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TECHNOLOGICAL AND MARKET-RELATED CAPABILITIES AND COMPETITIVENESS IN THE BRAZILIAN COMPUTER INDUSTRY: A CASE STUDY

CAPACIDADES TECNOLÓGICAS E MERCADOLÓGICAS E COMPETITIVIDADE NA INDÚSTRIA BRASILEIRA DE COMPUTADORES: UM ESTUDO DE CASO

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ABSTRACT

The computer market in Brazil is dominated by domestic private companies that compete with large multinational companies. This study aims, based on the case of *Positivo Informatics*, to discuss how national companies can compete in complex markets accumulating technological and non-technological competences. The theory on technological paradigms allows dividing the world computer industry into two groups: the companies that master the paradigm core, responsible for pushing forward the technological frontier; and the companies whose competences are focused on complementary elements of the paradigm. The analysis of *Positivo Informatics* shows that the elements providing it with competitiveness do not depend on its technological competences. The elements that keep the industry competitive are derived from the expansion of consumption among lower classes and company specialization in this population. We conclude that, in Brazil, the computer industry keeps being competitive without developing technological competences.

Keywords: Technological paradigms; Competitiveness; Technological capabilities; Learning processes.

RESUMO

O mercado de computadores no Brasil é dominado por empresas privadas nacionais que competem com grandes empresas multinacionais. O objetivo deste estudo é, baseado no caso da Positivo Informática, discutir como empresas nacionais podem competir em mercados complexos acumulando competências tecnológicas e não tecnológicas. A teoria sobre paradigmas tecnológicos permite dividir a indústria mundial de computadores em dois grupos: as empresas que dominam o núcleo do paradigma, responsáveis por deslocar a fronteira tecnológica; e as empresas cujas competências são focadas em elementos complementares do paradigma. A análise da Positivo Informática mostra que os elementos que lhe proporcionam competitividade independem de suas competências tecnológicas. Os elementos que mantêm a indústria competitiva são oriundos da expansão do consumo nas classes mais pobres e da especialização da empresa nesse público. Conclui-se que, no Brasil, a indústria de computadores se mantém competitiva sem desenvolver competências tecnológicas.

Palavras-Chave: Paradigmas tecnológicos; Competitividade; Capacidades tecnológicas; Processos de aprendizagem.

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1. INTRODUCTION

The world computer industry may be highlighted through its continued and always breakthrough technological development. This never-stopping evolution means that this industry has experienced several paradigmatic changes over the years. Thus, the computer industry may be an interesting context for studying the role of paradigms with regard to the development of technological capabilities by a company.

The concept of technological paradigms, proposed by Dosi (2006), enables us to deal with innovations in the computer industry as a systemic action driven by a group of companies. In this system, each component has different effects on the industry technological trajectory. The many components of the computer paradigm are distinguished as levels of appropriability (see DOSI, 1982, 1984 and 1988) and opportunity.

The world computer industry, nowadays conditioned by the so-called Wintel paradigm (Wintel is the combination of Windows, the operational system created by Microsoft and Intel, the microprocessor producer), may be divided into two groups of companies. The first group comprises two enterprises, Microsoft and Intel, responsible for constructing the computer's platform, which is the operational system and the microprocessor. The second group consists of the companies that master the secondary or peripheral competences of the paradigm, related to the production of components that will be connected to the computer platform.

The key characteristic of the paradigm involves the commitment of companies to the second group, developing innovations that must be compatible to the platform made by Microsoft and Intel; this way, a hierarchy between the first and second group of companies is set within the paradigm, with a direct implication for the competitiveness of computer companies.

Almost all computer producers, the focus of this article, rely on innovations to create differentials and advantages, in order to keep their competitiveness. The dynamic innovative behavior can be better observed in the computer global players. Although having huge technological advantages over the Brazilian companies some major computer enterprises established in Brazil, such as Dell, HP, Samsung, among others, are not leading players in the Brazilian market. In 2010, 4 domestic companies had 24% of total market share (the 8 biggest computer producers controlled over 51% of the national market). The Brazilian company called *Positivo Informatics* had almost 16% of the national market; in 2011, its market share was 15.6%.

Data mentioned above shows that the national private companies, especially *Positivo Informatics*, are able to compete with multinational corporations and even gain market share over them. The Brazilian computer industry has a paradox that can hardly be seen in other high technology sectors: indeed, it is clear that the national computer producers play a distinguished role when competitiveness is analyzed in Brazil.

The Brazilian paradox brings up the discussion about technology as a competitiveness driver in the national computer industry. In order to add new features to this heavily debated theme, we analyzed the way how hierarchies observed in a paradigm can change the development of competences by a company. Based on the *Positivo Informatics* case, this article aims to discuss how the national companies are able to compete in complex markets accumulating both technological and non-technological competences. *Positivo Informatics* presents itself as an example to make clear why the Brazilian computer industry is characterized by the high competitiveness of nationally owned enterprises. This article shows that, in Brazil, technological competences are important elements to improve competitiveness, but non-technological competences may not be neglected as variables that can keep the competitiveness of computer producers.

For achieving the proposed goal, this article is divided into five sections, in addition to the introduction and conclusion. The next section describes the Wintel paradigm, in order to identify the competitiveness drivers in the world computer industry. The third section presents the methods used in the study. The fourth section briefly describes the national computer industry from 1993 on. The fifth section discusses the peculiarity of the Brazilian computer industry through the *Positivo Informatics* case. The last section discusses the competences of *Positivo Informatics* with regard to its competitiveness and how this company constructed them over the years.

