Take, for instance, the case of Telebrás, the former holding of state-owned telecommunication companies. This company recruited its staff amongst the best public management schools as well as in the top IT-oriented schools. Liaisons with the French telecommunication framework were strong and soon the Brazilian Telebrás was pioneering with computer-based intranets. They went as far as taking over a local manufacturer of PCs and transformed the design of those PCs into virtual communication engines that were deployed among thousands of Embratel employees across the country. The employees were able to communicate by email in the late eighties when they would also access databases and engage in collaborative efforts to keep tabs on prices and develop a nationwide price index, while the government was relying on the efforts of a traditional school of economics approach, limited to a handful of metropolitan cities.

The broad-based support gave way to an IT policy known as “market reserve”, which in practice meant that import licenses of IT products were subject to the scrutiny of government officials and to discriminatory import duties or outright banning. The operationalisation of this policy under the leadership of the Special Secretary for Informatics (SEI) was most important from 1980 to 1984, when the law of Informatics was passed, but SEI continued shaping policy well into the late eighties.[15]

The “market reserve” policy took formal shape and involved an array of props:

- Tax breaks favouring domestic production
- Prohibition of imports of products similar to those produced domestically
- Manufacturing of IT products and accessories was restricted to national companies, meaning those that had their financial and technological decision centres in Brazil.
- High tax burden for the import of allowed IT products
- Non-national IT enterprises were required to export
- Enterprises were required to invest in R&D and manpower training a share of their revenue

In 1984, after decades of arbitrary industrial policy decisions backed by a military government and as a transition to civilian rule was taking place, the market reserve policy became law, ensuring the protection of local manufacturers from foreign competition. While the law provided a more stable investment environment it also crystallized the discouragement of foreign competition, leading to substantial smuggling and an unfavourable price/quality ratio of Brazilian made IT products.

Software, in the form of operating systems, was the centre of a bitter trade dispute in 1987, which led to the later dismissal of the market reserve policy. Microsoft’s MS DOS version 2.0 was banned by Brazil’s SEI in October of 1987, alleging the existence of a similar local product, which Microsoft believed to be largely a pirated version of its own.[16]

The banning of MS DOS in Brazil brought about the threat of American trade retaliation. Cleverly, the USA government threatened to retaliate without going as far as publishing a list of targeted Brazilian imports, i.e. all Brazilian exporters to the USA felt under pressure. This mobilized against SEI a significant share of Brazilian exporters to the USA, as well as local manufacturers of IT products not as keen on using the local versions of Microsoft. Thus, the veto of Microsoft’s MS DOS, and the threat of American sanctions brought together unlikely partners such as orange juice, shoe and aircraft exporters, as well as a share of local manufacturers of IT products.

[15] The Informatics Law was passed in October of 1984.
[16] Data on software sales for this period is scant. Tapia (op. cit, page 228, believes that software sales in Brazil in 1987 amounted to $624 million and that 90% of them were imports, leaving $62 million for local developers.

This group demanded a revision of SEI's decision, which was obtained for Microsoft's MS DOS version 3.3, in January 1988, scarcely four months after SEI had vetoed version 2.2 of the same operational system. By May 1988 Brazil had a new Software Law that met most of the interests of foreign software developers. The Software Law did not explicitly denounce the market reserve policy in place, yet the disputes that led to the Software Law showed that the "market reserve" policy could be overturned in the near future.

The IT market reserve policy, and the law it gave place to, subjected the local market to high prices for low quality or backward IT products, as well as delays in the penetration of IT in the productive processes. By 1990 the strangling of the IT sector was considerable and a policy loosening was sought by way of allowing the imports of parts and accessories. To the foreign opposition to the "market reserve policy" local industrialists added their weight. Many among the latter again feared American retaliation to their products in the USA, while local manufacturers felt that the limitations that the policy was impinging upon industry would threaten the country's competitiveness in other fields. As a consequence of this renewed local and foreign opposition to the market reserve policy, it was overturned.

The new IT law (1991) no longer discriminated as much against foreign companies.[17] Tax breaks no longer benefited only national enterprises, the new IT law focused on priority areas but, most importantly, the new law sought to protect the industry while encouraging innovation. Protection would now require reciprocity, for instance, investing at least 5% of gross revenue in R&D activities.[18]

The costs of manufacturing IT devices fell, the grey market (smuggling) lost much of its lustre, domestic competition increased and a consolidation of the market took place. This resulted in fewer, but larger, local IT companies that sought commercial partnerships with foreign manufacturers. The latter ranged from joint ventures to distribution channels. By 1993, though the tax incentives for local manufacturing were maintained, the incentives now benefited foreign companies as well, attracting companies such as Compaq, Acer, IBM and, later, Dell.[19]

This new drive towards efficiency was also encouraged by government purchases, now released from having to choose bids with the lowest price; and quality would now be allowed to play a role in deciding government purchases.[20] Besides, while earlier tax benefits used to be granted on the basis of an index of local manufacture, now tax benefits were now granted depending on agreement to Basic Productive Processes (PPB, Portuguese acronym) which allowed targeting on niches of the productive process. Companies were now also required to attain ISO 9000 certification in no longer than two years.

[17] Law 8.248/91
[18] 2% must be allocated to research in partnership with universities.
[19] Local manufacturing was exempted, until 1999, of 15% tax on industrialized products.
[20] Decree #1.070/94.

Thus, the Brazilian IT sector was protected from the start, helping local hardware producers to multiply their turnover 20 times during the decade ending in 1990 (reaching $4 billion) when the roof was blown off the greenhouse by economic liberalization trends.

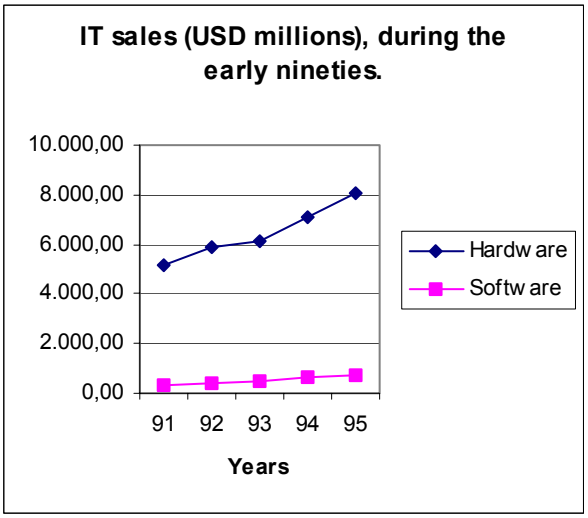

Figure 1 Ministry of Science and Technology data.

While the market reserve policy was overturned in 1991, the government's insistence on adherence to PPB procedures granted local manufacturers a price advantage of up 35% price advantage for legally imported similar PCs.[21]

The end of the market reserve policy shaped the policy for the software sector

By the end of the market reserve policy there had been software development for some time in Brazil. Software like Microsiga, the pioneering Brazilian ERP system, was widely used from the early seventies; and the country policy makers had been intent in sponsoring an alternative to Microsoft's Disk Operating System through to the early eighties.

But a software policy as such had played a second fiddle to the quest of building a national hardware capacity. Hardware has industrial potential and managed to attract the interest of quite a few of the modernizing entrepreneurs propped-up by the official development funding system, whose loan analysis guidelines favoured hardware.

Much of the Brazilian software policy was tainted by the same siege mentality that pervaded the shaping of the hardware policy. For instance, at times the software protection policy required that imported software be registered with an official agency which required the software coding to be revealed. It is not surprising that few foreign software developers agreed to reveal their trade secrets. Yet hardware issues always had the lead and took most of the bureaucratic wisdom and concern.

The end of the government's protection of the Brazilian IT hardware sector, in October of 1992, meant that this industry would be hurt most. It would consolidate and merge with the foreign giants. The consolidation would free a substantial number of qualified employees who would find scant opportunities in Brazil.

[21] A bitter complaint reflected in "ExportIT, Brazil, an update", US Department of Commerce, July 2002, page 5.

Software development offered an employment alternative and export growth potential. Softex was created, allegedly to break the lack of funding for the domestic software industry and to penetrate international markets.[22], [23]

Softex was a program created within the CNPq, Brazil's Council for Scientific Research (whose functions are similar to those the French CNRS). Softex was the first (1993) of three pillars of an IT development initiative, the other two being ProTeM and RNP (National Research Network), precursor of the Internet in Brazil, these last two begun in 1994.[24]

Born from the vision of CNPq's Directors, the Softex initiative had close professional relationships with several foreign-trained software experts who were active in a few Brazilian cities.

CNPq's efforts secured funding for the launching of the Softex program in early 1993.[25] Softex would support autonomous and geographically dispersed nuclei, which, fostering ties with local authorities and clients, would seek to sponsor software developing and exporting capabilities. These independent nuclei would promote the sponsoring of local software labs, incubators and software training, including training on business issues. The Softex nuclei sprung up around universities, but were prompted to seek local support and to respond to local needs.

Scarcely six years after the launching of Softex there were 21 incubators sponsored by Softex through the program Genesis. Yet their existence begs an immediate question: if Brazil had the capability to develop software, but only needed to "learn" to export software, why would it have been necessary to develop new companies? Would it not have been better to focus first on those companies with an already proven track record and products and support those to find new markets? This seems to have an obvious answer, for it would be almost impossible to reach the $2 billion exports target with start-ups.[26] Softex was meant

[22] Brazilian Society for the Promotion and Export of Software, Softex for the Brazilian acronym of Software Sociedade Brasileira para Promoção e Exportação de Software, created in 1992 and operational in 1993.

[23] The target was reached by assuming that it would be possible to capture for Brazilian software a share of the international software market equal to that of Brazil in international trade, slightly above 1%.

[24] PROTEM's purpose is to refocus research in IT and to promote closer links between research groups and industry; RNP is reckoned to be the most successful of the three CNPq initiatives; its purpose was initially to link Brazil's main research centers into an international computer network and later to facilitate the operation of the Internet.

[25] The project's initial core funding came from the UNDP Grant CNPq/Pnud/BRA92/019, February 2, 1993.

[26] In private communications both Maria Helena Tourinho and Paulo Tosta da Silva (BNDES and Finep, respectively) both claimed that the larger Brazilian software companies were reticent in embarking in software exports. It may well have been true and this would explain why Softex diverted its attention towards incubators and small companies. Further ahead I will deal with the lack of incentives to export among the larger software houses.

to promote exports, not to start-up companies for software development. It may make sense to have an agency to take care of promoting incubators, training and the like. But if the purpose had truly been exports, there would be little need of promoting the development of completely new software development companies. Thus, without letting go of its original attributions, Softex had added a host of new obligations.

By the mid nineties Softex had begun establishing offices abroad. Poor results led to a policy reversal and to the closing of these foreign offices, already numbering ten. A Funcex report criticizes Softex for the choice of the foreign representatives offices, as the private entrepreneurs seemed to be focusing mostly on the Latin American market and the Softex offices were elsewhere.[27]

In 1996, the CNPq Program Softex came to an end, not before allowing for its "privatisation'. Softex legally turned into Sociedade Softex, no longer a Program within CNPq, but now a private contractor of CPNq, [28] to be led by a council representing Brazil's IT community, as it can be represented by IT users, developers, resellers and government agencies.[29]

For all its strategic shortcomings, Softex has secured a niche for itself as the clearing house for information regarding software development and publishing in Brazil. Under the Softex aegis several commendable initiatives have prospered, including a Brazilian Software online catalogue in four languages.[30] In addition, since Softex's refocus on

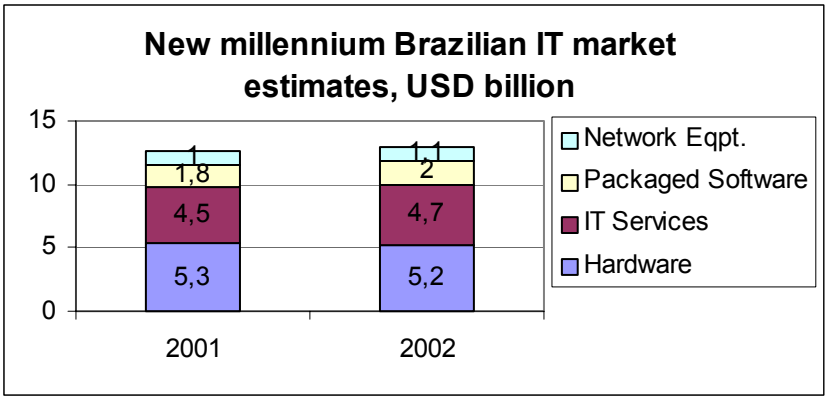

Figure 2 Source: IDC through US Department of Commerce, ExportIT: Brazil, an update, July 2002.

[27] Funcex, A Experiência Exportadora do Setor de Software Brasileiro: o Caso da Softex, July 1998, Rio de Janeiro, page 54

[28] This again illustrates what Schwartzman (op. cit.) took as an example of bureaucratic insulation. Over a decade Softex officials would be also drawn former government of legislative staff, taking positions at Softex after having funded it from the federal budget.

[29] The list of the IT society represented in the Council of Softex includes, CNPq, FINEP, ASSESSPRO (Brazilian software developers) ABES (mostly foreign software developers) SUCESU (veteran society of computer users) ABINEE (representing electro-electronic industry, including heavy industry) BNDES (national development bank) SEBRAE (Technical support provider for small and medium enterprises) APEX, agency for export promotion and SBC, Brazilian Computing Society.

[30] http://www.lightinfocon.com.br/port/products/lb/samples/softex/index.asp?lang=port . However, a quick search for "security" in "bank automation" yielded only one solution provider, despite hosting 102 entries for "bank automation" in March 6th, 2003.

the promotion of quality aspects of Brazilian software, a renewed effort was put behind getting to know the field, and assessing how many are doing what in Brazilian software. As it turns out, Softex's membership now reaches almost 900 members, but it has dropped its export orientation.[31]

Size of the sector, performance, expectations

Statistical description of the software sector

When the government removed the protection of the IT hardware sector, in 1991, hundreds of well-trained Brazilians, who had spent their best years being trained on hardware issues, or who were working in that field, risked being laid off. Many turned to software development. There had been a competent software development core working on operational system issues, but not much of a software industry, except that related to data processing bureaus. So Brazilian software development, barely over three decades old, saw a flurry of new companies starting up during the nineties.

By 1995, all software sales in Brazil stood at $706.5 million and were only 9% of hardware sales. Software development companies were employing 4848 staff, of which 2413 held university degrees and 12 held PhD degrees.[32]

By the end of year 2002, International Data Corporation expects the Brazilian packaged software market to have grown to close to $2 billion. Brazilian software development remains small because it is largely confined to the domestic market.[33]

The software industry accounts for only 0.12% of all formally employed Brazilian labour. [34]

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[31] 877 members in July 2001.

[32] Data inferred from small sample data collected by the Ministry of Science and technology. The data was collected on only 133 software companies and 231 hardware companies and is available at http://www.mct.gov.br/Temas/info/Dsi/pan9195/T9195_11.htm

[33] Estimates of Brazilian exports of software vary widely. The highest thoughtful estimate is $200 million for year 2002; and includes the hard-to-price software embedded in, say, cellular phones. Probably actual software exports in 2001 were not higher than $150 million.

[34] This relative political insignificance entails a relative dearth of official statistics regarding the sector's activity and structure. The Brazilian Ministry of Labour and Employment, through the RAIS database, collects annual data on formally employed staff by all companies in the whole spectrum of economic activity. This universe comprehends 5.5 million companies. Those focused on software development and related consulting, comprised 16,067 companies in 2001. In any year, software companies may have hired formally employees who are not longer active by the reporting date, when such employees are said to be inactive. In this research piece, aimed at assessing the overall size of the Brazilian software sector, both active and inactive employees are considered. This renders a staff number that is approximately 30% above the figure for staff effectively employed at the annual reporting date, but, on the other hand, allows taking into account the total amount of people that the sector formally mobilizes to produce its output. In addition to the variations in the numbers employed along the year, the number of hours contemplated in their contracts may be well vary substantially while remaining under the standard 40 hour week.

Well paid, but not too much

Of the almost 39 million Brazilians formally employed in 2001; 45,789 had been employed by the software development and consulting sector where, on average, the employees were making $331 per year, or only 60% more than the average formally employed Brazilian, who was making $207 per year with roughly half the average schooling.[35]

Elite labour in terms of training

Nonetheless, though the software development sector is small, by Brazilian standards it is an elite sector in terms of the qualification of its manpower. The level of schooling in software companies is substantially higher than the national average: a full 83.3% of the labour force of software companies has at least a complete secondary education (eleven full years of schooling) while only 39.4% of Brazilian employed labour shows a comparable level of schooling. Further, the share of labour with at least a university degree is more than double the comparable average share for Brazil.

Also worthy of note is the substantially higher percentage (five times higher) of staff with incomplete university education in the software companies.

Personnel in software companies, by schooling level, compared to all Brazil

	Software	Brazil
	%	%
Under 4 years	1.0	9.5
Full 4 years and under 8 years	4.1	24.7
Full 8 years and under 11 years	11.6	26.5
Full 11 years	36,6	25,2
Incomplete university studies	19,1	3,8
BA and above	27,6	10,4
Total	100,0	100,0

RAIS database, 2001

The relatively large share of labour with full secondary education in the software sector testifies to the success of an educational policy of providing IT technical education at the high school level.

[35] Please bear in mind that this pay rate is a very poor indicator of the hourly pay for an IT worker effectively commissioned. Because the IT sector is more prone to hire staff under less formal agreements than old economy industries the above pay ratio is even a poor indicator of the pay ratio of IT staff vis-à-vis most industries. Yet, even then, while this indicator substantially underestimates hourly pay in the IT sector, 60% above the national average is telling that we are looking at a vigorously paid labour force.

Female workers make up 37% of the labour force of software companies and are relatively homogenously distributed throughout all schooling levels.

South-eastern Brazil claims more than half the industry

The regional distribution of employment is heavily concentrated in the south-east of Brazil, which accounts for 55% of employment. This is the most heavily industrialized core of the country, and it includes the states São Paulo, Rio de Janeiro and Minas Gerais, states which seat three of the countries largest software clusters: in the cities of São Paulo, Campinas and Rio de Janeiro.

The south-west, which holds Brazil's capital city and its heavy bureaucratic data-processing services, claims 22% of formal employment in software. The south of the country accounts for 17% of formal employment, mostly concentrated in not more than three creative software poles.

Small size prevails

A full one-third of the labour force is employed by companies with less than 20 staff. Half the labour force is employed by companies with under 50 staff, three quarters of the labour force is employed by companies with under 500 staff.

Distribution of staff by company size

Number of Staff (brackets)	Formally employed		Cumulative
	Absolute	%	%
Zero	1164	2,5	2,5
Under 5	4379	9,6	12,1
5 to 9	4421	9,7	21,8
10 to 19	5308	11,6	33,4
20 to 49	8008	17,5	50,8
50 to 99	4736	10,3	61,2
100 to 249	4532	9,9	71,1
250 to 499	2294	5,0	76,1
500 to 999	3837	8,4	84,5
1000 +	7110	15,5	100,0
Total	45789	100,0	

RAIS database, 2001

Very young labour force

The age structure of the labour force points to a very young labour force. Almost two-thirds of the labour force is under 30 years of age. Almost 90 percent of it is under 40 years of age.

Foreign labour is largely absent from Brazilian software

Brazilian born staff represent 99.6% of the labour force out of a total of 45789 staff employed in the software sector in 2001.

The highest contingent of foreign-born staff are Latin Americans, with a grand total of 73 staff. The highest sole country foreign-born nationals are the Portuguese, with 27 people. There were only six North American working in Brazilian software in 2001.[36]

This dearth of foreigners formally employed in the Brazilian software industry deprives the sector of the informal links to the global software industry, and thus to potential demand abroad for Brazilian software services.

What software is produced today in Brazil

The last publicly available software census effort was carried out during 2001 and refers to the universe of Softex members in year 2000. Membership to Softex tends to be limited to companies active in software development, publishing or distributing, besides those developing software for their own use.[37]

For all the above caveats, Softex has data on 699 companies formally and informally staffed by up to 67,000.[38]

Three quarters of the large companies were launched prior to 1980. But two thirds of the software companies opened since 1991, at about the time the hardware sector was deprived of the system of protection known as "market reserve". Since the software sector is relatively new, it is not surprising that over three-quarters of the companies in Softex's universe are small, staffed by less than 50 people, with almost 36% being staffed by less than 5 people, and a full 52% of them staffed by less than 10 people.[39]

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[36] Some of the few North Americans formally employed in the software sector may be there more for their knowledge of English than for their software skills.

[37] Membership to Softex cannot be taken to be an indicator of the breadth of activities in Brazilian IT, and even amongst those active in software, it is quite likely that Softex does not cover as well the very small companies, those with less than 6 employees.

[38] The Softex 2001 Census is based on the reports of 699 companies of the 877 in Softex's universe. Note that the total employment reported by Softex is about 50% higher than the total formal employment figure rendered by official Ministry of Labour (RAIS) statistics, which focuses only on formally employed labour across the full universe of software and consulting companies. At the time of the Softex census a federal representative running for re-election already led Softex. The Softex census was carried out with the support of the Ministry of Science and Technology and the preliminary results, on which these comments are based, can be found in the above ministry's site: http://www.mct.gov.br/sepin/Dsi/CensoSW/censoSW2001.htm Accessed on March 6th, 2003.

[39] Staffed refers to all types of relationship to the company, from owners to trainees and those outsourced.

Distribution of companies by staff			
Rank	**Number of staff**	**Number of companies**	**%**
Micro	1 to 5	123	17,9%
	6 to 9	123	17,9%
Small	10 to 49	287	41,7%
Medium	50 to 99	67	9,7%
Large	100 to 500	68	9,9%
	over 500	21	3,0%
Total		689	100,0%

Software Census, Softex, (2001)

There are large companies involved with software activities, some of the largest undertake quite a few other activities. Some of these large companies are associated with banks, such as Scopus is with Bradesco, providing internet banking facilities and ATM and other servicing activities. Scopus, S.A. claims to be staffed by over 900 people in its Via Anhanguera (SP) facility alone. Itautec Philco, S.A. boasts about 2500 people in Sao Paulo alone, where it develops software and produces ATMs besides PCs, servers and consumer products.

What do the software companies do?

Almost 60% of all companies active in software develop packaged software or develop software for third parties. When asked whether packaged software development is the sole software development activity, 12.7% replied that it was.[40]

Very few, only 10%, develop software that will be embodied in hardware devices.[41] The share drops to 1.7% when the same companies were asked whether that was their only software development activity.

A full 17% of surveyed companies publish or distribute software, but only 2.6% declared that to be their only activity.

A full one third of the companies declared to develop software for its own use, but only 2.8% of them declared that to be their only software development activity.

[40] Note that the sample reflects only 194 companies that have an exclusive software activity. The percentages of sole activity are taken with 699 as the base.

[41] Companies demanding software to be embodied in their hardware tend to be large and few in numbers. Software being developed for them would also be concentrated in a small number of developers. On the other hand, customized software developed for non-embodied uses serves a much broader array of purposes, and large amount of clients, and therefore of developers.

Type of role in software-related activities			
Type of activity		**Number of replies**	**Percentage of total replies**
Does Develop software	Packaged	413	59,10%
	Customized	400	57,20%
	Embodied	71	10,20%
	Internet-related	289	41,30%
	own-use	233	33,30%
Publishes or distributes third party software		117	16,70%
Does not develop nor distribute software		60	8,60%
Total number of replies		1.583	
Software Census Softex (2001)			

While some software developers seem to be well plugged into the software demand by other sectors (57%), only 5% develop software exclusively for third parties, signalling a relative lack of specialization in the segment.

Something similar seems to happen to the Internet-oriented software developers: while a full 41% of the sample portray themselves as such, only 2.8% make their living exclusively from developing software for the Internet.

A similar, if less steep, drop takes place amongst own-use software developers: while a full one third of the sample claim to produce software for their own use, 2.8% of the sample exclusively develop software for their own use. [42]

It looks like in Brazil we have a universe of relatively small companies developing packaged software. A full 59% do that. Yet only 13% percent of the sample exclusively produces packaged software. To reach the market Brazilian software developers are supported by more than 120 publishers, yet only about one in ten of those that declare to publish or distribute software do exclusively that.[43]

[42] Many of those that produce software for own use are large companies with large software developing units, such as banks. Some may also sell software for third parties, perhaps even packaged software but, by and large, they seem to be very different from the rest of Softex's universe.

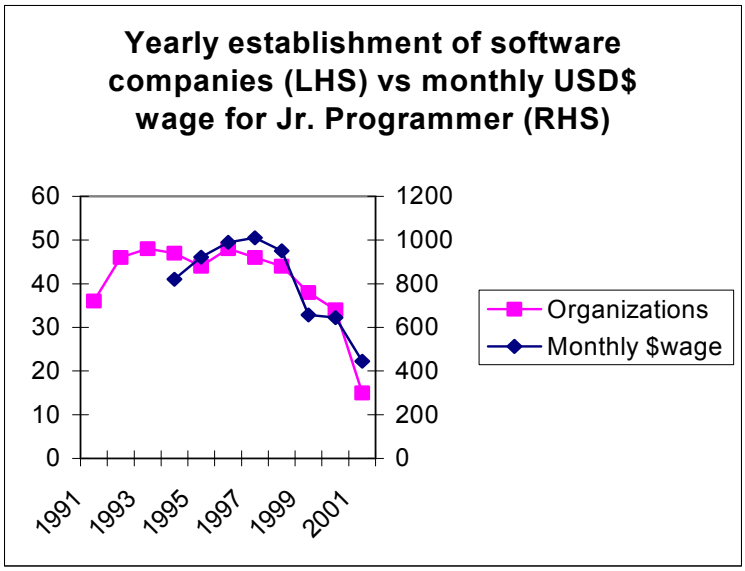
[43] A caveat: while there are many good reasons for software developers to affiliate to Softex, there are not that many for software publishers or distributors to do the same. It is possible that the Softex sample underestimates the share of software publishers and distributors in Brazil.

Why so little specialization among software companies?

In all, Brazilian software developing companies are still coming of age. Only one third of respondents to the Softex survey were founded before the lifting of the market reserve policy in 1991; meaning that two thirds of software companies affiliated to Softex are, at most, a decade old.

Since the lifting of the market reserve the software companies were being founded at a rate of about 50 a year until about 1997, when both the rate of start-ups and the monthly wage of Junior. Programmers began to drop in earnest. The wage issue is dealt with in greater detail in subsequent sections. But both trends illustrate the fragility of the new Brazilian software industry.

Among the largest companies in the survey, those companies with 500 staff or more, all were founded before the lifting of the market protection policy. Even 78% of the second largest cohort, those companies with under 500 staff but more than 99, were founded prior to the lifting of the market reserve policy. On the other hand, over 83% of the companies with less than 10 staff were founded after the lifting of the market reserve policy.



Thus, Brazilian software companies tend to be new and small. Worse, while still new and small they were hit by a recession that cut deeply into wages. It is not surprising that so many of the new and small Brazilian software companies still have to define a market niche for themselves.

Very few seem to have a focus capable of plugging them into the other sectors, to which they sell their services: those that produce customized software or that

produce embodied software account for only 6.7% of the companies surveyed (47 companies altogether).

Yet, without a clearly defined area of specialization it is hard for a software company to develop products that it would be capable of servicing abroad if they were exported.

Domestic versus foreign market shares

Software sales in 2001 by the 30 largest software-developing companies active in Brazil amounted to $2.1 billion.[44] Brazil is at a loss when estimating the amount of software exports. Most knowledgeable estimates consider that $200 million a year is probably the ceiling of all software exports in 2001. This figure includes the hard-to-price embedded software developed for cellular phones and the like. It is quite possible that Brazilian exports of software were closer to $150 million than $200 million in 2001.

This means that total exports would be less than 10% of total domestic sales by the top 30 software companies active in Brazil. Exports as a share of all domestic software sales may be closer to 5%. This means that the Brazilian software industry remains a domestic-oriented industry in a rapidly internationalising economy.[45]

Recent foreign investments created a new demand for software. The new software would now be required to blend seamlessly with the software solutions used worldwide by foreign investors in Brazil. The foreign software developers, or their internationally accredited integrators - such as the international consulting companies – would now stand a better chance to fill the new demand more promptly and at a lower risk than indigenous solutions would.

The fast denationalisation of Brazilian industry and services led to a shift in the relative significance of local software developers. In the view of the President of the Brazilian Association of Software Developers (ASSESPRO) the market share of Brazilian companies in the sales of the largest 50 companies selling to the Brazilian software market dropped by half in the five years at the close of the millennium.[46]

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[44] Info Exame, number 185, 2001, actually posts the sales of the 200 largest IT companies, of which this author selected the 30 software developers among them.

[45] A measure of the speed of internationalization is the rapid growth of Foreign Direct Investment (FDI). The stock of FDI in 2000, which stood at $103 billion, was 2.5 times the amount in 1995. Industry accounts for one third of the most recent investment foreign investment stock and services for most of the rest, given that agriculture accounts for only 2% of the stock of FDI. Central Bank of Brazil, http://www.bcb.gov.br/mPag.asp?perfil=1&cod=550&codP=137 (accessed on March 6th, 2003)

[46] From 38% to 16% according to figures presented by Ernesto Haberkorn, President of Assespro, the association of Brazilian software developers, in communication to the annual meeting of the association at Atibaia, October, 2001.

In the Info Exame sample (table below) there are 18 foreign software developers which account for 87% of domestic sales by the top 30 companies. Twelve Brazilian companies account for the rest. The average sales per employee for all companies in that sample is $197 thousand, but the average sales per employee among the foreign software developers is $393 thousand while it is only $71, thousand among the Brazilian developers. Only four foreign companies posted sales per employee below the overall sample average, while only one Brazilian company posted sales per employee above the sample average.[47]

[47] The staff numbers of the foreign companies include only those employed in Brazil. No foreign companies declared research expenses in Brazil. The only one that did appears to have declared the cost of software development worldwide. The total number of employees in that sample is 10711.

Software houses among Brazil's 200 largest IT companies, by sales (2000)

Company	Sales in USD thousands	Year on year growth of sales	Net profit in USD thousands	Number of employees	Research investment in Brazil in USD thousands	R&D as share of sales	Sales per employee in USD thousands	Country of World headquarters
MICROSOFT	438600	38,98	N/D	280	N/D	N/D	1566	American
BROADVISION	413916	256,22	38 673	2300	N/D	12,5	180	American
COMPUTER ASS	260000	4	N/D	360	N/D	N/D	722	American
ORACLE	227156	66,23	N/D	800	N/D	N/D	284	American
CONSIST	138136	N/A	N/D	600	N/D	N/D	230	American
SAP BRASIL	127903	-23,5	N/D	450	N/D	N/D	284	German
DATAMEC	105214	-15,91	17 874	833	N/D	N/D	126	Brazilian
INTEGRIS	57309	-39,92	-660	341	N/D	N/D	168	French
DBA	53772	41,57	2 035	1069	1450	2,7	50	Brazilian
DATASUL	43 803	-11,3	-1 412	137	4257	N/D	320	Brazilian
SYBASE BRASIL	27801	11,78	N/D	79	N/D	N/D	352	American
PEOPLESOFT	26712	107,19	N/D	225	N/D	N/D	119	American
EVERSYSTEMS	25346	49,42	8 088	354	N/D	N/D	72	Brazilian
JD EDWARDS	25 000	N/A	N/D	108	N/D	N/D	231	American
NOVELL	22800	0,69	N/D	55	N/D	N/D	415	American
RM SISTEMAS	21580	51,7	2 112	380	2942	13,6	57	Brazilian
INFORMIX	18674	44,96	N/D	60	N/D	N/D	311	American
SYMANTEC DO BRASIL	17500	N/A	N/D	28	N/D	N/D	625	American
STERLING COMMERCE	15073	-2,03	262	33	N/D	N/D	457	American
NETWORK ASSOCIATES	14381	10,02	-4 897	33	N/D	N/D	436	American
MÓDULO	13364	144,75	-4 106	261	3518	26,3	51	Brazilian
ATT/PS INFORMÁTICA	12 901	-1,13	21	179	1028	N/D	72	Brazilian

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Company	Sales in USD thousands	Year on year growth of sales	Net profit in USD thousands	Number of employees	Research investment in Brazil in USD thousands	R&D as share of sales	Sales per employee in USD thousands	Country of World headquarters
PROGRESS	10120	62,99	114	47	N/D	N/D	215	American
PROCENGE	7460	-14,49	402	143	155	2,1	52	Brazilian
THRU PUT DO BRASIL	7001	N/A	N/D	38	N/D	N/D	184	American
PL ALCORAN INFORMÁTICA	6770	-41,51	-1 392	220	225	3,3	31	Brazilian
SISPRO	5894	-8,86	332	215	313	5,3	27	Brazilian
BRQ	5662	-9,56	259	293	N/D	N/D	19	Brazilian
i2 TECHNOLOGIES	5600	N/A	N/D	18	N/D	N/D	311	American
CETIL SISTEMAS	5364	6,22	-165	250	452	8,4	21	Brazilian
Totals	2104780			10711				

Domestic benefits of Brazilian IT and software prowess

Beyond Internet, Brazil is a highly networked economy

Amongst countries in Latin America, Brazil stands out as one of the four most networked economies in the region.[48] The appreciation of network readiness takes into account the availability of telecommunications infrastructure that will carry the message, as well as the connectivity to the World economy. Also the accessibility and affordability of the network to the domestic users are crucial to this index, as is the existence of a servicing capability to ensure a high degree of availability of the network itself. Brazil fares 38th in a World ranking of network readiness, but only 54th in public access to the Internet, as a result of a significant digital exclusion, partly on account of a comparatively high average cost of $14.73 for 20 monthly hours of dial-up access and packages of $40/moth of broadband access.

Comparative drive towards networked economy 2001

	Harvard's NEI (2001)	Country's Drive Index[49]
Argentina	3,71	0,5
Brazil	4,01	1,3
Chile	3,80	0,8
Mexico	3,57	0,6
Uruguay	3,67	0,7
Average		0,8

While Harvard's NEI is illustrative of a country's preparedness to relate to a networked World, it neglects the magnitude of the effort deployed to do so. Presumably this effort should be greater the lower the average of income per capita. Once we take the income difference into account, to reflect the drive, or relative effort, put by each country in achieving its network preparedness, Brazil comes up at the top of the Latin American ranking in 2001. See table.

This drive towards a highly networked Brazilian economy appears despite a low penetration of PCs per household, as low as 10.6%. PCs , and perhaps even internet access, remain unaffordable to a large contingent of the population. Nonetheless, workers piggyback on company internet access and the population at

[48] **Readiness for the Networked World,** Harvard's Center for International Development study for the World Economic Forum. Harvard's NEI Index attempts to portray a community's degree of preparedness to take part in an interconnected World. Accessed on March 5, 2003

[49] Harvard's NEI was divided by the World Banks 2001 estimate for each country's income per capita in thousand dollar units.

large piggybacks on someone else's internet access, contributing to substantially increase the accessibility ratios from the estimated 6 million persons (US Department of Commerce) to 9 million estimated by the association of ISP providers, or the 14 million estimated by the Yankee group, or the 23 million internet users claimed by the Ministry of Telecommunications.[50]

The government has also been intent on deepening the PC penetration and Internet connectivity, favouring over 13 thousand schools and over 7 million students by the end of 2002. The public post office system is also promoting internet kiosks at over 5000 selected point-of use sites and the government is planning to offer every Brazilian an email address. These public accessibility-oriented initiatives garner the support of NGO's who offer access points and training in low-income neighbourhoods, and private for-profit initiatives seek operational alternatives offering Internet kiosks at convenience stores and bakeries.