2. THE WORLD COMPUTER INDUSTRY UNDER THE WINTEL PARADIGM

2.1. Theory Background

Before discussing the world computer industry, it is important to introduce and discuss some concepts on which this article is based, i.e.: (i) technological paradigms; (ii) technological trajectories; (iii) technological competences; and (iv) non-technological competences.

Technological paradigms constitute a concept proposed by Dosi (1982; 2006, p. 152) "as 'model' and a 'pattern' of solution of selected technological problems, based on selected principles derived from natural sciences and on selected material technologies". Dosi's idea of a technological paradigm is based on the main claim of Thomas Khun's *The structure of scientific revolutions*, where the author argues that science is presented as a general model able to answer to the questions posed by the natural world by means of the scientific advance. Both scientific and technological paradigms are successful if they are effective to solve the problems presented to them. This way, technology is a model for constructing artifacts with certain and desired economic qualities.

The technological paradigm is the structure allowing a technology to be constructed, the progress of any kind of technology is somehow framed by the paradigm borders and the way how technical progress is conducted is defined as technological trajectories (DOSI, 1982; 1988; 2006). Within a paradigm, there can be numerous technological trajectories.

In the process for developing a technological trajectory, the company must be able to construct its artifacts; the ability of producing several artifacts the same way may be named competence. The notion of competences is derived from the concept of routines proposed by Nelson and Winter (1982); routines are the daily tasks fulfilled by the company.

The company capacity to make things its own way constitutes its competences. Those related to technology are defined as technological competences, for instance: an enterprise, through the R & D (research and development) process, develops the ability to construct semiconductors, in other words, the company acquires the competence of producing semiconductors by means of routine tasks. The competences not related to technologies - the non-technological competences - are those related to the value chain management or the ability to sell directly to customers, as Dell, for instance, which created the direct sale process. The non-technological competences of Dell had no influence on its competences to produce computers.

These concepts are very important. They allow us to see a company as part of a system, in which not everything is possible, answers by the enterprise must observe the competitive process and the technological structure set by the paradigm. All these components are tightly connected, so that technological paradigms set the whole structure, the technological trajectory is a way to conduct the technical progress within the paradigm. The competences acquired through R & D allow the company to create a technological trajectory.

The neo-Schumpeterian approach advocates for a direct relationship between the accumulation of technological competences and the improvement of competitiveness (FREEMAN, 2004; BELL; PAVITT, 1993; 1995; LALL, 1990; 1992). It shows to be complex, in a Schumpeterian theory, to understand the construction and maintenance of competitiveness without relying on any technological variables. This article explains that it is possible for a company to be competitive by means of distinguished technological capabilities.

2.2. The Competitive Process under the Wintel Paradigm

This section divides the world computer industry into two groups, or tiers, of companies: the paradigm core (first tier), and the companies focused on secondary elements of the paradigm (second tier). The existence of such groups has direct implications for the innovative efforts of an enterprise.

In the early 1990s, the Wintel paradigm was on the rise, Microsoft and Intel combined, and through their main products the computer's platform was constitute (BRESNAHAN; GREENSTEIN, 1999). According to Bresnahan and Greenstein (1999, p. 5), platform is "a bundle of standard components around which buyers and sellers coordinate efforts". The platform is, therefore, the key component of computer industry; all companies, during their innovation process, must consider the way how the components produced by them may be connected to the platform.

The continued leadership of Microsoft and Intel has led to a standardization of the industry around the Wintel platform. These companies enjoy a privileged position, from where they can set the industry technological requirements by means of the platform. The computer producer must be committed to technological prescriptions of the platform, in order to provide effective components. Thus, the companies focused on elements of the second tier, involving technological development tied to the platform development (BRESNAHAN; GREENSTEIN, 1999).

Considering the importance of the platform for the computer firm, how can the companies deal with the platform conditioning elements? This answer may be given in a brief discussion about the IBM entry into the personal computer (PC). IBM entered the PC age constructing a computer by means of several suppliers, in a "deverticalized" way (TEECE, 1986; STURGEON, 2002). The company strategy was focusing on its capabilities with regard to sale channels and organization of suppliers (BRESNAHAN, 2007; BRESNAHAN; GREENSTEIN, 1999; TEECE, 1986; BRESNAHAN; MALERBA, 1999).

IBM chose Intel and Microsoft as the platform suppliers, thus, these companies regarded the technological competences as a key element of the industry. IBM lost industry control when the computer platform was outsourced, and the company can no longer hold the competences which define the industry technical advance and technological trajectory. Thus, in the PC age, Intel and Microsoft became responsible for setting the industry technological frontier in the world market, in other words, these firms are in control of the computer industry paradigm (BRESNAHAN, 2007; BRESNAHAN; GREENSTEIN, 1999).

This process defined the Wintel paradigm rise, and it was not encompassed by a technological breakthrough: nevertheless, this process ended up in the exit of IBM from the PC segment and the transference of industry leadership to Intel and Microsoft (BRESNAHAN, 2007; BRESNAHAN; GREENSTEIN, 1999; HAGEDOORN; CARAUANNIS; ALEXANDER, 2001). The origins of the Wintel paradigm are pointed out by Hagedoorn, Carauannis, and Alexander (2001). These authors argue that the Wintel paradigm is a kind of hybrid from the IBM/PC paradigm and the Apple/Macintosh paradigm. The Wintel standard borrowed Macintosh's user friendly features, such as the icons. From the IBM/PC paradigm, Wintel inherited the Microsoft's operational system Windows and the Intel's microprocessor; besides, IBM/PC contributed with the "deverticalized" way the computer industry is organized (HAGEDOORN; CARAUANNIS; ALEXANDER, 2001).