Spreading accessibility is not the only government target. The government itself has moved promptly to become a keen Internet user, providing over the Internet 72% of the available federal services to the public. The federal government has also engaged in e-procurement, opening government purchases also to small and medium sized companies. State governments are also rapidly following suit, both in e-government and in supporting public accessibility.

These and other initiatives have made Brazil the Latin American leader in e-government and have promoted the country to 20th World ranking e-government user.

Nonetheless, while PCs are present in almost 50% of the upper income households, only 4.8% of the lower income households have them (socio-economic C and D households). Moreover, 20 hours of monthly Internet access in Brazil, as a share of income per capita, comes at nearly 8 times the cost in the USA and over twice the comparable cost in Argentina and Uruguay.[51]

Despite this low PC penetration and high cost of Internet access, e-commerce has flourished in Brazil. International Data Corporation estimates that e-commerce in Brazil had reached $5.3 billion in 2001. This may be an upper estimate; nonetheless, e-commerce is poised to grow rapidly once legislative barriers are sorted out.[52]

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[50] ExportIT Brazil: an update, July 2002, U.S. Department of Commerce. Page 15 and 16.

[51] Brazilian overall tax rate on telephone services, at 40.2%, is two to three times higher than the tax burden in many neighbouring countries; in Mourão, Ronaldo R de F. "Por que pagamos tão caro pela telefonia?" Telebrasil, June/July, 2002, page 46.

[52] By late 2002, an election year, the Brazilian congress had not adequately dealt with e-commerce

Largest ten Internet based financial transactions, 2001

	Type	USD$ millions
Banco do Brasil	Public	3686
Bradesco	Private	2802
Itau	Private	2500
HSBC	Foreign	1458
Unibanco	Private	1167
ABN AMRO	Foreign	938
Caixa Econ. Federal	Public	851
Bank of Boston	Private	667
Banco Santander	Foreign	623
InvestShop	private financial	210
Ten largest		14902

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One indicator of overall software use is e-commerce. Taking orders electronically is only the beginning of the transaction, making sure that the products are in stock and will be delivered, besides tracking the operation, has required deep streamlining of the managerial procedures of the companies adopting e-commerce. That streamlining relies in varied levels of enterprise resource planning software and gauging the depth of e-commerce penetration provides an indirect way of gauging the penetration of software in Brazilian business practices. In 2001 the 100 most active e-transaction providers of Brazil clocked almost $23 billion in sales, almost twice as much as in 2000.

Brazilian banking automation enabled the quick transition to e-banking which was induced in the mid-nineties, as a response to the loss of float revenue stemming from lower inflation rates. The low value of average Brazilian banking transactions put further pressure on banks to reduce operational costs by promoting e-transactions. The results are impressive; the ten financial institutions in Brazilian e-banking were responsible for $15 billion dollars in 2001. The three first institutions account for 61% of the total and are three largest Brazilian banks, the two second ones are private banks and account for 36% of all e-transactions.

B2B Largest ten operators, 2001		
	activity	USD$ millions
Ford	cars	1921
Mercado Eletronico	e-market place	833
Intel	computers	688
Genexis	e-marketplace	500
Cisco	computing	499
Porto Seguro	insurance	325
Grupo VR	prepaid restaurant	250
Itau Seguros	insurance	202
Ticket Servicos	services	201
Ten largest		5420

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Business to business e-transactions accounted for $5.4 billion in 2001, almost $2 billion by Ford alone. Intel sales are 100% carried out over the Internet, still a feat to be achieved by its American headquarters. E-markets account for $1.3 billion

Business to consumer transactions are expectedly less prominent while the ten most prominent sold $700 million in 2001. Automotive sales account for almost $490 million of those sales, while about $120 million can be considered frequent e-purchases direct to individual customers.

Perhaps the highest constraint to faster development of B2C e-commerce is the lack of adequate fulfilment expertise in a country so vast. Brazil cannot, as the USA did, build on an established sales-by-mail industry capable of reliably distributing small sales across the country. In all, one can say that while e-commerce require a substantial physical infrastructure to work on, both digital and organizational, Brazilian software developers and technicians have significantly contributed to achieving an impressive growth of e-sales.

B2C largest ten operators, 2001		
		USD$ millions
General Motors	automotive	435
Mercado Livre	auctions	78
Carsale	automotive	38
Americanas.com	retail	30
Submarino	retail	30
Itautec Philco	computers	21
Magazine Luiza	retail	20
Lokau.com	auctions	19
Ford	automotive	16
Ponto Frio	retail	16
Ten largest		703

Info Exame, May 2002, pg 68

Why does Brazil export so little software?

In earlier sections we have argued that Brazil's software industry is relatively new, mostly made up of small companies led by young staff. Few of these are being been built around a product on which they specialize. By and large, the small companies end-up dispersing attention on various activities, without achieving a

core competency that may allow them to sustain an international activity. Besides, the domestic market, as illustrated by the achievements in e-government and e-business, has provided a substantial area for the domestic companies to work for.

Nonetheless, the earlier section points out to the threat posed by international software companies encroaching into the domestic market, largely since the mid nineties. Brazilian companies will have to compete internationally even if they aim at sustaining a large domestic presence. Where would the export drive come from?

There are older and larger companies, staffed by more experienced employees, but many of those companies grew around or inside larger conglomerates, in the financial or even in the public services. These nominally software companies may not excel in selling software services to third parties, preferring to focus on developing software for their own use.

In 2001 there were about 40 companies staffed by between 50 and 100 employees and founded in the last 10 years, which have therefore shown a significant growth profile. There are a further 100 companies which were founded since the mid nineties which are staffed by between 10 and 50 employees, which have shown a significant growth potential too, surpassed by only 10 companies which, having been founded in the same period, are now staffed by over 100 employees.[53]

Past growth record would suggest that there are less than 300 Brazilian software companies that have shown the aggressive domestic growth that would indicate the potential to become an international winner. Nonetheless, perhaps only 200 of those could muster on their own the financial and organizational clout necessary to succeed internationally.

Yet, when it came to design an official software export promotion program – Softex - in 1992, the government was dealing with a different universe. The market reserve policy had just been lifted and all companies would now have to attempt to survive in a more competitive scenario. Then there were probably less than 300 software companies started prior to 1992, of which less than 200 would survive until the 2001 census (and enrol in Softex). Of those that did, about 100, would fail to grow to over 100 staff in the next ten years.[54]

Today's export by software companies is shaped by opportunities, past potential and public policies. Opportunities were plenty, and many sectors we will discuss in greater detail. For instance, in Internet banking, Brazilian banks pioneered this, sustaining well into the late nineties the World third place in number of Internet customers. If competence in software development was illustrated by examples such as in Internet banking, and the cost advantage was held by software developing costs less than one half of American ones, why was Brazil not

[53] Softex Census, 2001 http://www.mct.gov.br/sepin/Dsi/CensoSW/2001Tab10.htm accessed on March 8th, 2003.
[54] Softex Census, 2001, op cit.

exporting more software development services, at least in internet banking services?

That Brazil was not exporting triggered the official response to market failure: in the way of technical, information and financial props by government. This policy was steered by Softex, to which we now turn.

Picking out the likely international winners in 1992 can only have been a daunting task, despite the number of companies being so small: perhaps even too small to deserve an official program such as Softex.

Software export performance, allegedly Softex's raison d'etre, was unsatisfactory. At its inception, in 1993, official Softex estimates deemed possible that by the close of the century the software exports of Softex-supported companies would have reached USD$2 billion. However, by 2000 all software exports, supported by Softex or not, may have reached, USD$100 million, twenty times less than promised. These results, despite Softex's best efforts, beg the obvious question, what went wrong?

In first place, even without the benefit of hindsight, one would have to readily admit that to expect to bring Brazilian exports of software products from naught to $2 billion in seven years would have been an exaggeration, to say the least.[55] Nonetheless, current levels of software exports still seem to be depressed, given the size of the international market, given Brazil's capabilities shown in the domestic market, and despite the effort developed in training and deploying almost 10 selling outlets abroad. So, what went wrong?

The real reason is that Softex was not client-led. Rather than Softex helping to figure out first who the clients might be and then sorting out how and what products could be sold to them, the drive was put behind pushing what was available. Much of the latter had been developed by mimicking foreign successes or developed to sort out local business environment problems. None of these offered good prospects for success abroad.

If the drive had been put behind what Brazil was good at - low-cost competence in software coding within similar time zones as the leading markets - the push-stance would have been, at least, less of a failure. Yet Softex authorities went about assuming that the foreign market would readily take what Brazil had to offer for the domestic market. That it did not do so readily was a sobering experience, and in the eyes of our brave officials, the resistance could have only been due to lack of information: this is why Brazil invested public funds in software branding.

[55] The initial mix of Brazilian software did not offer much in terms of customized software development. Most of what was on offer consisted of clever work developed with the local market in mind, after all, Brazil was coming out of a market reserve scenario.

In all, up until 1997, Softex had expended $4,090,300 in taking 117 Brazilian software developers to nine international fairs (five COMDEX fall, three CEBI, one in Argentina). Of the total above, 31% was paid by the exhibitors with own or shared resources.

By a deadline, for a fixed price and with a two-year free maintenance guarantee "thrown in", the Code Partner Solution Centre offers software development in São Paulo. Code Partner have made this sales stance their competitive edge after learning (-by-doing) that customers may not know how to define the software solution they want or need. Most software developers, eager to reach closure, accept to deliver ill-defined products that later require adaptations which are charged for, further aggravating the client.

On the other hand, Code Partner expends considerable effort in training clients both to specify their demands and to learn the constraints under which developers work out their solutions to the clients' problems. This client-led and cost-conscious approach to software development led Code Partner to focus on careful budgeting and quality process controls based on CMM2 and ISO 9001 procedures. This attitude is at the core of their ability to offer a fixed price, to observe a deadline and to offer a quality guarantee.

Code Partner believes that their offer is a strong incentive for potential clients to dispel the reluctance with which they must appraise competing offers by independent and smaller software developing houses, like themselves. Nonetheless, Code Partner, has grown to employ 125 programmers deployed over five largish domestic partners. Besides, Code Partner has plugged itself to the computing department of a prestigious local university both to secure competent manpower, and to ensure that they remain abreast of technological innovations.

It was an important effort, considering that the two-year expenses for support of nuclei (mostly incubators), during the three year period 93-95, Softex's budget to support all 14 nuclei in Brazil stood at $2,196,803, or 78% of the amount spent by Softex at the fairs.[56]

The Funcex appraisal of Softex is at a loss when attempting to quantify the total resources managed by Softex.[57],[58]

Since Softex was strongest at funding a network of incubators throughout the country, the market orientation of those incubators is an important marker of the importance that market orientation played in Softex.

It is hard to assess how much attention was paid by software developers at incubators to client needs. Arguably all the attention possible, as incubators should take ideas that cater for the market. Yet, when headhunters were asked what were their most-searched areas for IT personnel, it turns out that Softex-supported incubators were developing services for less than half of those areas.[59]

The areas of expertise of the IT professionals that headhunters seek out is an indicator of what the market is in need. It does not meant that companies would be

[56] Funcex, page 93.
[57] Funcex, page 111-112. This is not to suggest malfeasance by Softex, but that it does not seem that the program was managed from the start with a view to being appraised. When it comes to the accountability criteria, Softex may not be worse than many official Brazilian programs.
[58] The Softex case in the Brazilian software exports sector. FUNCEX, June 1998, page 57.
[59] Desenvolvimento Estratégico em Informática. Project evaluation, UNDP, BRA/92/019, September 1999, Page 72.

willing to buy software developed by third parties, rather than develop it on its own. But if companies are willing to pay for expensive head hunting activity, there must be some action behind it and, largely, software incubators were not on to it, indicating some departure from healthy client orientation in the Softex-sponsored incubators.

Market factors

Before someone comes up with a lazy idea like throwing more money to the Brazilian software sector one would want to analyse why this sector has performed so poorly in terms of exports. First we will analyse market attitudes and institutional factors.

Foreign client-orientation is mostly what Brazil is lacking in

Achieving client focus is hard for the small companies, particularly if they are away from the large industrial and trade centres.[60] Those that have escaped smallness do show a significant focus on the client's needs. See for example the (boxed) case of Code Partners. Here we have a company making its business model out of pleasing the client. The company offers not only to deliver for a fixed fee and by an agreed deadline, but also to stand behind its product by offering free corrections if necessary. Much of this business model depends on the credibility of Code Partner to deliver. While this can be shown personally and by a verifiable track record, the latter are not as readily accessible, or as meaningful, to foreign clients. An association with a reputable international consulting group was attempted but Code Partner continues to look out for strategic partners. [61]

Those companies that keep a close client orientation do flourish. They may suffer a difficult start but they grow. See the boxed BISA case. This is a small company that came to life in Recife - the left-leaning capital city of Pernambuco, a poor state of North-eastern Brazil. The sugar industry was in the doldrums and trade union unrest provided the core of the demand for BISA's services.

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[60] "Their software needs are a decade behind our software development capabilities" responded the head of an important IT business environment when I pointed out that the fresh fruit exporters of his hinterland may have some funds to spare for software to manage their business, for they were amongst the largest in a national fresh fruit export drive selling about $1 million a day.

[61] Code Partner has focused on dispelling a crucial hurdle in offering software development services: lack of reputation. While Code Partner may have an enviable record at home, it needs to reassure foreign clients of its reliability. By siding with an international management consulting company, Code Partner plays to the transitivity characteristic of reputation: to a foreign client Code Partner may be at least as reputable as the international consultants know to the clients. For the significance of reputation and strategies for software developers see A. Banerjee and E. Duflo: "Reputation Effects and the Limits of Contracting: A study of the Indian software industry. 2001 mimeo of paper forthcoming in Quarterly Journal of Economics.

The BISA case is illustrative because here you have a small software company which started in a poor state whose mainstay industry was folding. BISA's demand came from the trade unions, where unrest was being generated precisely by that industry's loss of markets. Keeping close to clients is harder for small companies. The larger companies know this well and some have developed ingenious ways of securing access to new markets and opportunities.

Bisa was set-up in 1991 and its main area of focus is catering for the organizational needs of trade unions: management of affiliates, mail campaigns, office management. As the left-leaning trade unions have grown, and its most sympathetic party, the Workers Party, has succeeded in obtaining the mayorship of an increasing number of cities, BISA's line of products has shifted towards office automation. BISA is now present in 23 Brazilian states, where it trains people to provide support to almost 220 institutional clients.

Gerino Xavier, Bisa's leader and co-founder, a graduate of the local Federal University with graduate studies by CNRS in France, believes in meeting the clients' needs and looks. His offices are cramped in a low-rent area of Recife (PE) one of the Brazilian states with lowest income per-capita. He has been invited to move to new premises at the business environment Porto Digital, but Gerino does not believe it is worth moving where rates are higher and parking is difficult. His clients do not seek what they will find at the Porto Digital, so it makes no sense for him to pay higher rent. Instead he spends considerable effort networking at congresses focused on the managerial needs of mayors and trade unions.

Among Bisa's leading products is Filiados 2000, software to manage databases of trade union affiliates, Partidos 2000, to handle affiliations to political parties, Jurídico 2000, to manage courtroom handling of labour cases, Mala Direta – to handle the communication between the trade union and its affiliates.

Gerino Xavier's penetration among trade unions, earned ideologically, by strong credentials, and long years of hard work, has helped him position BISA's software prowess in securing orders for relatively simple software products designed for office automation: Agenda: a PIM, an add-on to text editors to customize communications, Contabilidade 2000, a basic accounting facility, Finanças 2000, a cash and bank balance manager, among some 10 other software products designed and targeted on the needs of his clients.

At the other end of the size-spectrum we have Microsiga, and Datasul - the two largest Brazilian software houses active in Enterprise Resource Planning.

Microsiga, (see box) has a network of franchisees and develops software solutions on demand. Its main product is an ERP for small and medium companies. Microsiga has developed a Microsiga Institute, which purports to support software developers in the up-grade of ideas to reach a marketable stage. Through its Institute, Microsiga learns of new needs and new talents as well as supplying them with its systems, thus extending its system's reach into markets it could only penetrate at a much higher cost if Microsiga proceeded along the traditional path.

Microsiga has sustained a network of value added resellers (VARs) in several Latin American countries, plus Puerto Rico. These VARs find the clients and report the problems. Microsiga then develops in Brazil solutions for those clients. Through this network Microsiga keeps an ear close to the ground, feeling for new needs, developments and opportunities.

Datasul is the other of Brazil's two leading ERP software development companies. Datasul sells about $50 million a year, directly employs 400 university-trained staff and has about 1800 clients in 8 countries. Exports account for almost 5% of its revenue. [62]

Datasul was founded in Joinvelle, 1978, by Miguel Abuhab in 1978, mechanical engineer, and had AVEG, Latin America's largest maker of electric motors as its first client. Datasul's ERP solutions were first developed for AVEG and now work on Progress database platforms.

Progress database software has been at the core of Datasul's international expansion, which now includes, a strategic commercial alliance with Foresight an Atlanta (USA) based company with 50 software developers and 200 clients.[63]

Through Foresight, Datasul markets Frameworx —A Foresight Enterprise Solution Powered by Datasul. [64]

Microsiga grew around Ernesto Haberkorn, when Ernesto's SIGA software (1969) sought to integrate administrative, financial and costs in a one-stop managerial software. With the advent of microcomputers, in 1983, Microsiga was born and grew to catch almost 50% of the Brazilian market in small and medium sized companies willing to pay for a home-grown ERP software. Since 1998 Microsiga also offers solutions for departments of larger companies, and builds into new markets secured through partnerships. Microsiga has also made inroads into the automation of commercial ventures. It almost quadrupled its work force between 1993 and 1998, when it had reached 410 employees and year on year growth sales over 40% reaching close to $100 million nowadays, drawn on over 400 clients. In 2002 Microsiga had 800 employees.