Intel and Microsoft established the industry technological standards by mastering the paradigm core. The platform segment was surrounded by highly complex competences which create entry barriers extremely difficult to be overcome by other companies in the computer industry. As paradigm rulers, Intel and Microsoft enjoyed a high appropriability level (DEDRICK; KRAEMER; LINDEN, 2009). These characteristics constitute a mechanism which keeps these companies as platform leaders (DEDRICK; KRAEMER, 2008; DEDRICK; KRAEMER; LINDEN, 2009).

The other companies held the so-called secondary competences which have minimal influence on the industry technological trajectory. They operate outside the paradigm core and must fit their innovation processes with regard to technological prescriptions designed by Intel and Microsoft. Hence, all innovations introduced by these companies are technologically constrained by the standards posed by Intel and Microsoft (BRESNAHAN, 2007; BRESNAHAN; GREENSTEIN, 1999; DEDRICK; KRAEMER, 2008). Although computer producers are tied to the secondary paradigm elements, these elements are diversified enough to provide the companies with some room to innovate.

The existence of two distinguished groups in the computer industry is crucial to explain the technological limitations experienced by the second group of companies. These firms are specialized in non-core computer components, such as wireless and battery technologies (DEDRICK; KRAEMER, 2008).

Innovations based on the secondary paradigm elements have a low appropriability, as Dedrick, Kraemer, and Linden (2009) demonstrated in their analysis of the HP nc6230 notebook value chain. These authors investigated which companies in the value chain are able to extract most of the product value. As a conclusion, Dedrick, Kraemer, and Linden (2009) claim that the Wintel paradigm leaders managed to catch more value than all other companies, even HP. The conclusion of Dedrick, Kraemer, and Linden (2009) is similar to that found by Teece (1986); according to this author, in a high appropriability regime, companies which control the paradigm core can have a higher profit over their own innovations. Teece (1986) also showed that in low appropriability regimes, companies holding complementary capacities over the paradigm core have increasing difficulties to profit from their own innovations, such as computer producers.

Computer companies, thus, enjoy low appropriability with regard to their innovations, whereas the key elements are dominated by Intel and Microsoft. In this case, if producers wish to differentiate their products by adding innovations, there is no certainty that the customer is willing to accept and pay for that differentiation (DEDRICK; KRAEMER, 2008).

Two interesting examples may be cited as innovative answers given by computer producers to avoid or diminish the low appropriability with regard to the paradigm. The first is the creation of direct sales, an innovation which excluded retailers from the value chain and allowed Dell to catch more value through its own innovations and computers (KRAEMER; DEDRICK, 2001). The other example is provided by Dedrick, Kraemer, and Linden (2009), by analyzing the n630 HP notebook; the authors pointed out that HP made a lighter notebook using a different material than plastic. Company concerns to develop new competences, complementary to the paradigm core, constitute a key process in order to be a competitive player within a paradigm.

Computer companies must keep their competitiveness by means of a strong innovative behavior. Some examples of computer producers are Lenovo, Dell, HP, and *Positivo Informatics*. These firms are basically focused on two products, desktops and notebooks, which have many differences from each other (DEDRICK; KRAEMER, 2008). The secondary capacities held by computer companies in the desktop segment are focused on the value chain end. Thus, these companies are devoted to sales and market

identification, whereas the secondary competences related to notebooks are rather knowledge-driven and related to engineering and development of certain kinds of components.

The accumulation of technological competences is essential for the company to improve its competitiveness; according to Dedrick and Kraemer (2008), these competences, in the desktop segment, are: (i) combining software and hardware to work together in a more effective way; (ii) innovations related to the firm's brand; (iii) user interface; (iv) cost reduction; and (v) quality improvement. The production of desktops basically relies on highly standardized components offered by many suppliers; it is possible to assemble a desktop using components provided by different companies. This equipment is, somehow, very simple to produce and the components do not need any adjustment to fit within the desktop.

The notebook segment is far more complex. The decreased size of these devices requires advanced competences on engineering, especially those related to energy consumption and battery autonomy. Although notebooks have some standard components, most of them are very specific to each model, such as batteries and motherboards (DEDRICK; KRAEMER, 2008). Notebook components require a specific shape and size to fit into the small space designed to each of them; kits have been produced and sold as a closed package by an only supplier, generally an original device manufacturer (ODM).

This closed package is named barebone, containing all computer parts except memories, hard disks, and other standard components. Each notebook package is closely related to the device architecture, thus, it is difficult to assemble a notebook relying on several suppliers, and it is also impossible to design different notebook families with the same components, because each component is specific to each notebook family. Indeed, if the computer producers wish to change the design of their notebooks and add some special features, the knowledge needed for this kind of activity is highly complex and competences related to component engineering are required. This way, the notebook size becomes a barrier to the addition of new features. For conducting such activities, computer producers need to master abilities aimed at reducing the number or size of components.

The technological differences of products demand from the companies distinguished groups of abilities to deal with innovations related to the production of this kind of equipment. Desktops are technologically stable products and the major innovations are generated by suppliers, especially platform constructors. Computer

companies just assemble the product, without any concerns about the engineering of components. Desktops follow a particular trajectory of accumulation of competences which mainly involves product cost reduction (DEDRICK; KRAEMER, 2008).

Therefore, the innovation options offered by notebooks in these secondary elements allow the computer companies to decrease paradigm constraints. Thus, notebook innovations have a higher appropriability level from the point of view of companies. The diversity of innovations also leads to the accumulation of competences, which encompasses: (i) improving the microprocessor capacity; (ii) reducing energy consumption by this microprocessor; (iii) constructing more durable batteries; (iv) improving the notebooks connectivity and portability; and (v) using new materials, besides plastic, in notebook construction. All these competences create differentiation among notebooks, providing each firm with specific products.

As discussed in this section, the world computer industry dynamics led to the existence of two groups of companies which interact in a hierarchical way. The core paradigm defines the technological characteristics by means of the platform; the standards posed by Microsoft and Intel constitute technical constraints that all firms should observe. These companies set the industry standards, as well as the technological frontiers, defining the industry technological trajectory. The other companies are enclosed in the paradigm borders, and they have to deal with paradigm constraints by means of their innovative efforts. The less technologically complex products are desktops, which provide little space to innovation and, thus, low appropriability for producers. However, with regard to more technologically complex devices, such as notebooks, there is a vast range of elements which can generate innovations and lead to better conditions in terms of notebook innovations.

Therefore, a strongly innovative behavior on the part of computer producers is a way of overcoming paradigm constraints.

3. METHODS

First, we will present a brief background of the Brazilian computer industry and its technological behavior; for this, we used data provided by the Innovation Research (PINTEC) conducted by the Brazilian Institute of Geography and Statistics (IBGE). We chose as analytical variable the expenses on R & D.

The choice of Positivo Informatics as a case study is based on the distinguished role played by this company in the Brazilian computer industry. Positivo Informatics was

founded in 1989, but only in 2004 it started selling its computers in the retail market. In 2006, the firm entered the stock market. The sale of desktops and notebooks corresponds to 97.6% of Positivo Informatics revenue. Positivo Informatics, as most of the Brazilian companies, doesn't have a strongly innovative behavior. Nevertheless, Positivo Informatics has a large market share (15.6%, in 2011) and it holds the market leadership position for seven years. In Brazil, Positivo Informatics is able to compete with global players, such as Dell, HP, and Lenovo. However, as any other company, Positivo Informatics deals with constraints related to the paradigm, with effects on competitiveness. Thus, this section aims to discuss the competitiveness of Positivo Informatics, focusing on its accumulation of competences.

The case study was designed by means of two interviews conducted with the chief technology officer of Positivo Informatics, Mr. Luiz Mariano Julio, the first on March 11th and the second on July 7th, 2011. We also used annual reports of the company, from 2004 to 2009.

4. THE CURRENT BRAZILIAN COMPUTER INDUSTRY: THE PERIOD AFTER THE LIBERAL REFORMS

This section presents the current Brazilian computer industry; our analysis start in 1993, when the government established the new information technology policy. This institutional framework deployed new actions in Brazil which were important so that the private national companies can keep their market share.

In the 1990s, the Brazilian market was opened to international competition. Local companies had to compete with highly effective multinational corporations; at first, this fact was regarded as the end of some local companies, especially those technologically driven, such as computer producers, but this did not occur, as shown by Table 1. It is important to observe that the new information technology policy was able to boost the domestic consumption of computers, especially due to tax reduction. In addition, the government established a new policy named "Connected PC Program", which increased sales of computers.

Table 1 – Major computer producers in Brazil

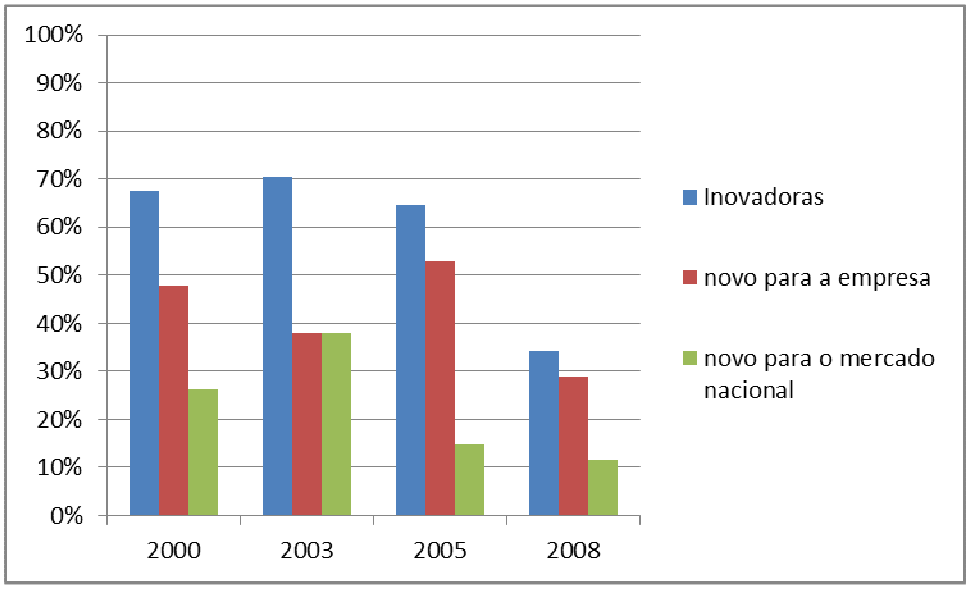
Company	Market share (1997)	Company	Market share (2009)
Compaq (USA)	10.40%	Positivo (Brazil)	16%
Itautec (Brazil)	6.80%	HP (USA)	7%
IBM Brasil (USA)	5.60%	Dell (USA)	8%
UIS (Brazil)	4.90%	CCE (Brazil)	5%
Tropcom (Brasil)	4.70%	Acer (Taiwan)	4%
Byte On (Brazil)	3.40%	Lenovo (China)	4%
HP (USA)	3.10%	STI (Brazil)	4%
Microtec (Brazil)	2.90%	Itautec (Brazil)	3%
Fivestar (Brazil)	2.90%		
Accer (Taiwan)	2.50%		
Market share of nationally owned companies	25.60%	Market share of nationally owned companies	24%
Market share of multinational corporations	21.60%	Market share of multinational corporations	28%
Total	**47.20%**	**Total**	**52%**