Much of this expansion has been achieved under franchising. Microsiga has opened 35 regional offices. In 1998 it opened its first representative office abroad in Argentina. Microsiga's franchise network employs a further 1200 people.

The Microsiga Institute's Latin American Developer project, supported by Microsiga's many partners operates, aims to help bring into fruition ideas of Latin American start-ups. Relatively large start-ups (under $1 million in sales) submit to Microsiga's Institute their ideas in exchange for help in developing them. In this way Microsiga, builds partnerships, learns of new needs and extends its influence in Latin America at a low cost.

Like Microsiga, its largest Brazilian competitor, Datasul, is threatened by international ERP developers like SAP and, more recently, by Microsoft, who, in the last few years acquired middle-market ERP developers such as Great Plains

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[62] Phone interview with Datasul founder and President, Miguel Abuhab on June 24th/02

[63] To figure out the size of the Datasul's foreign partner we might see that the small corporation from Dublin, Ohio, recently made the news for recovering a $1,635 check from Enron, the Chapter 11 mammoth. Ilan mochari, "How to collect from Anyone, (even Enron)" in Inc. Magazine, September 1, 2002. http://www.inc.com/magazine/20020901/24541.html

[64] There are other Brazilian ERP competitors, but they still aim for a niche markets. For instance, RM Sistemas, based in Belo Horizonte, is a renowned player in the field of Brazilian software solutions for corporate Human Resources needs. RMS is now aiming at becoming a major player in the retail ERP Brazilian market and has sold (2002) software licenses in Mexico. In this new Brazilian niche RMS may find itself competing with the likes of Empresário and Loja Fácil, the latter catering for small shops. The lower end of the market quickly becomes geographically fragmented. See box on Loja Fácil.

(USA) and Navision (Europe). Navision is active in Brazil and is searching for partners.

Datasul's founder believes that the 100 to 150 thousand Brazilians trained to use Datasul software is a significant barrier to entry of competitors in this market. Microsiga can boast a similar barrier to entry. Nonetheless, SAP scored a major commercial hit by announcing in the Brazilian media, during the first semester of 2002, that the largest Brazilian bank, Banco do Brasil, had agreed to finance the acquisition of SAP's ERP solutions by Brazilian small and medium sized enterprises willing to modernize.

Niche strategies

The strategies relied upon by Datasul and Microsiga are not necessarily expensive, but they do require a certain amount of size to work out. They are not open to all, except to the largest domestic players. If the smaller companies were to export they would be unlikely to be able to compete without an as clear client-orientation as Datasul and Microsiga. Some small companies may have a distinct product which, though developed for the domestic market, may either have some advanced qualities or fill a niche, capable of attracting the interest of foreign clients.

Módulo Security Solutions operates in the field of security systems for private networks. Its products include the security for the Brazilian IRS service over the Internet, and its crucial role in guaranteeing the security of the Brazilian elections, the World's largest with comparable density of IT solutions. Heatseeker for security networks and Safe Vote are its products. The latter earned Módulo and invitation to the White House to explain its services, after the botched American Election of 2001.

Módulo has opened offices in San Raphael and expects to sell over $1 million in 2002, still only 10% of its sales in Brazil. It has plans of setting up shop in Argentina, Chile and Mexico as well.

This seems to be the case for Módulo, a company that has a strong base in Brazil in the field of providing security for large computer networks, including the computerization of the Brazilian elections (see box.). It also seems to be the case with Epsoft - who sold a voice recognition service to Japanese banks, and of Sira Informática - who established itself with Beijing Development to sell environmental and agricultural software in China. Sira's products have already facilitated an increase in the sugar content of Chinese grapes, as well as better managerial integration of chemical laboratory analysis in Chinese agriculture. Cyclades sells communication hardware and migrated to Silicon Valley, leading Brazil to account for only 25% of its sales. Automatos also migrated to California, but undertakes its Management Service Provider software development in Brazil, where it holds 95% of its staff. Automatos' non-Brazilian market may account for 50% of its revenue. All these companies had an established record of niche home sales before they moved abroad.

Yet local success may mean only solving our problems, not theirs.

Brazil is the tenth industrial powerhouse of the World This manufacturing industry sits on top of a substantial telecommunications network and other infrastructure. Brazilian software developers have, within the country, a significant testing ground for software designed to enhance the productivity of industry. Nonetheless, the most pressing needs of industry may have to do more with Brazil's business environment than with industrial processes. While the first may determine the latter, and technology may be similar in Brazil and abroad, the business environment certainly is not. This is why I argue that software developed to solve Brazilian problems may not be as attractive abroad.

Brazil still has an array of business lines of credit in place, some effectively subsidized and rationed, practiced by official development banks such as BNDES. Yet access to those funding sources can be lengthy to the point of effectively being out of reach for the smaller software houses. Hurried software entrepreneurs, with little to show in terms of collateral, would also shy away from Brazilian commercial loans, whose real interest rates, fifth highest among emerging economies, hover at five times the average rate in developed countries.[65]

Not only capital costs are higher in Brazil, the final product frequently fetches a somewhat lower price in Brazil. The gist of the matter is that, for instance, a robotized mobile phone assembly plant costs more in Brazil, where it produces mobile phones that sell for lower unitary cost (see boxed case). Therefore, using plant capital more intensively, and for a longer period, is more in the interest of the Brazilian manufacturer that in the interest of the American one. This is why a software solution developed to reach a more efficient use of machinery in Brazil, will be more rewarding and attractive to a Brazilian manufacturer than to an American one.
Besides, the American manufacturer operates in a business environment that requires longer-term delivery contracts, with steep fines penalizing non-delivery. Not so the Brazilian environment. The American entrepreneur may balk more readily at buying unknown technology, which could conceivably lead to costly penalties if the optimising software did not measure up to its promise.

[65] Folha de S. Paulo, February 23rd, 2003, page B1.

In July 1998 less than 6 million mobile phones were in operation in Brazil. Since Brazil had to deploy some 20 million mobile phones in less than 3 years, producing them in manual assembly plants was out of the question. Yet mobile phone assembly plants in Brazil cost about $5 million and optimal use of those plants is paramount in an environment where capital is costly and where cellular phones sell for a lower price than international ones.

The assembly of mobile phones is robotized. There are so many robot arms movements involved in producing one mobile phone that correct sequencing of those movements will allow time saving, increasing the productivity of the plant. The assembly equipment, the $5 million hardware, comes with "thrown in" optimizing software that seemed to be poor. That software is commissioned by an industry which makes its money by selling hardware rather than software. It is understandable that the software may be poor: hardware producers will make more money by selling a new production line when the earlier one reaches capacity. Software which may extend the usability of an older machine will delay additional orders for their hardware and would cut into sales.

KMP's group of software engineers studied the problem in Brazil and concluded that they could do better (KMP is a fictitious name). With an eye to the size of the World mobile phone manufacturing industry, KMP outfit invested $700,000 in developing software to optimize the performance of assembly lines for electronic components in Brazil. KMP proved it could enhance performance, in some cases by as much as 25%. In most cases KMP's software enhanced performance by 12 to 15%. In one case in Sao Paulo, by deploying this software, a company expanded production capacity to the point of making redundant the commissioning of a fourth production line, thus saving the company $5 million in direct capital costs (plus perhaps another $4 million in interest outlays).

KMP's outfit sold 5 copies of this software in Brazil and with that behind them they went to a trade fair in the USA. Potential clients, mobile phone manufacturers were impressed but balked at ordering.

KMP's software for optimizing mobile phone assembly plants has not sold any copies abroad and the developers are considering selling the copyright to the software altogether.

Thus, when developing software solutions for industry, the choice of the problem to solve is as important as the solution itself. If one finds out the problem in Brazilian industry but not in American industry, no matter how good the Brazilian software solution may be, it will be harder to sell in America.

Brazil's banking software arena

The peculiarities of the Brazilian business environment, which may have played against our hero in the case of mobile phone assembling software, may also provide significant opportunities.[66] If a Brazilian company wants to sell abroad a packaged product it better have one with fewer competitors in its target market.[67] Brazil cannot claim such lead in many areas, but finance is one area where Brazil stands a chance.[68]

[66] See case on software for mobile phone assembly plants.

[67] Technology minded people may play down a foreign market's "irrational" resistance to buying products or services originated in a country not renowned for producing them. Yet, the Country of Origin Effect is real enough and Brazil does not yet have a technology savvy appearance in World markets. The Brazilian Agency for Export Promotion, APEX, reports that a preliminary research commissioned to PriceWaterhouseCoopers found out that the international market at large expects five S's from Brazil: Sand, Sun, Sound, Sex, Sports; allowing no "S" for Software. APEX, "A primeira exportação a gente nunca esquece" 2002, in print.

[68] Others are agribusiness and industrial automation.

Brazil has experienced many years of erratic monetary policy and ensuing inflationary spurts that required, at times, daily micromanagement by the Central Bank. Domestic banks were thus spurred to deal with interesting bearing current accounts, very fast clearing facilities and flexible enough bank automation as to accommodate a regulatory environment in a state of flux.[69] These characteristics, while not present in all other markets, led the Brazilian banks to design robust and flexible banking automation software which in turn made their banks very tech-oriented.[70] The robustness had to deal with size and changing environments. The volatility of those environments was what rendered the flexibility that Brazilian banking software now can offer.

Brazil's peculiar three-decade long history with volatile inflation patterns led its banks to automate. While banks could thrive on managing balances eroded by inflation, they could afford to remain relatively inefficient. However, only by automation were they able to cope with their large size, with the regional dispersion of its clients and with the fast changing banking regulations aimed mostly at curbing inflation.

For instance, holding onto customers during a period of high inflation required that customer balances were rewarded. At the time (early 1980s) this was not allowed by banking regulations. Yet commercial banks found a way out: they would borrow from clients overnight, and lend those funds out in the secondary market for government bonds. This required that banks were capable of both, keeping track of whom they had borrowed relatively small amounts from and making sure that due credit was given to the lenders by bank opening hours the next morning.

Banking automation was necessary to keep track of these transactions, which being small and numerous could not be handled quickly enough by bank clerks. This is part of the reason why the Brazilian financial system became so highly automated. Once this was achieved, banks' staffs were familiar with technology, and an elite within the banks was technologically advanced. This is how Brazilian banks converted early into Internet banking.

Besides shaping the relationship of banks with their customers, the fact that banks are so technically oriented, has helped to shape the relationship between the banks themselves and between them, the clearing houses and the Central Bank. This is how this environment came to adopt, in April of 2002, the Brazilian Systems Payments. By means of this regime, banking transactions will be cleared in real time across the country. The system became effective in July 2002. This has required fully linking almost 17 thousand branches, almost 7000 points of customer services, plus the whole network of ATMs.[71]

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[69] 1680. Brazil's Efficient Payment System: A Legacy of High Inflation Robert Listfield and Fernando Montes-Negret (November 1996) World Bank

[70] To the point of Brazil featuring the second Internet banking facility in the World. Its largest private bank, Bradesco, has an online community third only to Bank of America and Wells Fargo.

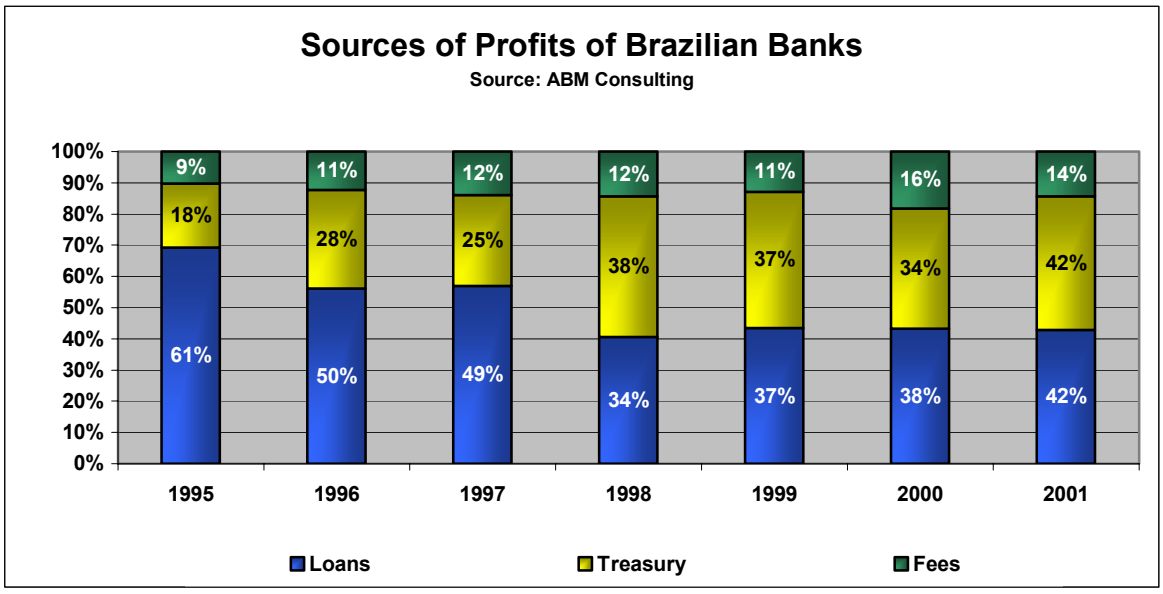
[71] Automação de serviços financeiros no Brasil, Economia e Tecnologia, 4(5) September 2001.

The market volatility also induced the Brazilian banks to take advantage of the Internet, as a means of remaining close to its customers. As the size of the banks grew through consolidation, the Internet helped the banks to reduce its operating costs. The top ten Brazilian banks by the size of their Internet activities performed transactions for $14.7 billion during 2001, a quarter of which were undertaken by the largest bank, Banco do Brasil. Bradesco and Itaú, the two largest Brazilian private banks account for a further 36%, while the topmost foreign bank, HSBC, accounts for 10% of that share.

The two largest private Brazilian banks, Bradesco and Itaú have in-house software development facilities. Bradesco has Scopus and Itaú has Itautec Philco. Both these banks own the software and have the financial clout to market it abroad. Yet they have not. Why?

Major bank players

The two largest private banks, those who would be inclined to license their software abroad, have developed their software largely in house. While this may be understandable, it also means that their captive software houses, which hold the software development capability, are institutionally tied to the banks. The latter operate in a near oligopoly, make very high yields and do not see selling software as part of their business.



Brazilian banks take few risks; about 60% of their high profits stem from low risk activities. Why should they engage in selling their competitive software?

Yields in the private banking sector are large, both in relative and in absolute terms. These banks consistently peg net returns over 23% on their own capital and

yield profits well over $550 million a year.[72] Profits from software exports are unlikely to yield such margins in the first few years. The result being that the in-house software developers are discouraged by their private banks from seeking profits from sales abroad of software services. Since the sheer size of the two largest Brazilian banks swamps the rest of the market, selling their software in the Brazilian market also offers very limited opportunities.

The most likely result is the stagnation of the banks' software houses. For, while the banks were able to attract competent software developers at the time the banks were automating, the banks will no longer be able to attract such developers when they are not growing as fast.

Clearly, in the case of the largest financial software houses, the limitation to export stems - not from insufficient funding by government agencies, nor lack of project management skills, nor from lack of client orientation - but from an institutional ownership limitation. It is the banks' vertical integration that stifles the commercial aggressiveness of captive software developers.

Other constraints

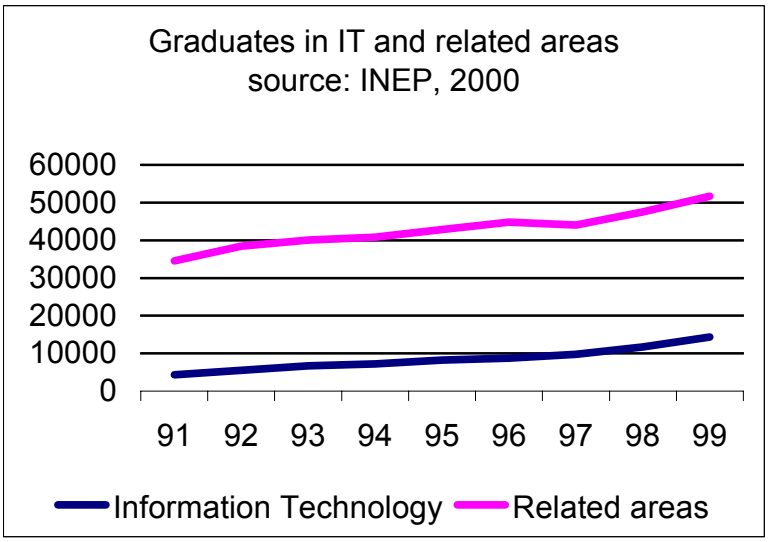
Skills

The market reserve policy - perhaps too strong - perhaps too long-lived - did provide an incentive for the development of an indigenous IT labour capacity. Brazil may be approaching 900 IT PhD's in 2002, yet this says little on the matching of skills to demand. It is quite likely that a significant retooling went on in Brazil, as hardware lost ground to software production, when the former lost its protection.

The IT sector and research and training policy

The following paragraphs will discuss the growth of the Brazilian IT manpower, segmented by level of training, in order to illustrate the magnitude of the effort in bringing the Brazilian IT sector to its current size.

[72] Yet, in 2000, Brazilian banks were still not particularly efficient. The ratio of staff and administrative costs to operational revenue, averaged over 13 of the largest private Brazilian banks, comes out at 85%, about double the international satisfactory ratio.



The undergraduates

Students graduating with IT degrees stood at over 14 thousand, in 1999, 3.3 times more than in 1991. Students graduating in related areas stood at 37.4 thousand in 1999, only 23% more than in 1991. [73] There is no doubt that a substantial public effort was behind the growth in IT graduates.

Here we are considering undergraduates taking 3400 hours of course work, administered at a rate of about 800 hours per year. IT, being a relatively new field, is less stable in terms of course names and curricula, both of which have changed substantially over the 1991-1999 period. We have aggregated data for all courses directly related to IT, including Telecommunications. Some courses are more akin to those that we would want to work with, but in-house training smoothes the differences in quality/scope of undergraduate work. [74]

[73] Engineering (all branches, except Telecommunications), Electronics, Mathematics, Physics, Statistics, Sciences, Economics.

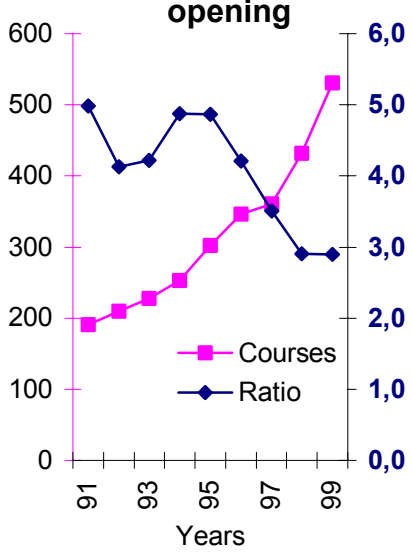
[74] Course names changed over a decade, but BA courses whose graduates are contemplated here as undergraduate courses in IT are: Systems Analysis, Data processing Management, Computer Science, Computing, Informatics, Data Processing, Computer Networks, Wireless Computing, Digital Technology, Telecommunications.

Post-secondary but non-university IT diplomas First semester, 1999 Source, INEP - 2000			
	Humber of hours	Number of courses	Graduating students
Basic IT	2000-3000	3670	341324
IT Technologist	2000-3000	796	12780
Technologist	1000	239	10382

In addition, this study considers related areas from which an eventually overheated software sector could draw skilled manpower. These are areas that could provide adequate manpower should Brazil face an IT labour bottleneck.

In addition, we must consider the post secondary **non-university** degrees. These come in three categories. The first two are called "Basic IT" and "IT Technologist" courses; and they require between 2000 and 3000 hours of training. The third category refers to the "Technologist" course, which involves 1000 hours of technical courses. These can be administered as post-secondary education but most schools may offer this Technologists diploma during the last two years of secondary education.

Number of IT courses offered and ratio of candidates per opening



While all three courses are non-university courses, they do provide a minimum of IT skills which companies can build on with further in-house training.

Evolution of IT vs. non-IT training

Both IT graduates and those of related areas have grown substantially over the last decade, see graph in previous pages.

The growth of IT graduates has increased, as well as the number of courses, but in excess of the appetite of the market for such training, as indicated in the diminishing number of applications to entries towards the end of the period. The ratio of applications to entries is now just under 3. Nonetheless, the surge in IT undergraduates has grown even as a proportion of those in related areas, from 12% at the beginning of the last decade to almost 38% towards the end of it.

However, the second tier is still so much larger that, if in 1999, only 5% of the second tier were "bought out" by the IT sector upon graduation, and assuming they were trained to 90% of the efficiency of the IT graduates themselves, the IT output graduate labour force for that year would increase by 16%. This means that Brazil, could, even in the short run, significantly increase its IT output and cater for an export market.[75]

The most highly trained

At the graduate level the picture is less bright than in the case of the undergraduates.[76] Graduate level course are heavily concentrated in the Southeast of the country, more so in the case of PhD courses, and to date (2001) graduate courses have produced only 5245 Masters and barely over 400 PhDs who took, on average, almost 60 months to complete their degrees. Only about 500 MSc and just over 100 PhDs graduate every year.

See the number of thesis dissertations, activity normally reserved to the most proficient among the highly IT trained: there are only 611 supervisors of MSc degrees. Of those, almost half as many can supervise PhD dissertations. So few highly trained IT personnel deprives the IT industry of conceptualisers. The latter are the ones who provide the interface between the problem and the coders. The conceptualisers help define the problem, structure it in modules and translate it to an algorithm the coders can work on. Conceptualisers do not need, but frequently have PhDs and are among the highest paid in Silicon Valley.[77] The relative scarcity of staff with conceptualising characteristics is a severe bottleneck to develop a self-sustaining software industry in Brazil.

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[75] It is not hard to believe that the overall efficiency of a small software company's staff could be even increased by the addition of non-IT graduates. For instance, many IT trained personnel working in non-software development activities could be immediately re-allocated to IT activities proper. Besides, most newcomers could be quickly brought o 90% efficiency levels when selected from the "related areas". Science and Engineering graduates themselves are already quite proficient in IT by the time they graduate.

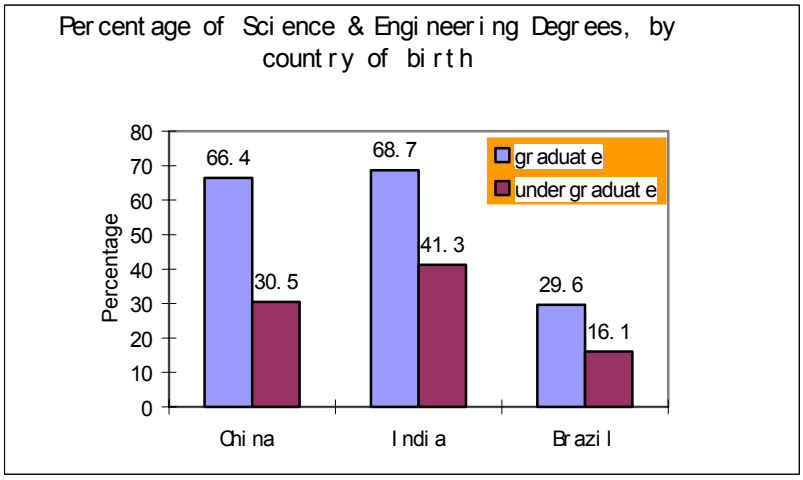
[76] From data by Jose Carlos Maldonado, presented at the XXIst, SBC conference, Fortaleza, CA, Brazil, 2001 with the title: Pos-Graduacão em Ciência de Computação no Brasil, Situação Atual

[77] "Conceptualisers: these are the architects of the industry. Their skill lies in translating a problem or a need into a blueprint for software to resolve it. They translate the process for solving a problem into the major logical blocks that would have to be built to solve it. They are expert in programming, and have wide knowledge of languages and programming approaches. They must be able to write down the specifications of the component blocks and explain them to designers and coders. "From THE PERIL AND THE PROMISE Broader implications of the Indian presence in information technologies by Ashok V Desai Senior Visiting Fellow, Center for Research on Economic Development and Policy Reform, Stanford University, Stanford CA 94304, August 2000, page 1.

MSc programs in Information Technology					
	Years				Total
	1998	1999	2000	2001	Up to and including 2001
Student entries	783	949	921	959	
Completing students	408	461	548		5245
Total number of students		1858	2442	2801	
With scholarships		680	639	741	
Number of supervisors				611	

PhD level studies, all regions					
	1998	1999	2000	2001	Up to and including 2001
Entering students	126	131	112	112	479
Completing students	47	65	74		
Total number of students		480	563	592	
Number of scholarships		257	268	273	
Average months until completion				59,52	
Number of supervisors				269	

Brazilians studying in the USA[78]



The relative lack of local highly trained IT output could be supplemented with Brazilians studying abroad. Saxenian and Desai have pointed out the importance of national networks of foreign IT students in the USA in outsourcing to their home countries hefty software development contracts.[79] Yet Brazilian students of Science and Engineering in the USA are only marginal - comparable to those of Thailand - and just over half of the share of PhD degrees earned by Turkey.[80]

Morevover, while over two thirds of the graduate students of India and China are studying technical areas (Science and Engineering), only 30% of a much smaller cohort of Brazilians do the same.

Since such a smaller share of Brazilians "stay on' in the USA after studying Science and Engineering, it is not surprising that they almost do not figure in the statistics of H-1B visas granted by the USA to foreign nationals.

What can Brazil expect from this manpower structure?

Brazil is producing domestically too few very highly trained IT professionals, and appears not to be producing many more abroad, as there are too few training in the USA, and training in the USA is a good proxy for the rest of the World. Only about

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[78] Data for this section, culled from the US NSF and the Immigration and Naturalization Agency, was kindly provided by AnnaLee Saxenian in private communication

[79]The Silicon Valley Connection: Transnational Networks and Regional Development in Taiwan, China and India* AnnaLee Saxenian, University of California at Berkeley, January 2001. Report for University of Pennsylvania Institute for the Advanced Study of India project on "The Context of Innovation in India: the Case of Information Technology Industry."

[80] National Science Foundation table 5 data for 2000, kindly provided by Annalee Saxenian. Of the total number of 2000 PhDs in Science and Engineering awarded to foreign students in the USA, 9057, 126 went to Brazilians, 2358 went to Chinese nationals (People's Republic) and 821 to Indians.

10-15 percent of the Brazilian PhDs abroad are actually in computer science or closely related matters.

Yet the entry level IT professionals in Brazil are roughing it out. It seems Brazil has trained too many of them, relative to local demand for their services, a fact illustrated by their loss in real wages as well as the increasing reluctance of university candidates to engage in IT studies, as measured by declining ratios for candidates to IT entry slots at universities.

The relative dearth of graduate trained manpower severely limits the availability of “software conceptualises” as are necessary to create applications oriented to solving problems. Some conceptualisers, could still come out of other fields in Brazil, yet they should have sufficient industry and IT experience, a rare combination.

Brazilian software developers are substantially cut-off from international markets because neither they have the chance to develop the commercial contacts while studying abroad nor do they work abroad nor do they work with foreigners in Brazil.

Statistical appendix

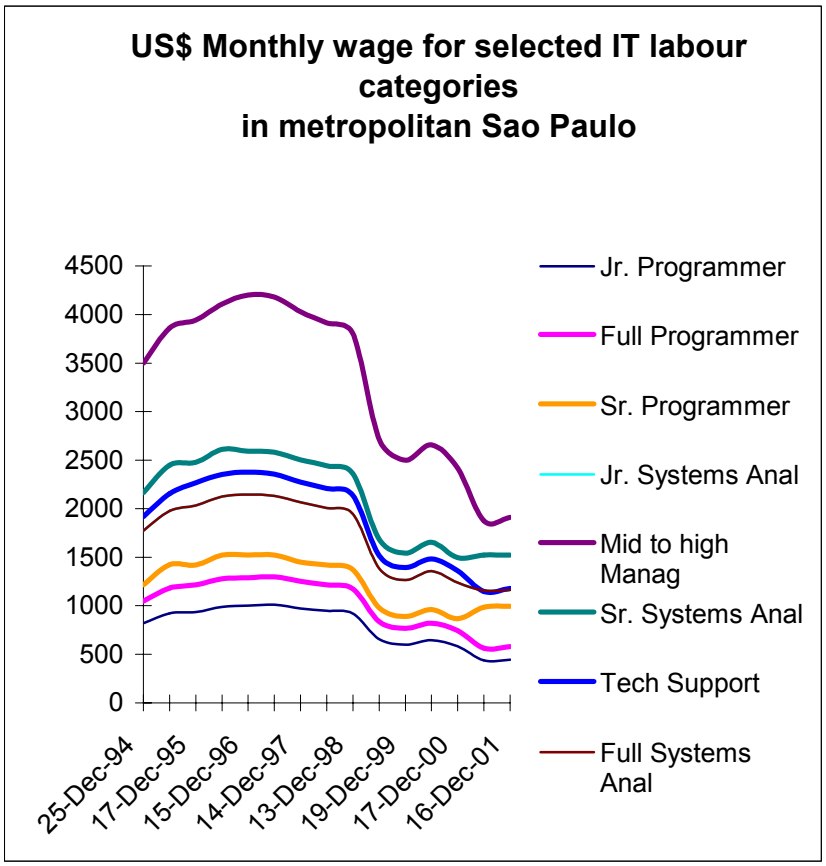
BSc students graduating in IT and related areas										
Focal area	90	91	92	93	94	95	96	97	98	TOTAL
Information Technology	4297	5540	6745	7236	8204	8709	9754	11736	14317	76538
Second tier	30273	32902	33349	33581	34631	36059	34277	35727	37353	308152
Total	34570	38442	40094	40817	42835	44768	44031	47463	51670	384690

Enrolments in Entry Examinations										
Focal area	91	92	93	94	95	96	97	98	99	TOTAL
Information Technology	96610	87749	99441	127758	154728	151312	150297	143045	158413	1169353
Second tier	290605	258940	258562	267745	301108	279518	291515	313033	360980	2622006
Ratio of IT Enrolments to entries	5,5	4,7	4,7	5,4	5,3	4,7	4,3	3,7	3,8	

Number of IT courses										
Focus area	91	92	93	94	95	96	97	98	99	TOTAL
Information Technology	191	210	228	253	302	346	361	-	528	
Second tier	**742**	**780**	**814**	**848**	**1147**	**1222**	**885**	**-**	**1467**	**7905**

Brazilian labour market for IT

The evolution of US dollar monthly wages for the IT sector in São Paulo is a good indicator of what is going on in the Brazilian IT labour market. The idea behind this appraisal is that, if IT graduates were being made available in excess of the demand for them, their earnings should drop in real terms. Furthermore, since new undergraduates are offered to the market every year, the wage structure should reflect an appreciation of the more senior professionals over time, reflecting the fact that, while their companies grew, the supply of experienced IT managers did not. The now senior managers were relatively scarce when they first entered the market, and should continue to extract a scarcity premium for many years to come, unless Brazil were to have imported IT professionals, which Brazil did not.[81]



During the period we have chosen for analysing the behaviour of wages in the software sector, Brazil launched the Real Plan to control inflation. Central to this plan was sustaining an overvalued exchange rate that would increase the local supply of goods, abating inflation. As a result of the policy, all local non-tradable suffered an appreciation in US dollar terms. Yet we preferred to use the US dollar

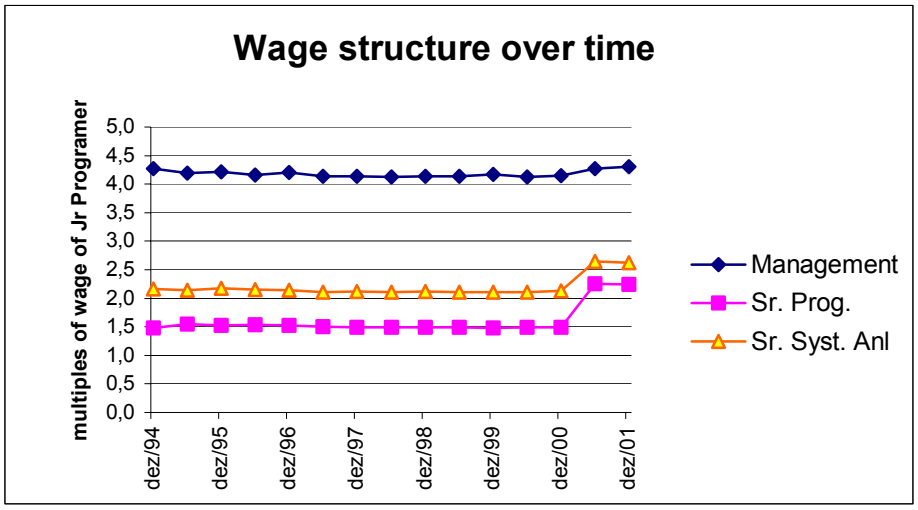
[81] See earlier section statistically describing software sector and indicating that foreigners formally employed in the Brazilian software sector are near negligible.

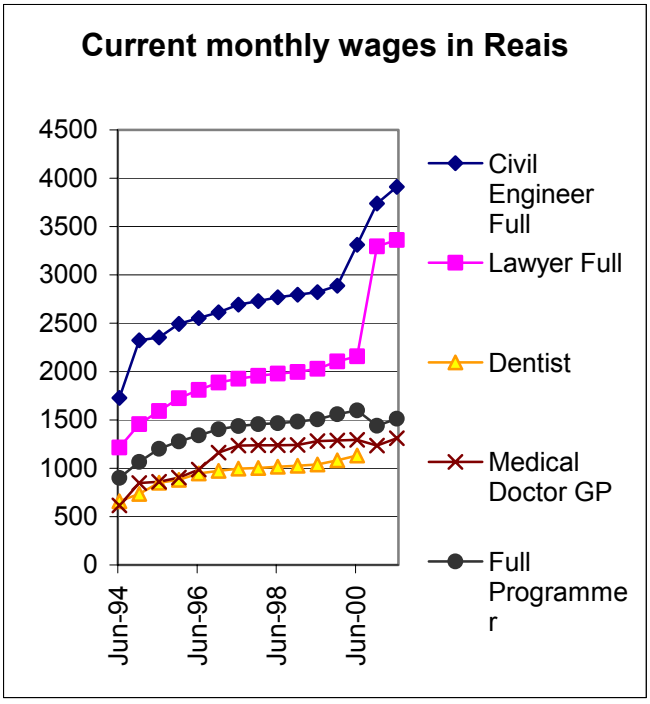
as a deflator precisely because the issue at stake is the exportability of the services of IT professionals rather than the export of IT professionals themselves. If the wages of the latter were to increase in dollar terms they would be less likely to leave, while the exports of their services are also likely to be less attractive.

The last week of June and December wage data were selected yearly for seven IT professional categories from data published by the newspaper Folha de S. Paulo. The data is supplied by almost 160 companies, based in Sao Paulo, with annual turnover above $20 million. To be published, data must have at least five reporting cases. The categories chosen reflect a Director/Manager level position, one technical IT support position, and three degrees of seniority (Junior, Full and Senior) for two different levels of specialization within the rank and file of IT: Systems Analysts and programmers.

The data shows that the dollar earnings off all categories of IT professionals increased during the period with an overvalued exchange rate and began to loose ground as that policy, and the associated high real domestic interest rate, deepened a recession which led to a significant currency depreciation in January of 1999. This behaviour of wages is true for all categories except for the entry level position, Junior Programmer, which never quite appreciated as much and lost ground as from 1997/8. The next lowest IT position considered, Full Programmer, does not fare much better.