Source: Prepared by the authors.

It is worth highlighting that nationally owned companies have a significant market share. This fact draws attention to the competitiveness of these companies across the spectrum of technological variables.

Graphics 1 and 2 display the amount of companies which developed products and technologies.

Graphic 1 - Companies that deployed product innovations and innovation level (%) in 2000, 2003, 2005, and 2008

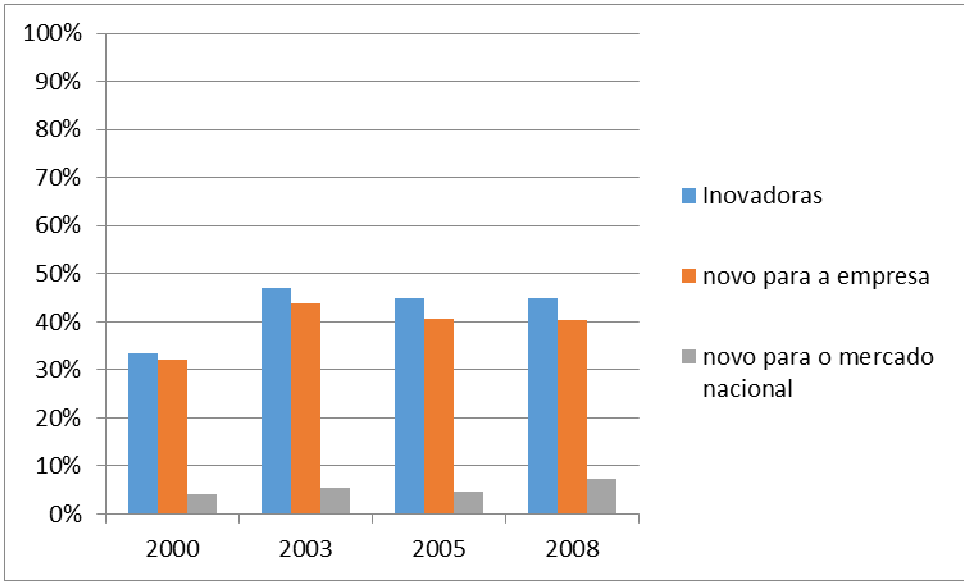


Source: Prepared by the authors.

Graphic 1 shows that, up to 2005, a relative amount of companies deployed product innovations. Also in 2005, the innovation level decreased and, in 2008, this figure was also severely decreased.

Graphic 1 indicates that, in Brazil, informatics is not based on the production of new computers. As indicated in section 2, what provides the world computer industry with its dynamics is the production of technologically new computers that push forward technological advances, and computer producers compete in a paradigm where new products are extremely important to keep their appropriability. However, in Brazil, the number of new products has decreased over the years. This fact, indeed, reveals a certain ineffectiveness of the Brazilian industry with regard to the ability to generate new products.

Graphic 2 - Companies that deployed process innovations and innovation level (%) in 2000, 2003, 2005, and 2008

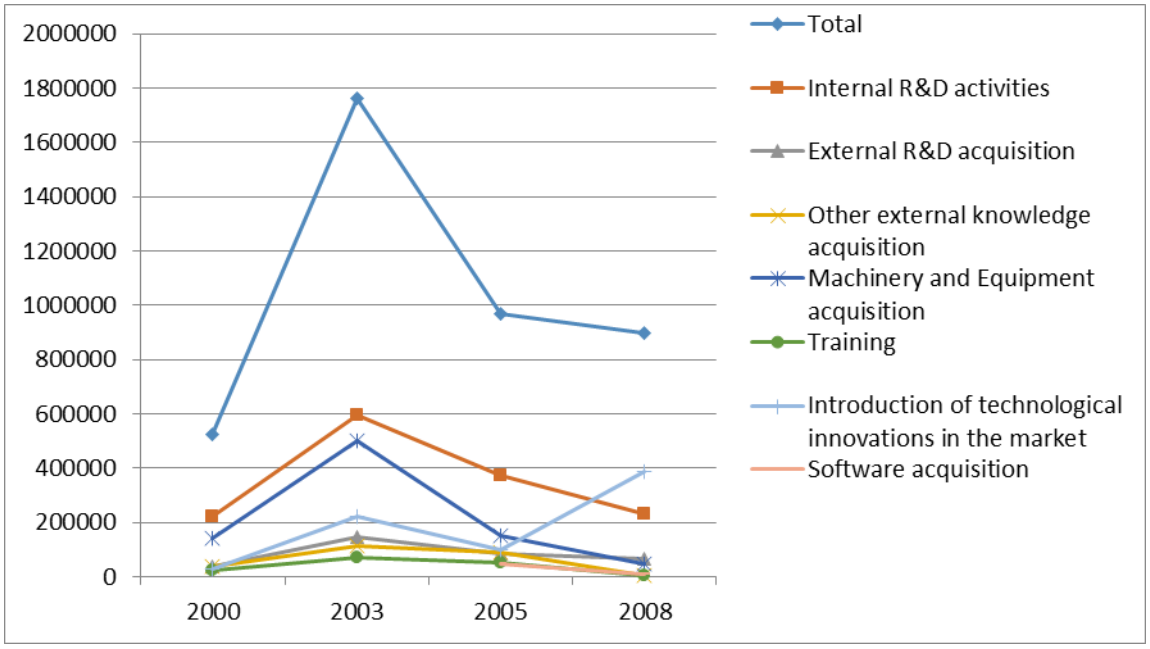


Source: Prepared by the authors.

Graphic 2 indicates that, with regard to process innovations, the scenario involves companies not committed to increase their productivity and reduce costs. Indeed, graphics 1 and 2 indicate that the national companies have a passive behavior, they do not foster the ability to produce innovation.

A more comprehensive analysis of the innovative ability of the Brazilian computer industry is obtained by investigating what variables are focused by the companies. Graphic 3 displays the variables where companies have invested their money.

Graphic 3 - Companies' expenditure (US$ dollars) on innovative activities in 2000, 2003, 2005, and 2008



Source: Prepared by the authors.

Graphic 3 shows that the overall innovative effort is falling down since 2003. The domestic R & D efforts aimed at the construction of technological competences are also decreasing. The introduction of technological innovations in the market, on the other hand, is increasing. According to IBGE's PINTEC (2005, our translation),

> […] the introduction of technological innovations in the market comprises sale activities directly related to the new or improved product, and it may include: market research, market testing, and marketing for launching the product. It excludes the construction of distribution networks for innovations.

The introduction of technological innovations into the market prevents the innovative activities to fall down even further, but this variable is not connected to the development of new technological competences. Besides, product innovation decrease and process innovation stagnation show the lack of a dynamic behavior on the part of industry.

It is not a surprise that the internal R & D efforts are declining because they are associated to innovation decrease. The national industry competitiveness may hardly be explained by means of its innovative behavior and accumulation of technological competences. In order to see what makes a Brazilian company competitive, there is a need to analyze it.

5. THE POSITIVO CASE

Positivo Informatics is a Brazilian computer producer whose competences may be divided into three competence groups: (i) capabilities required by the PPB(*processo produtivo básico*; in english basic productive process); (ii) competences resulting from the company's internal efforts; and (iii) non-technological competences. The competences accumulated by the PPB are relevant, but they will not be discussed in this article. The PPB may be regarded as the minimum technological requirement needed for a firm to compete in the Brazilian computer industry. Indeed, any company which does not fully benefit from the new information technology law, due to its inability to keep pace with the PPB has little chance to survive in this industry. The subsections below discuss the technological competences accumulated by means of internal innovative efforts and the non-technological competences that are also related to the paradigm constrains and the recent government policies.

5.1. Accumulation of Technological Competences by Positivo Informatics

In order to explain the competitiveness of *Positivo Informatics*, it is extremely important to observe that this company, since its entrance in the retail market, has focused on the lower income population. Relying on an intensive learning by doing process, the company is able to design and produce computers which are not expensive and show a good performance; this competence was achieved because of extreme specialization in the lower income population. Besides, *Positivo Informatics* has some hardware competences that allow it to change and construct some components without compromising the computer's performance; these competences are mainly obtained by trial and error.

The software competences held by *Positivo Informatics* constitute the factor which differentiates the company from the other Brazilian firms, especially the operation system and BIOS[1] optimization. These competences involve the ability to adjust or rewrite some primary codes to improve computer's performance and reduce failures. In other words, software optimization allows a better communication between software and hardware.

[1] The BIOS are the first codes to be loaded when the computer is turned on. The primary function of the BIOS is to load and start the operational system, also the BIOS must recognize and link the computer components "handling" the PC control for the user

In order to develop a competence which allows the company to optimize software, there is a need for training conducted by the suppliers, due to the complex knowledge required to learn the software code and to change it. This kind of training is associated to the level of trust the firm share with its BIOS and operational system suppliers. Nevertheless, it is known that no multinational corporation do software optimization in Brazil and few national companies are able to do this.

The *Positivo Informatics* competence in optimizing software was developed by means of training conducted in the USA with the BIOS supplier. Operational system optimization required from *Positivo Informatics* an active interaction with Microsoft: first, the company needed to show to Microsoft the competences its R & D team had accumulated; then, Microsoft provided *Positivo Informatics* with the Windows codes. This interaction evolved so that, nowadays, Microsoft assists *Positivo Informatics* in some optimization process and even gives some suggestions to it Besides, *Positivo Informatics* is one of the few Brazilian firms relying on Microsoft support for optimizing Windows 8, something which is worked on by means of monthly meetings. The development of competences is undertaken by *Positivo Informatics* through interactive learning, mainly due to the nature of its products.

5.2. The Accumulation of Non-Technological Competences by Positivo Informatics: Entrance into the Retail Market

In its early days, *Positivo Informatics* produced computers only when the government ordered them. However, in 2002, this strategy changed as the Brazilian State started buying less computers. In 2004, another Brazilian company, called Metron, the market leader in 2002 and 2003, entered into bankruptcy. Metron deserves attention because it was a company whose products were found in the major Brazilian retail stores, such as: *Casas Bahia*, *Ponto Frio*, *Extra*, and *Wal-Mart*.