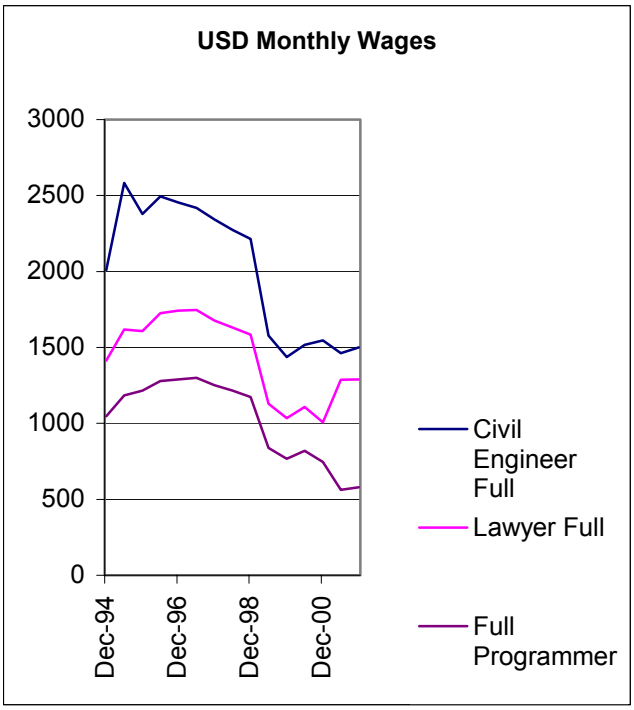
The next graph illustrates the evolution of the multiples of the wages of IT Management, Sr. Systems Analysts and Sr. Programmers, vis-à-vis the wage of the lowest paid: Junior Programmer. The graph shows that while the structure began to show a small but increasing disparity in earnings the latter grew steeper as from 2001, for all selected categories. At the end of the period, the managerial level IT professionals were almost 4.5 times as well paid as the Junior Programmer, while at the beginning of the period the ratio was only 4.3 times as well paid. This graph further supports, with São Paulo data, that the foot soldier in the IT labour market has begun to bear the brunt of an oversupply.





While the overvalued exchange rate should have made all dollar wages comparatively expensive over the period, those for other non-tradable professional services, such as the services of lawyers, showed an appreciation relative to those of Junior software programmers. This further underscores that whilst, as one would expect, a recent oversupply of IT professionals would show in a deterioration of the newest entrants in the market (i.e. Junior Programmers); the whole IT labour sector may be suffering the wage erosion already, as the appreciation of non-tradable services *par excellence (i.e. lawyers)*, appreciated in US dollars even more than the services of IT professionals.

In all, we can conclude that there are indications of a relative saturation of IT professionals in the Brazilian market and that this is reflected in the loss of earnings share at the entry level of the profession. The early scarcity of IT professionals in the 1980s continues to allow the more senior professionals to extract a premium from the market, but it is not likely to continue into the future, as the relatively more abundant professionals make it to the higher echelons. Moreover, an apparent bonanza felt by the profession in the mid to late nineties, in the way of a dollar appreciation of their income, was brought about mostly by an overvaluation of the domestic currency which favoured all non-tradeables, but even then, IT professionals were not amongst the most favoured ones.



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Given the evolution of IT wages, particularly for new entrants, it is not surprising that the appetite of youngsters to enrol in IT university courses has not grown enough to match the increase in openings for the profession.

Funding sources for Brazilian software developers

We have already argued that the interest rates asked for Brazilian commercial loans, may be out of reach for software houses with little collateral to show. Lack of commercial bank loans deprives Brazilian entrepreneurs of the comfortable alternative of borrowing from someone who already knows the companies or their owners.

PetroTech is the software-developing arm held by PetroTax. Both are the fictitious names of two small Brazilian companies. PetroTax makes its money from selling tax advice to over 2000 small and medium sized companies, most of which happened to use Dataflex, an old fashioned database management tool that would not run in more powerful machines such as IBM's AS400.

PetroTech noticed that switching to IBM's equipment would entail discarding the software already developed under Dataflex, plus discarding the training of the staff to use Dataflex.

Dataflex constrained the growth of the small companies but the investment in switching to more powerful engines would be too high; unless a filter could be developed, allowing Dataflex users to continue to program in that language oblivious to the fact that the filter would allow them to run their programs in more powerful IBM machines.

This solution would open, a worldwide market for IBM that could mean revenues of $6 billion. IBM was interested and PetroTech teamed up with Dataflex to develop the filter that now sells as part of Dataflex software, allowing PetroTech to reap a healthy license worldwide.

It took about two years for PetroTech to develop the filter and negotiate a deal involving Dataflex and IBM. PetroTech's English was poor but their idea was good. The funding came from angel investors, attracted by the promise of a ready market. No official funding was sought nor was provided. PetroTech listened to the clients and developed partnerships that rendered a product with a market, so much for the dearth of private funding for software in Brazil.

Further limiting the funding alternatives, during most of the nineties, Brazil had little tradition of venture capitalism and even less experience with angel investors, beyond immediate family members.[82] In this restrictive financial environment, fledging companies would have difficulty funding themselves, unless they happened to be solving someone's problem; to the extent that the beneficiary company would be willing to put up with some of the developmental costs. This is where the young start-ups lacked the necessary focus.

Scarcity of capital for expansion is at the root of any business, yet shortage of funding for software development in Brazil was aggravated by the lack a tradition of venture capital activity and by the dearth of angel investors in a country with a poor income distribution. The government attempted to fill the gap by essentially three mechanisms: non-returnable funding, loans and equity investment.

[82] Timid risk investment experiences began through BNDE initiatives in the early seventies, but they were focused on industries within the import substitution model. During the eighties Companhias de Participacão were the preferred risk-investment modality, but they were not focused on emerging technologies either. Only the CVM normative instruction 209 of 1994, regulated the private risk-investment framework for investment in small technology-based companies. CVM stands for Commissão de Valores Mobiliários, with oversight attributions over the capital market similar to those of the America Securities Exchange Commission (SEC).

These were conveyed through three institutions: CNPq, FINEP, and BNDES.

- CNPQ, scholarships awarded by the National Research Council[83]
- FINEP[84]
- BNDES[85]
- Promoting Venture Capital

CNPq

The CNPq would not issue individual grants to the companies but to the SOFTEX nuclei who would then reallocate the funding, including with a view to fund the operating costs of the nuclei and services provided collectively to the software developing companies. CNPq funding was planned for the first three years of operation of each SOFTEX nucleus and increased over the said period. The total disbursed by CNPq over the first three year was $13.9 million. The average ratio of funding in the hand of the companies, during the period 93 through 95, was 89% out of an average funding close to $4.6 million.[86]

Distribution (%) of CNPq funds between software developers and their Softex host nucleus, 1993-1995

Year of operation	Developers	Nuclei	USD$ Total

[83] Brazil's CNPq operates very much like the French CNRS. Closely linked to the Brazilian scientific community it supports mostly academic research through grants and scholarships. Getting involved with more commercially oriented Softex was a far cry for CNPq, whose investments in SOFTEX had an opportunity cost measurable, at least, in the scholarships CNPq did not grant for its usual purposes. If the Softex disbursements over 1993-96 amount to the $100 million quoted by the US Department of Commerce, July 2002, in ExportIT Brazil, an Update, page 7, then the first few years of operation of Softex could have covered the cost of sending almost 4500 students to learn IT for one year at a Master's level in the USA, at the standard cost of a CAPES scholarship abroad, as per the Brazilian Ministry of Education: http://www.adurn.ufrn.br/18-07/oglo.shtml.
Perhaps Brazil would not have needed 4500 of its young abroad for so long. Perhaps Brazil could have done better by sending them abroad for three months each. Then, would we be talking of over 18 thousand Brazilians abroad for a quarter of a year each. This contingent begins to sound like a sizeable fraction (almost 40%) of all formally employed staff in the software companies. It would not have been a feasible policy, but it shows how else the public funding could have been used to bridge the gap between local developers and the foreign market.

[84] FINEP is Brazil's main agency for funding of Science and Technology. Rather uniquely, its mandate allows it to support all phases of an innovative process, including its commercial distribution.

[85] BNDES is Brazil's Economic and Social Development Bank. Its yearly budget is comparable to that of the World Bank. BNDES has traditionally funded large enterprises and infrastructure. Of late it has also funded privatization programs and has expanded its investments in social areas. BNDESPAR is BNDES' equity funding agency.

[86] Out of a total of $2.196.803, Funcex, page 93

First	81,1	18,9	2196803
Second	86,8	13,2	4366627
Third	91,9	8,1	7294907
Average	88,6	11,4	4619446

Based on Funcex data pages 93-94

The number of companies involved was short of 200, which renders an average funding of close to $20 thousand each in three years. These were small companies, 52% of them selling between $100 thousand and $1 million a year.

FINEP

In 1997 FINEP offered close to $23 million in a joint Softex program called Software National Call (CNS, in its Portuguese acronym). The CNPQ pledged a further $5.5 million in scholarships with which the selected companies were to pay the subsidized interest rate to FINEP. No real collateral was required, and a12 month grace period and 24 months were required to repay the principal. For the first time Brazilian software was being contemplated with risk capital of a size capable of making a difference.[87]

In all, 350 companies showed an interest in the Software National Call but only 185 pursed the matter further and 40 software developers were selected with projects requiring $18 million of FINEP and $6 million of CNPq for an average disbursement of $450 thousand, over 20 times the average funding Softex had been dealing with. Almost a third of the companies involved with Software National Call were over seven years old and 17% of them were selling over $9 million a year. Half of them had between 11 and 50 employees. Almost two-thirds of them had never taken part in Softex earlier activities. This was a cut of more mature companies.

Nonetheless, it was not all blue skies for this new stage. Since there was no collateral requirement, FINEP had required a credit insurance fund, which Softex was at a loss to provide. Many months later, SEBRAE was brought into the picture.[88] This was a mixed blessing as it provided the necessary funding yet added new constraints to the project: 8% of all disbursements were to be added to the credit insurance fund. Further, SEBRAE would not collaborate with companies with over 100 employees. Compounded, the SEBRAE conditionalities meant that 15% of the pre-selected companies had to be left out. Furthermore, SEBRAE would only run with 90% of the risk. It took a few more months for FINEP to agree to run with the rest of the risk. The whole ordeal somewhat eroded the interagency spirit of cooperation.

[87] Much of the information on FINEP's involvement with software was kindly provided by Paulo Tosta da Silva in a stimulating interview and subsequent emails during May 2002.
[88] SEBRAE is Brazil's Small and Medium Enterprise support organization.

FINEP, unlike Softex, is a veteran in the field of funding technology. FINEP's bitter experience with the organizational weakness and lack of business acumen among software developers subsequently led FINEP to prefer to fund the buyer of the software product to be developed, rather than the developer itself.[89]

BNDES

By 1998 BNDES came up with an alternative funding scheme: PROSOFT, sized at about $25 million, to fund up to 85% of the needs of software projects with exports within the plans of the companies. This would be a loan with some degree of risk contract, in as much as the loan would be repaid according to the success of the company.[90] The grace period can be as much as two years and the payment of the principal in 72 months.[91],[92]

BNDES has a lending budget comparable to that of the World Bank but operates with about one third of the latter's staff. This means that BNDES is understaffed and forced to focus on large domestic projects and is ill-suited for catering for the needs of small and medium enterprises. BNDES prefers to operate through partner agencies, in this case it was SOFTEX, whose role is paid for by 0.1% of the loans disbursed.

BNDES's PROSOFT operations fell under the scope of small and medium enterprise and were limited to companies having yearly sales under $15 million. The largest loan should be under $2 million and should not be under $150 thousand. In fact no operation was under $600 thousand.

Up to November 2001 there were 17 approved operations with a total disbursed of $12 million. The size of the individual loans is close to the ceiling and the companies are not necessarily small: they are staffed by between 50 and 100 people.

NUTEC is a showpiece; it recently was bought over by Terra Networks, after having been bought by Rede Brasil Sul, a prominent telecommunications company active in Southern Brazil. NUTEC had received a venture capital injection from

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[89] Over a year later SNC applicants were exporting only 33 US cents on each dollar invested, too little to make it anywhere close to the ratio of 6:1 envisaged by Softex for five year period. In Desenvolvimento Estratégico em Informática, UNDP evaluation report, September 1999, BRA/92/019, page 82.

[90] Upon the appraisal of the deserving projects, a share of the difference between the quarterly net revenues and the quarterly effective revenues would be earmarked for repayment of the loan.

[91] The guarantees for the loans were the shares of the companies, meaning that the beneficiaries had to transform themselves into a corporation and have their balance sheets audited, which would cost them about $6 thousand a year.

[92] Much of the information on BNDES' PROSOFT was kindly provided by Carlos Castello Branco in an interview in November, 9, 2001 and in many subsequent emails

CRP, and BNDESPAR complemented it in 1993/4.[93] BNDES's involvement with NUTEC proceeded PROSOFT and contributed heavily to the design of the BNDES program.

Modulo (security software) might be another success case, and paid-off its BNDES loan in advance when it received a second round of capital investment. Módulo built its services around security procedures related to Brazil's computerized election, covering 90 million voters.[94]

INOVAR, venture capital

The National Software Call of 1997 was meant to be the first of a series, but the difficulties in launching it convinced FINEP to find another way out to support Brazilian software. Inovar was the answer and FINEP became one of the founding members of the Brazilian Association for Venture Capital (July, 2000). While FINEP invests in the VC fund, its role is mostly to bring together investors and opportunities.

In December 2000 the members of the Brazilian VC association declared to have $2.1 billion dollars for investment and had made investments for $747 million. Late or expansion-enabling investments accounted for 78% of the investments. Early phase investments accounted for 7%. Of the $747 million in investments, 98% had been made in the State of Sao Paulo and 1% of them (just under $8 million) were undertaken in the software sector.[95] Telecommunications was responsible for 34% of those same investments. New medias took 20%, e-commerce took 8%

In May 2002 the Venture Capital association has 69 members, 39 of which are private equity funds and venture capital funds. In 2002 only 15 funds were of the type aimed by the CVM regulation 209 of 1994, aimed at sponsoring the type of risk investment suitable for technology companies.[96] One of its recent initiatives is the launching of SPTec, a $10 million venture capital fund aimed at technology companies in the State of São Paulo.

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[93] See interview with Marcelo Lacerda, one of NUTEC's founders (1988) http://www.businessweek.com/1998/43/b3601051.htm

[94] http://www.thestandard.com/article/display/0,1151,9024,00.html. Besides, see boxed case on Niche strategies section.

[95] True that many of the other classifications, such as investments in Portals, may be intensive in software. Yet, without access to the raw data one must rely on what the survey analysts classified as software proper, and that was 1% of the total investments.

[96] Campos, Symara Helena Penow, Capital de Risco para Pequenas Empresas Emergentes de Base Tecnológica no Brasil, MBA dissertation, FECAP, 2002; Page 87.

Funding summary: a short, narrow and bumpy road

Brazilian software development is yet to meet with adequate funding. Softex's initial efforts through CNPq rendered some $ 5 million a year at inception. Then Softex talked FINEP into coming up with more substantial funding (Software National Call) and while average funding increased twenty fold it turned out to be a very sticky business and was dropped. Softex then talked BNDES into the business. BNDES earmarked a further $20 million but only 17 projects met BNDES' operational guidelines. FINEP then brokered the creation of a venture capital market, which signalled with $2 billion in year 2000, but they only risked $8 million for software.

The above means that, for almost a decade, third party investment in Brazilian software development has hovered under $10 million per year. Despite an increasing maturity of initiatives, and an increasing participation of the private sector, funding for Brazilian software has not taken off. It could well be that that is the size of the market for private or public investment in Brazilian software development as it stands. In order to attract more funding Brazilian software needs to focus on developing software that clients will want to buy.

Piracy and dumping heads and tails of a similar coin

Recent journalistic reports on the size of piracy out the size of all types of piracy at close to $21 billion a year, or close to 5% of GDP.[97] The figure includes all consumer goods like perfumes, watches, clothes and apparel, besides music and computer software. The latter possibly accounting for close to $380 million a year, or just under 2% of all pirated products sold in Brazil.

This means that software piracy is relatively small, compared to the rest – which is large enough to affect the way of doing business in Brazil. Nonetheless, for a software developer the issue of piracy is of paramount importance as it is widely believed that one in two software products in use in Brazil is a pirated copy of a fully paid for original.[98]

In Brazil a software developer contends not only with other competitors but also with its own pirated product, sold for a little above the cost of reproducing a CD. The government's effort to curb piracy has been quite limited and it is likely to

[97] A figure close to the increase of Brazil's public debt credited to Proer, a one-off government program to strengthen the finances of ailing banks, according to the Parliamentary Inquiry Commission (CPI) of Proer.

[98] "Pirataria S.A." cover article of Isto É, page 78 April 24/2002. Isto É is a weekly Brazilian magazine with national readership. The number of copies printed of the above issue is close to 150 thousand copies.

remain that way. An industry association took it upon itself to promote legal action against piracy.[99]

Software developers have responded to piracy by producing software that requires toll-access to either databases or keys that need to be paid for. To some extent software houses are also releasing a less-than-perfect software that requires paid technical assistance to work. In other cases a decent opportunity to reap the benefits of the Internet are failing to materialize.

How software business loses out to the many thieves

Let us consider two cases, one in which dumping by competitors and piracy of its own product put the software developer against the wall, forcing her to chose a complex marketing strategy, which eventually failed. The other case led to the service provider charging more expensively than she should, because she could not trust to cash in the business transactions their service would generate.

Loja Fácil is a software product catering for the management of small shops, those with approximately 600 sq feet of floor selling space. The software controls sales, revenues, some inventory operations. It is cheap and it works. It has 2000 clients mostly in Sao Paulo shopping centers. The product sells for under $200 or is licensed at $32/month, 90% of Loja Fácil customers chose the latter, which grants effective technical support. The product could easily sell in other Brazilian states, were it not for the peculiar avenue sought in some states to curb tax-evasion: to hold the software developer accomplice to the crime if the software were misused with the purpose of evading taxes. According to the entrepreneur who developed and markets the software, the fines are too steep and the judicial procedures too complex to run the risk of being an accomplice to a crime it cannot fully prevent from happening.

This is how an unsavory business environment halts the modernization of small enterprises and dissuades an entrepreneurial software developer from investing further in making its software more flexible to cover a greater geographical area.

[99] The Business Software Alliance sponsored 418 court actions against Brazilian users of pirated software in 2001. http://www.bsa.org/brasil/press/newsreleases/2002-01-31.890.phtml (accessed on March 4th, 2003)

LNQ: consequences of piracy and dumping[100]

LNQ came from a mainframe and CADCAM selling background.[101] Each CADCAM sale reached the half million-dollar mark but by 1994, the PC and lower-priced software dedicated to the PC were making a dent into LNQ's market. LNQ partners saw that the future lay in lower cost software designed for PCs. As they were active in the computerized design software they looked into the CAD market and identified a niche in the Brazilian market: architectural design software.

LNQ set up and association with an Argentine software developer and created a ten person strong division within the Brazilian company to distribute the said software, priced at $1000 the copy.

To the Argentine developer the association brought closeness to clients in one of Latin America's largest and fastest growing markets. The arrangement also allowed LNQ to develop conceptualising capabilities that were passed on to the Argentine developer in exchange for informal discounts in purchases of the software. By 1995 this software accounted for 10% of LNQ's sales.

Nonetheless, despite a promising start, LNQ's corporation was hard hit by two developments: piracy and competing AutoCAD penetration. Piracy allowed Brazilian consumers to have access to the leading edge LNQ architectural software at a price under $20.00/copy. Dumping allowed AutoCAD to become the industry's standard.[102]

Mid-sized to large companies purchased the Autocad software at $4000 the copy. Autodesk developed Autocad. Autodesk apparently did not mind illicit software

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[100] Dumping is a technical name in international economics typifying a situation in which a country sells abroad for a price too low to be sustainable in the long run. When dumping is practiced it triggers retaliations by commercial partners, for it is considered an unfair commercial practice aimed stifling competition. . See World Trade Organization's view on Dumping:
"If a company exports a product at a price lower than the price it normally charges on its own home market, it is said to be "dumping" the product."
http://www.wto.org/english/tratop_e/adp_e/adp_e.htm (March 3rd, 2003)
Here "dumping" is used in a more loose sense to typify a situation in which copyrighted software is allowed to circulate at a price that does not reflect the cost of developing and marketing it but only the cost of making it available in the target market. The latter, however, is hard to determine, as once the software development, plus the marketing and other costs have been covered in one market, such as the USA, the cost of making the same product available in another market, such as in Brazil, amount to not much more than the cost of reproducing a CD or downloading a file.

[101] LNQ is the fictitious name of a prominent Brazilian software developer and reseller, whose manager was interviewed on March 19, 2001.

[102] According to FGV 13th survey (CIA/EASP) March 2002, page 10, AutoCAD holds 80% of the technical drawing market in Brazil. This survey draws data on over 2000 companies amongst which are 60% of the largest in the country. Architectural design companies only mimic what happens to the rest, when it comes to choosing a CAD tool.

piracy when smaller companies or individuals perpetrated it.[103] This policy allowed Autodesk to reap enough benefits for software development while still ensuring that Autocad became the professional standard in Brazil.

The penetration of Autocad severely limited sales of other the architecture design software: LNQ's sales effort, averaging $100,000/month in sales, barely covered costs. By 1998, in agreement with the Argentine software developer, LNQ began steep discounts of this software. Initially the discounted software was selling at $500 and a few months later at $300 the copy. Not surprisingly, the discounted software could not beat pirated copies and near-free Autocad, and LNQ continued to loose market share.

LNQ responded with a new strategy: dropping the price of their software to nil and seeking revenue through associated services sold through e-market places it would create. LNQ, and their associates would now only earn money if their customers did.

LNQ, and their Argentine counterparts, began giving the software for free as an insert to an Argentine magazine of which about 30 thousand monthly copies were distributed in Brazil. LNQ effectively created an e-marketplace for architects, contractors and suppliers. The software allowed architects to plan a house and list the requirements of all inputs. The building contractors and suppliers would then bid for the quotes asked by the architects through LNQ's site. LNQ's revenue would come from advertising on the site and from cuts in the sales the suppliers and contractors would make.

LNQ's outfit invested up to $1 million to develop the site and create the network of associated suppliers. JP Morgan and local investment banks showed an interest in the expanded project, which would have been sold in Argentina, Brazil, Venezuela, Spain and Italy. This international project was sized at $36 million.

It looked like it was very much like touch and go for LNQ, then the Nasdaq crash came and international investment banks receded from their ventures abroad. Local investment banks, managing thinner private equity funds, cut short their commitments to LNQ's project, which floundered.

At present LNQ still looks after the interests of the same software in Brazil and takes royalties on the instruction material of which sales average $10,000/month (100 to 150 books per month). It was not in LNQ's plans to become a bookseller. Since acting as a bookseller seemed to be the only way to make money out of its architectural software venture, LNQ dropped it. For all practical purposes this software venture is defunct.

[103] A Google search in October 15, 2002, for reporting on court sanctions regarding piracy of AutoCad rendered only five non-independent cases.

Case of Neogera

Neogera provides managerial and control services to multisite civil construction operations. If a construction company wishes to control what is going on in various construction sites without actually visiting them, at least not too frequently, Neogera can help.

Neogera was created in Sept 2001, as a 50/50 joint venture by the holdings of Promon, an engineering design company (turnover $35 million/year) and Camargo Correa, a civil construction company (turnover $1.7 billion/year). Neogera is currently staffed by 20 civil engineers.

What does Neogera sell?

Neogera allows clients readier access to data on their own projects and execution programs, as well as it allows them to cut costs by enabling better bidding practices. Neogera's solutions vastly expand the state of the art management in the construction industry.

Neogera does not develop much software itself; it provides a software solution to customers by integrating third party software. For instance, its e-commerce unit is based on Paradigma.[104]

Low availability of broadband connectivity still limits the use of Neogera's full array of products, but a more recalcitrant obstacle lies in the dishonest business practices that pervade the area.

How does Neogera sell?

Neogera charges monthly payments for its services. These payments reflect the number of projects and users and disk storage use. Ti does not charge for data transmission, so, Neogera charges by size. Smaller users would pay less. This fee is only a proxy for activity and a client may find itself paying monthly fees for a project which is dormant.

Apparently the construction industry is riddled with a type of collusion against the government, one in which buyers and sellers agree to do business declaring not more than half what they actually pay and receive, thus saving on taxes. The obvious loser is the government's revenue, and Neogera believes it would join the government in the loss if it were to attempt to charge commissions on sales.

[104] This software was developed in Florianópolis, Brazil, and won the Microsoft Fusion award in 2001 (E-Commerce Solution of the Year).

Neogera also believes that it may be cut out altogether by some clients if it intended to charge a commission on sales: some clients would do all the research through the Neogera tools and then close the deal over the phone with their suppliers, effectively excluding Neogera.

How piracy burdened Neogera and LNQ

Both LNQ and Neogera could do better if they operated in a more ethical business environment, or a better regulated one. Neogera's services cannot be pirated, but they could be circumvented and probably would be if Neogera's services were priced more creatively.

Except for the odd additional service to customers, Neogera chose not to develop any software, unlike LNQ, which invested heavily in software development with its Argentine partners.

There is no doubt that LNQ's business plan was inherently riskier, but it was the standard bread and butter situation in the software development trade. Yet it was LNQ's incapacity to also fight passive dumping by Autocad that ate into LNQ's market share. Perhaps LNQ could have withstood the piracy of its software by providing associated services that could not be pirated, but it could not take on dumping and piracy together.

While piracy is not an issue for Neogera, the generally low business standards in that segment of the Brazilian market should be a matter of concern for all software developers, let alone the government. Dumping, active or passive, should be a matter of concern too, because as piracy does, dumping also inhibits competitive software development.[105]

The alternative policy environment

This section deals with the following questions: is Brazil's training and research capability deep and broad enough, to provide the manpower capable of delivering substantially expanded technology exports? Does Brazil have the intellectual maturity to jump into the IT export bandwagon?

Research capacity

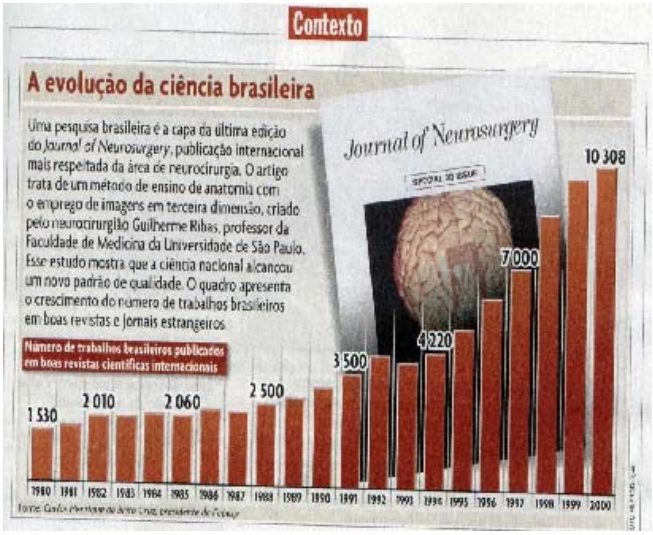
Brazil's intellectual maturity, as expressed by its research capability, is crucial for investing in the exploitation of the software sector.

[105] Narrowly focused on enhancing revenue for foreign software developers, the Brazilian site for the Business Software Alliance, would not, on March 13, 2002, yield any hits for a search for the keyword "dumping". Incidentally, no hits were reported either in the site for Europe (English) nor for Malaysia, the only ones researched besides Brazil.

During the last decade the number of Brazilian research groups almost trebled, the number of researchers multiplied more than four times, indicating larger, possibly more complex research groups. There were almost 50 thousand active researchers in 2000. Almost 57% of these had a PhD degree, a share that has been growing since 1993, pointing out to the increasing maturity of the manpower training.

While the number of research institutions with close links to the Brazilian Science Research Council (CNPq) may still be small (224, in year 2000) the number of institutions has been growing steadily since 1993, when they were only 99.

The number of PhDs per researcher has increased by 10% over the period, signalling a more mature research community.



International research standing of Brazil

As we would expect of a research community which has grown, diversified and matured over the last decade, publication in internationally indexed journals has increased, even drawing the attention of the larger public, as testified by the perceived newsworthiness of this growth, which was reported in the Brazilian weekly with the largest circulation.[106]

Acceptance of Brazilian research output to indexed international journals has increased steadily since the 80s. So has the share of articles published by Brazilians vis-à-vis other Latin-Americans, and even more steadily vis-à-vis articles of other nationalities.[107] Nonetheless, perhaps as a result of severe cuts in CNPq's

[106] Data was culled from the Institute for Scientific Information (ISI). National Science Indicators Brazilians are rightly proud of the growth of publications in international journals during the last decade, as depicted in page 27 of Veja's weekly edition of January 16, 2002. Veja enjoys national readership and sold 1.3 million copies of that edition.

[107] It is interesting to point out that while Brazil's share to other Latin Americans has grown, it has grown more slowly than its share of publications by the rest of the World. This suggests that the share of all Latin American authors grew relative to the World and that this may mean that part of the more favourable standing of Brazil's performance may be due to an increased coverage of the indexed journals, now covering more Latin-American journals than before.

budget, 2001 saw a decrease in Brazil's share of the World's output of scientific papers, from 1.08% in 2000 to 0.95% in 2001.[108]

The section has argued that while Brazil's research community may be small by World standards, it has increased, diversified and matured substantially, becoming increasingly competitive by international standards. One would rightly expect that such significant growth in reflective potential would be accompanied by an increased capacity to provide solutions. Not so.

Research not leading to patents

During the last decade Brazilian requests for patents has stagnated at around 12 to 14 thousand a year. Brazilian research groups are failing at appropriating the product of their research. Payments for foreign technology have, however, multiplied by four since 1994, after having hovered around $250 million per year in the four previous years.

1994 saw the country's first successful economic policy drive to control inflation. The policy mix called for an overvalued exchange rate and an economic openness without parallel, at least in the previous six decades of Brazilian history. Foreign direct investment surged and with it payments of royalties and fees for the use of foreign technology.

To unleash the software export potential

We argued that while client orientation is crucial, for a peripheral software developer. Such closeness comes dearly and is more readily accessible to the larger software houses, which are already taking care of that in various ways, except for those in the financial area.

If Brazil is to export more software it cannot rely only on the larger software houses, it needs to induce exports by a broader spectrum of software developers with comparative advantages and strong muscles. Upon looking for unique products or services we found them in the financial sector. The financial sector is more competitive abroad that others are.

Brazil's peculiar financial history provides such originality that it is more likely to find exportable software in the software developed for the financial sector. It is not that other sectors do not provide adequate exportable software potential, but simply that the financial sector software comes in a more promising (large) size, with the financial clout and the necessary international corporate standing.

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[108] "Pesquisa Cientifica tem queda no Brasil", in O Estado de S. Paulo, page A12, September 18, 2002.

Yet here again one hits a stumble block. Most software developers in this segment are owned by the larger banks and have them as their main clients. This stifles the software houses commercial ambitions in two ways:

- In first place these software houses are not used to have to sell to survive.
- In second place they cannot argue that they deserve the financial backing they would need to compete abroad, because, their shareholders already make too high returns for a more manageable risk.

To the roots of an anti-export bias

Several software companies had only exported when invited to do so by foreigners visiting them in Brazil. It appears that Brazilian software developers would rather wait to be invited, for then they would be relieved from the responsibility of offering themselves.[109] Such responsibility is rooted in the duty to deliver once one has advertised or proposed. On the other hand, when invited to offer, that responsibility is shifted to the inviting party; for when invited to collaborate in an international partnership, the Brazilian IT developer feels relieved from the burden of having to perform up to standards she may intimately feel is not up to, a feeling which inhibits salesmanship. Thus, the burden of cost of failure would be borne more heavily by she who invites, and the Brazilian developer feels more at ease to collaborate in the joint venture when invited.[110]

While formally correct this explanation is anchored on the premise that Brazilians may feel that their technical standards, or their marketing capabilities, or whatever else is needed to succeed abroad, are not as high as those that prevail in a World which they might not see as their own.

Failing to succeed domestically may be costly in itself, but venturing abroad is inordinately expensive to Brazilians. Expensive both financially and in terms of the cost of loss of face due to an eventual failure, made all the more daunting because of the financial cost involved. It is not clear to me that fearing to venture abroad may be a personality trait of Brazilians alone or of IT entrepreneurs specifically, but intimately I feel that for a people, as a society, that come from so far back educationally, failing in the realm of the mind should, for the selected few educated enough to venture, be far worse than for a football team to loose a game abroad, having already won so many.

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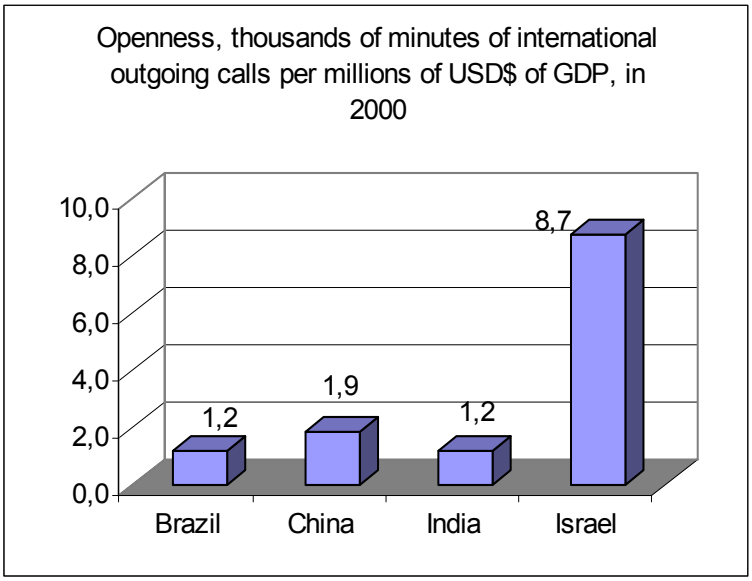
[109] I owe this insight to the psychoanalyst Elizeth Andrade de Oliveira.

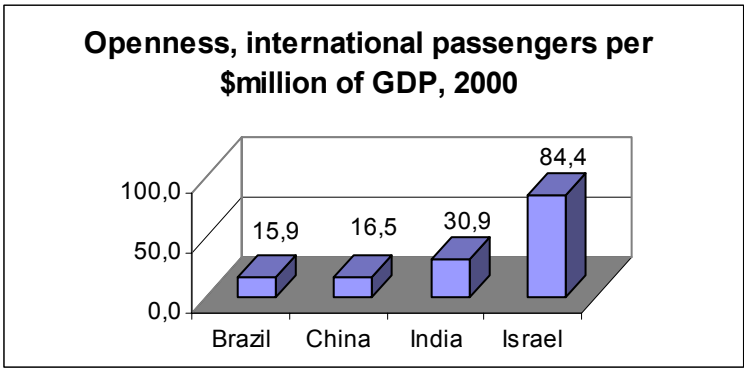
[110] A high-executive of one of the largest Brazilian software houses producing some of the most internationally competitive Brazilian products told a journalist that he hopes his company will be invited by the head office of a foreign bank once they realize how clever their software solution for their Brazilian operation had been, and he justified why the software house would not take the initiative to sell abroad: " for it is hard to venture abroad unprotected, it is hard to wear off the prejudice against a developing country with an image not linked to technology production" O Estado de S. Paulo, May 12th, 2002, page B12.



Based on Telegeography and World Bank data

The World remains relatively unfamiliar to the common Brazilian, and perhaps even to the nucleus that provides the cohort of software developers.