When Metron bankrupted, a new opportunity emerged in the retail market and *Positivo Informatics* took it. First, the company offered technical assistance with regard to the computers sold by *Casas Bahia*, which could not offer this service anymore due to Metron bankruptcy. Not only *Positivo Informatics* was able to offer such technical assistance, but the firm managed to sign an agreement in order to be the exclusive desktop supplier of *Casas Bahia*, the biggest retail store in Brazil. Another element providing *Positivo Informatics* with an advantage over its competitors was hiring the whole sales personnel from Metron. *Positivo Informatics* entered into the retail market in

such a successful way that after two months the firm had obtained a revenue equal to that obtained for the whole year of 2003.

Casas Bahia became a key partner for *Positivo*; the exclusivity enjoyed by the company as the only desktop supplier created a huge advantage over the competitors. The ability of *Positivo Informatics* to sign such an agreement was due to the business diversity of *Positivo* group; it was already the supplier of advertising material for *Casas Bahia*. By means of the previous agreement, *Positivo Informatics* became the exclusive computer supplier for *Casas Bahia*, a commercial advantage which also turned it highly dependent on this partner. Sales through *Casas Bahia* amounted to 70% of the revenue of *Positivo Informatics* in 2008.

The role played by *Casas Bahia* with regard to the competitiveness of *Positivo Informatics* is indisputable, but the company tried to diversify its market scope in other retail stores using its many brands, i.e.: (i) Positivo, the main company brand, sold for retailers only as a closed package by a minimum price; (ii) Sim+, simpler and cheaper computers which may be bought separately by retailers; (iii) Kennex, a strategic acquisition made to enter into the *Pão de Açúcar* group; and (iii) Neo PC, a brand created to enter into the *Ponto Frio* retail stores.

Positivo Informatics started selling computers in the retail market when it became the only desktop supplier for *Casas Bahia*, whose customers are mainly from the poorer social strata in Brazil (classes C and D). The successful trajectory of *Positivo Informatics* is, to a large extent, explained by the adequacy of its computers to the customers of *Casas Bahia*. Indeed, the specialization of *Positivo Informatics* in a specific population reflects its entrance into the retail market. The company consolidated itself in the Brazilian social strata showing the biggest increase in consumption over the recent years (Table 2), and this was crucial for expanding the company and increasing its accumulation of competence

Table 2 - Brazilian households with PCs (%)

Social stratum	Number of households (millions)	2005	2006	2007	2008
A	2.5	89.5	86	88	95
B	5.1	56.9	63.2	63.2	70
C	18.2	16.4	18.8	25	25
D/E	26.9	2	2.8	4	3

Source: Prepared by the authors.

Table 2 provides a clue for understanding why and how *Positivo Informatics* became the market leader in Brazil; its specialization in the retail market aimed at the lower income classes and the policies which boost consumption turned *Positivo Informatics* into one of the few computer suppliers for this population in the country.

6. DISCUSSION ON THE COMPETENCE ACCUMULATION PROCESS OF POSITIVO INFORMATICS

At a glance, it is possible to see that *Positivo Informatics* is heavily focused on the domestic market, which is experiencing rapid growth since 2005. Indeed, the income increase enjoyed by the poorer classes provided the company with a great opportunity for expansion. Nevertheless, any computer producer could survive exploring the Brazilian market, thus, *Positivo Informatics* managed to acquire some advantages over its competitors.

There is no doubt that *Positivo Informatics* holds a strong competitive position in the desktop segment and the competences the company has acquired over the years provided it with advantages over its national competitors. However, the firm is constrained by the technology and its desktop capabilities cannot be applied to notebooks. The company weakness becomes clear when it comes to the lack of competences aimed at notebooks, although there is a recent process of replacing desktops by notebooks. Despite *Positivo Informatics* holds a large market share in the notebook segment, the company has no technological competences related to the development of new batteries and it is unable to produce notebooks using new materials as the multinational corporations can do. These kinds of competence increase the competitiveness of any company and enable it to compete internationally in various markets. The notebook segment shows that *Positivo Informatics* has not the same

advantages it enjoys with regard to the desktop segment. These products require higher appropriability of innovations, and the focus on poorer classes is not an advantage with regard to the notebook segment.

The technological competences of *Positivo Informatics* do not distinguish this company from the multinational corporations, although some competences are more advanced in *Positivo Informatics* than in other Brazilian computer producers. It became clear that the competitiveness of this company is not based on its technological capabilities.

The ability to take the leadership position in the retail market by means of an opportunity is the main reason for the competitiveness of *Positivo Informatics.* The technological competences accumulated by the company constitute an evolution with regard to its consolidation in the retail market, generating a competence creation process which leads to the accumulation of a specific knowledge in the Brazilian context. However, the knowledge elements increasing the competitiveness of *Positivo Informatics* are not related to a long run strategy associated to an effective industrial policy; indeed, its competitiveness may be pointed out as a consequence of the implementation of the Wintel paradigm in Brazil.

The Wintel paradigm constrains the expansion options of *Positivo Informatics* and shapes its innovative efforts. The pressures faced by *Positivo Informatics* are also derived from the other computer producers operating in the Brazilian market, especially the multinational corporations. These global players have huge scales and hold an enormous amount of knowledge on the industry that increase the effectiveness of their innovative efforts, even though their efforts are focused on the secondary paradigm elements.