Brazilians are substantially underexposed to personal international contacts. Take, for instance, the low levels of international calls placed from Brazil. The minutes of phone calls originated in Brazil, when standardized by level of GDP, are as low as India's. China's international calls are 60% higher. Indian software developers have broken the yoke of isolation through VSAT communications, preceded by years of more intimate and more recent contact with the English. But Brazilians at large depend on phone calls to keep in close touch with the World. Israeli's are in much closer touch than Brazilians, in fact, seven times as much.



Based on ACI and World Bank data

This portrayal of Brazilian isolation is reproduced in another index of personal contact with the foreign World: international travel. Here again Brazilians fare poorly, poorer even than the Chinese.[111] Indians see twice as many international travellers as Brazilians do, and Israel, again, turns out to be the most exposed to international travel or travellers, six times than Brazilians, per unit of GDP.

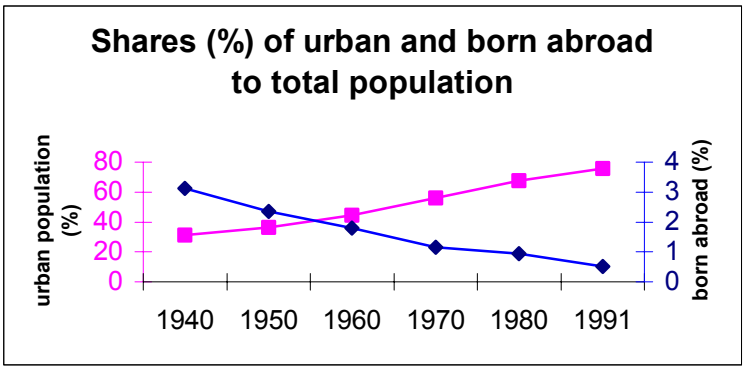
Naturally, the graphed index entails a different degree of exposure to international travellers depending on the population density of the host country. For instance, Israel shows a movement of international travellers that is 50% above its own

[111] The ACI data, standardized by World Bank GDP data, refers only to international passengers, independent of their nationalities. It does not allow us to ascertain who travels.

population, which in turn spreads in a territory of only 20 thousand kilometres, making it almost impossible not to bump into a foreigner in Israel. Besides, the fact that only 20% of Israel's population was born there, boosts the current ability of native Israelis to know about the World.

On the other hand, the 18 million international travellers of China represent less than 1.5 percent of its population. Yet, what the data brings out is a measure of the possibility of contact with people who bring a message from another World. Brazilians, again, are singularly closed up on themselves, the total of international air passengers is only 5.6% of its population.

Furthermore, the share of foreigners residing in Brazil has declined for the better part of the 20th century, depriving Brazilians of a low-cost opportunity to familiarize themselves with foreign ways. For instance, while in the forties one could reasonably expect a Brazilian student to have a foreign born classmate in a class of 30 students, nowadays a Brazilian resident would need to meet 200 resident people before she met a foreigner.



Moreover, Brazil, which was essentially a rural country until well into the second half of the 20th century, had almost 80% of its population living in cities by the end of the same century. The newly urbanized, frequently the less exposed to foreign traits, brought with them their rural habits and rites to the cities, depreciating the value of cosmopolitanism.[112] One can only expect that the Brazilian population at large would be, at the turn of the 20th century, with regards to the rest of the World, a more closed society than it was one hundred years earlier.

The Internet has awakened Brazilian interest in communication with the rest of the World. A 1996 Business Week already referred to a rekindled interest in English language triggered by the need to communicate in English over the Internet.[113],[114]

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[112] During an unhappy 1996 interview with the Portuguese press the President of Brazil referred to Brazil's population as "hillbillies" (caipiras) when attempting to offer an explanation for his people's resistance to globalization. http://www.convest.unicamp.br/vest97/provas/fase1/fase1.htm

[113] Familiarity with English language remains poor in Brazil, as perceived by business whose business is to spread proficiency in English: Global English is a worldwide provider of English training and began its Brazilian operation in 1999, but by 2000 Brazil was already Global English second most important market. http://tendencias.infoamericas.com/market_reports/2000/0600.htm

[114] "In Brazil, for instance, demand for English classes took off about four years ago and has intensified over the past year because of the popularity of the Internet, says Lorna Burleigh, regional director of the Sao Paulo area for Yazigi language schools, which enroll 110,000 students in Brazil. ``Many people who speak English well now want to improve their writing skills to communicate better on the Internet,'' says Burleigh" http://www.businessweek.com/1996/14/b346959.htm.

The significant increase of foreign investment has also triggered a more intense demand for second languages, including among the lower income classes.[115]

This tension, brought about by desire and inhibited in the fear of not being good enough, may well be at the root of the attitude of not venturing abroad. This requires further interpretation, for, while unfamiliarity may breed fear, it could nowadays be easily be dispelled with more information. Fear of not being good enough has deeper roots.

Suggestions for policy options

This work has pointed out to a significant underperformance in Brazil's standing in international software trade. Lack of significant international Brazilian stature in Artic research would not come as a surprise. That Brazilian software does not prominently figure out internationally does come as a surprise; and the surprise is both a testimony of Brazil's domestic prowess in the field as well as an indictment of Brazil's software export policy.

This work has amply suggested that Brazil's strength in domestic software should qualify its professionals to a higher international standing. These suggestions were put forward in several allusions, for instance, to Brazil's privileged standing in e-commerce, or even in fields like robotics or bank automation.
Brazilian software developers did not develop passively, by studying abroad, a familiarity with foreign quality standards. Neither did Brazilians have the chance of learning such traits in Brazil, by working with expatriates, as there are practically no foreigners formally employed in the Brazilian software industry. Besides, when it comes to a cultural openness, Brazilians are closed in their own language, with little proficiency in international languages, little connections abroad and little international travel.

Thus this work has argued that it is this lack of openness that lies at the root of Brazil's poor software export performance. The single most significant reason borne out of this study to explain Brazil's underperformance in software exports lies in the software entrepreneurs' lack of familiarity with foreign business circles. This handicap prevented Brazilian software developers from focusing on developing what the potential clients may want of them, which need not be packaged software which Brazilians could hardly have provided in a competitive way, both in quality or in after sales services.

This research has argued that the lack of familiarity of Brazilian software developers with foreign business circles comes as a result of four aspects:

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[115] "Do you speak English?" Após, 1(1) August 2002, where a market research piece by Paradigm Language Support claims that out of 9 thousand business executives claiming to be fluent in English only 1% could show they were, page 21-2.

a) the young age of Brazilian software entrepreneurs
b) a cultural attitude which may dissuade Brazilian technologists from believing that they may be good enough to compete;
c) an industrial policy which believed they were not good enough and protected the industry for too long – instilling it with a siege mentality;
d) this mentality was reinforced by the international market's attitude which, while welcoming to Brazilian music and sports, does not as readily accept Brazilian technology products.

This is how Brazilian software developed in Portuguese language with no helping foreigners to speak of, as a result of which, Brazilian software was know only to Brazilians, with little or no recognition abroad.

What should be done?

While managing an exchange rate for the sake of software development should not be a policy option, its is never late to remind policy makers that an overvalued exchange does not help exports and that an export-oriented program may need refocusing to take into account the country's fluctuating macroeconomic competitiveness.

During much of the nineties the domestic currency was substantially overvalued, making the development of Brazilian software relatively expensive and the importing of competing software relatively cheap, blunting the edge of Brazilians in the domestic market, where they could be overwhelmingly competitive. On the other hand, an overvalued exchange rate made travelling abroad relatively cheaper, easing the presence of Brazilian software in international trade fairs and foreign media. The overvalued exchange rate phase must have helped Brazilian entrepreneurs to gather intelligence on foreign markets and this may be put to good use in the next phase.

Some background conditions are now improving independently of software policy gestures. From a macroeconomic perspective, the next phase, which began in 2000, can be characterized as one of a weaker currency, helping to sustain an export-oriented strategy. This should help the Brazilian software sector, both allowing it to strengthen its competitiveness in its large domestic market, as well as increasing its attractiveness abroad.

A related issue is the one of foreign labour. It seems that having so few foreigners formally employed in software sector is a constraint rather than a bonus. If foreigners were to want to be employed in Brazil, they would come with an understanding of what works and what does not. Moreover, they are likely to return to their countries and help Brazilian software out. So far the brunt of official disbursement and intelligence efforts has been put behind sending Brazilians out to scout, mostly at fairs. Some efforts could be diverted to allure capable foreigners to work in Brazil and that may turn out to be very useful. That no effort was deployed

on even thinking on the implications of this policy or how to bring it into effect, is mostly the result of a siege mentality that precluded the vision of a larger picture.

Macroeconomics aside, perhaps the most significant shortcoming of Brazilian software policy, one reaching over the series of lesser woes, has been the spillover effects of a siege mentality nurtured during the seventies. This siege mentality can be traced back to the military dictatorship era, even if it were not for the fact that some of the recent leaders in the software policy sector were still remnants of the military era.

The strong autarchic bent of much of what was officially done for software in Brazil stems from an ideological stance that precluded foreign cooperation and hampered Brazilian insertion in World markets. This is how Brazilian software industry. Which totals over 45 thousand formal employees, came to employ only six North Americans. This autarchic bent also shows up in the way software developers are trained and incubated: segregated from non-technologists. Breaking up this autarchic pattern is crucial for a healthy growth of this sector, both domestically and internationally. Otherwise, the Brazilian software sector may remain an excellent opportunity almost nobody knows about.

Brazilian software developers have proven to be excellent at what they know best: developing software and networking the economy. But have mostly failed at selling, even domestically, where they loose market share year on and year off. Much of this failure can be attributed to lack of business skills among technologists.

While merging or establishing strategic alliances with older economy companies would help to break the managerial deadlock, establishing such partnership with foreign companies would contribute more to Brazilian software penetration into international markets. These alliances may be hard to structure, but this policy could have been pursued at least through internships of Brazilian software developers in companies abroad. It was not lack of funding which precluded the opportunity, for the funds which were spent in directly funding the Brazilian software export policy during its first six years could have sustained thousands of short internships abroad per year; perhaps allowing up to a tenth of the formally employed workforce in the software developing and consulting sector to become acquainted with foreign software demand and commercial practices.

To circumvent the Country of Origin Effect one would expect to see more Brazilian software developed for the already active exporting sector. One would expect to see more software in the musical and tourism areas, more development of sports games – particularly soccer ones - more software designed for agriculture, particularly for managing irrigation and flower and fresh fruit exports.

Brazilian banks have been at the forefront of banking automation in the developing world, and some of their innovative software has even been a world leader, like the open architecture software on which their Internet banking is based, including the

associated security measures. Yet the banks' software houses have been deprived of the sales force that would prod management to reap opportunities, including international ones. What management was left in those software houses is technology managers, It is not even required of those managers to pay attention to the market, for the software companies are sized to the demand of their holding banks.

At present Brazilian banks make enough money for a manageable risk. There is no incentive in that sector to subcontract other software houses to reap international opportunities. Software houses submerged in banking conglomerates are likely to remain stifled, grow old, and loose competitiveness as a result. Unless these software houses are separated from their financial conglomerates there is little future to them.

A much overlooked area of Brazilian proficiency in IT, which could be exported, is the knowledge of how to network a mid to low-income economy. Brazil has introduced a surprising level of networking for a developing country, and has excelled, despite the income limitations, in making government, the private sector and NGO's - available on the internet. E-commerce has flourished, despite regulatory setbacks. Such knowledge would we welcome in other countries but so far there are no news of Brazilian consulting companies packaging this knowledge and making it available to the World Bank, IDB or UNDP, the major international contractors for this type of work. Helping Brazilian consultancies offer such services through the multilateral institutions may render both Brazilian technical manpower and some developing countries a considerable benefit.

Interviewees

Over a period of eighteen months many people contributed with their time and knowledge to help me sharpen my focus on the subject matter of this research piece. Some I met at their offices, some at conferences such as the Brazilian Computing Society in Fortaleza, during August 2001, others at industry meetings such as the ASSESPRO one in Atibaia, during November 2001. Those that did not object to have their names mentioned are listed below, roughly in the order I first contacted them. Those that did object to be mentioned are not, neither here nor in the rest of the text. To all, my gratitude.

NAME	Affiliation and city of work at time of interview
Marcio Vaz Ferreira Ramos	Projectus, São Paulo
Descartes Teixeira	ITS, São Paulo
Joaquim Celestino	INSOFT, Fortaleza
Cláudio Marinho	Softex, Recife
Jose Cavalcanti	FACEPE, Recife
Merval Jurema	ITECI, Recife
Silvio Lemos Meira	UFPe, Recife
Xavier Girino	BISA, Recife
Paulo Kumpis	Sistenge, São Paulo
Antonio Carlos Barbosa de Oliveira	Banco Itaú
Rudy Villela Marinho	LSE
Alessandro Nasser	Neogera
Carlos Hargreaves	CPO, São Paulo
Ronaldo Brandão	Xseed, Fortaleza
Altamiro Castelan	RioSoft, Rio de Janeiro
Abel Antonio Thomaz	Mega, Itú
Alvaro Junckes	Logocenter, Joinville
Fabio Silva	Porto Digital, Recife
Chris Dutton	Shell, Gas and Power, London
José Luiz Guntzel	Informatica, UFRGS, Porto Alegre
Tadao Takahashi	SOCINFO, Brasilia
Vanda Scartezini	MCT, Brasília
Luciana Varejão	Vaguard-It, Recife
Sérgio Luis Costa Reis	Solving, São Paulo
Cristiano Andrade	Bluefin, London
Fernando Sodré	Radix, Recife
Paulo Tadeu Araújo	CESAR, Recife
Paulo Tosta da Silva	FINEP, Rio de Janeiro
Carlos Eduardo Castello Branco	BNDES, Rio de Janeiro
Maria Elisa Tourinho	BNDES, Rio de Janeiro
Reinaldo Bergamaschi	IBM, T. J. Watson Research Centre, NY

NAME	Affiliation and city of work at time of interview
Ernesto Haberkorn	Microsiga, Sao Paulo
Alberto Bastos	Modulo, Rio de Janeiro
Antonio José J. Botelho	Genesis, PUC, Rio de Janeiro
Tadaaki Wakabayashi	Loja Fácil, São Paulo
Cláudio Emanuel de Menezes	DISOFT, São Paulo
Michael Stanton	RNP, Rio de Janeiro
Djalma Petit	Tecsoft, Brasilia
Alexandre Messias Krell Pedro	Itautec-Philco, São Paulo
João Lo Ré Chagas	Itautec, São Paulo
Jose Carlos Lopes de Almeida	Itautec, São Paulo
Mohamed Mourabet	Pulso, São Paulo
Roberto Gianetti da Fonseca	SILEX, São Paulo
Carlos Sá	Datasul, Joinville
F. Ted Tschang	Singapore Management University
Fernanda Emiliano	Code Partner Solutions, São Paulo
Carlos Alberto Borges da Silveira	PeopleSoft, São Paulo
Paulo Bogossian	Intermédica, São Paulo
Miguel Abuhab	Datasul, Joinville
Amedeo Petrocco	ASSESPRO, São Paulo

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Over 2001 and 2002 we met several times to discuss our work, twice in London, once in Berlin and once in Recife, Brazil. In all those cities we enjoyed a most amiable atmosphere and were exquisitely looked after by our hosts. In London we were looked after by the London Business School and by Goodenough College, in Berlin by the Institute of Advanced Study, and in Recife by the Secretariat for Science and Technology of Pernambuco. To all those institutions, and to the people that made those gatherings possible, in particular to Anna Malaczynska and Kerrie Quirk, of CNEM-London Business School, I express my appreciation for they genuinely looked after us and fostered the type of exchanges which helped to improve our joint work and my own in particular.

I wish to thank exceptionally those that helped me complete my work in Brazil. In Recife I wish to thank Circe Monteiro, of UFPe, for organizing our workshop there, in December 2001, and for bringing to the workshop much of the very best that Recife has to show, in particular students, managers, professors and professionals such as Jose Cavalcanti of FUNDEPE, Claudio Marinho of SECTMA and Softex, Professor Silvio Lemos Meira, of UFPe and Fabio Silva of Porto Digital. Those colleagues, and many others, contributed with extensive debating of the presentations and for their welcoming effort my colleagues and myself remain truly thankful.

I am also very thankful to Joaquim Celestino Jr. of INSOFT, who helped me much with the Ceará leg of my research by introducing very interesting efforts developed there; and to Paulo Tosta da Silva of FINEP and Carlos Castelo Branco of BNDES for revealing to me the intricacies of official funding schemes to support Brazilian software. Dr. Kaizô Beltrão's help was decisive in opening access to IBGE and Ministry of Labour's data, when the Ministry's of Science and Technology own dried out. I also wish to thank Mr. Descartes Teixeira of CITS who helped me more than he may even realise, by putting me in the right track very early on; and also for introducing me to my research assistant (2001-2002), Eliane D'Ippolito, whose long professional experience with Brazilian software helped to open many doors. Maria de Lourdes Delgado helped me mostly during 2002, particularly in research

based on newspaper data, where her specialization on media helped me much. To both my research assistants I remain truly thankful.

Interviewees also gave me much of their time and to them I remain particularly grateful. Most of the interviewees are the unsung heroes of Brazilian success in the software development arena and they were very generous with me in sharing their views, apprehensions and dreams.

There has been an important official effort in developing Brazilian software laudable enough to make any Brazilian proud of their record in software development, and thankful to the government officials who helped to make it happen.

I hope that this analytical effort will help all involved to discuss more deeply and independently what went wrong in terms of achieving a significant exports record and how the policies may be adjusted to the new times and to the lessons do be drawn of independent appraisals.

Several colleagues, including my own colleagues in this international collaborative work, commented earlier pieces or versions of this work and helped enormously with their discussions on the approach and the potential rewards of research avenues. Leda Maria Vieira Machado proofread an earlier near final version, contributing to shape my own views with her insights borne out of her own speciality: public policy analysis. The responsibility for eventual remaining errors is, however, only my own.

To all who helped me so much, including to those who understandably wish to remain anonymous, my deepest gratitude.

Alfredo Behrens
São Paulo,
April 2003