In Brazil, the multinational corporations face difficulties to adapt their products to the needs of Brazilian consumers; they have a limited ability to design computers for our market, since most consumers are from the lower classes (Table 2). This constraint faced by the multinational corporations helps explaining the gap observed in the Brazilian computer industry when Metron bankrupted. This allowed *Positivo Informatics* to become a successful computer producer focused on the lower social strata in Brazil.

The specialization of *Positivo Informatics* in this population is a two-edged sword: on one side, this focus is responsible for rapid growth and high competiveness; on the other side, this specialization constrains the company ability to add differentials generated by means of internal innovative efforts. *Positivo Informatics* can only add differentials to its products when the technology involved is stabilized in the market, since this fact allows keeping computer prices stable. This process, somehow, keeps pace

with the population income, while the multinational corporations focus on adding differentials to their computers.

The *Positivo Informatics* case points out that the Brazilian computer industry is extremely dependent on the domestic market expansion, especially among the lower classes. Currently, this is not the focus of multinational corporations. Thus, the actual competitors of *Positivo Informatics* are the other national companies which adopt the same strategy. In other words, all nationally owned companies operating in the Brazilian computer industry are focused on the lower income population.

The *Positivo Informatics* specialization in the lower income classes may be regarded as a choice allowing this company to avoid a direct competition with the multinational corporations within the Brazilian borders. The trajectory of *Positivo Informatics* led it to bridge a gap observed in the national computer industry, within the Wintel paradigm, which could not be bridged by the multinational corporations due to the little attention they pay to the lower classes, that became relevant with regard to computer consumption in 2004 and 2005 (when *Positivo Informatics* started selling its computers in retail stores). It is worth observing that the entrance of this company into the retail market coincided with the creation of government policies that boost computer consumption among the poorer classes. Thus, any nationally owned company could occupy the same position as *Positivo Informatics*.

When *Positivo Informatics* entered into the retail segment, notebooks were not disseminated in the Brazilian market. However, nowadays, desktops have been replaced by notebooks. If this fact is taken into account in the analysis of the *Positivo Informatics* case, its technological weaknesses become even more apparent. The participation of *Positivo Informatics* in the computer industry is not constrained only by the kind of consumer, but also by the kind of products the company produces. The competitiveness of *Positivo Informatics* heavily relies on the desktop segment and the company has not a major market share in the notebook segment. As discussed before, notebooks are technologically more complex than desktops, and the innovations related to notebooks may generate higher appropriability. Thus, notebooks are not regarded as a priority by the customers of *Positivo Informatics*.

Despite the success of *Positivo Informatics* in bridging the gap observed in the lower classes, the multinational corporations have also developed strategies and competences with regard to this market segment. The Brazilian market expansion has opened way to multinational corporations able to provide cheaper products, such as Lenovo and Acer.

The *Positivo Informatics* case shows that the local competitiveness of a Brazilian computer producer is, to a large extent, explained by its non-technological competences, especially the exclusive agreement with *Casas Bahia*. *Positivo Informatics* constitutes an interesting example of paradigm constraints; due to its specialization in the lower income population and in the desktop segment, *Positivo Informatics* is unable to rely on technological competences related to notebooks and, thus, its market competences are different from those of multinational corporations. Through the *Positivo Informatics* case, we may infer that a company can be competitive in the Brazilian computer industry without accumulating technological competences or having a strongly innovative behavior.

7. CONCLUSION

The technological paradigm concept applied to the world computer industry, along with the idea of complementary assets and competences proposed by Teece (1986), allows dividing this paradigm into two: the paradigm core and the paradigm border. Dividing this paradigm into different competences and appropriability levels implies that there is a hierarchy within the paradigm, something which differently influences both on the industry technological trajectory and the paradigm shift. By means of the analysis of world computer industry, two groups of companies and competences were set: the paradigm core companies (Intel and Microsoft), which control the computer platform capabilities, and the non-paradigm core companies, which control the secondary competences in the computer industry, in other words, these companies produce the components that will be connected to the platform.

In Brazil, computer producers do not expend high amounts on innovative activities (Graphic 3), however, the nationally owned companies hold the biggest market shares (Table 1). Thus, in Brazil, the computer producers can be competitive despite their lack of technological competences. A brief analysis of the Brazilian computer industry shows that the companies are devoted to the domestic market and their growth is, to a large extent, explained by the national polices which boost computer production and consumption.

This analysis of the biggest Brazilian computer producer is relevant for understanding this peculiarity; *Positivo Informatics* holds the biggest market share and it is extremely competitive within the national borders, however, in international terms, its market share is irrelevant.

We may infer that *Positivo Informatics* does not neglect technological development, but the accumulation of technological competences is not responsible for its competitiveness. The competitiveness of *Positivo Informatics* is mainly derived from the exclusive agreement signed between this company and *Casas Bahia*, which has led *Positivo Informatics* to have a great demand for its desktops. When this paradigm was introduced to the Brazilian context, it did not apply to the entire Brazilian computer industry. A spot emerged for companies able to produce computers aimed at the low income population. *Positivo Informatics* managed to consolidate itself in this specific segment of the national market, but this process has brought some difficulties for the company with regard to its way of accumulating technological competences.

As an overall conclusion, we may claim that the competitiveness enjoyed by the Brazilian computer producers is not based on the accumulation of technological competences because of constraints posed by the Wintel paradigm; that is the reason why all nationally owned companies are specialized in the lower income population and in the desktop segment.

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