Universidade de Brasília
Departamento de Economia

Série Textos para Discussão

Implications of Information Technology in the Brazilian Path of Growth

Bruno F. F. da Rocha
Universidade de Brasília

Joanílio Rodolpho Teixeira
Universidade de Brasília

Texto nº 302
Brasília, agosto de 2003

Department of Economics Working Paper 302
University of Brasilia, August 2003

UNIVERSIDADE DE BRASÍLIA
DEPARTAMENTO DE ECONOMIA

TEXTO PARA DISCUSSÃO Nº 302

Implications of Information Technology in the Brazilian Path of Growth

Bruno F. F. da Rocha
Universidade de Brasília

e

Joanilio Rodolpho Teixeira
Universidade de Brasília

Brasília, 01 de agosto de 2003

UNIVERSIDADE DE BRASÍLIA
DEPARTAMENTO DE ECONOMIA
Campus Universitário Darcy Ribeiro
Instituto Central de Ciências
Caixa Postal 04302, 70910-900 Brasília, DF, Brasil
Tel.: (55-61) 3072498, 2723548
Fax: (55-61) 3402311
E-mail: econ@unb.br
http://www.unb.br/ih/eco

Implications of Information Technology in the Brazilian Path of Growth

BRUNO FABRÍCIO FERREIRA DA ROCHA*

JOANÍLIO RODOLPHO TEIXEIRA*

Abstract – Information Technology is considered the state-of-the-art novelty of late 20th Century and early 21st Century. The way in which a country is able to assimilate and make it turn ideas into new goods, services and organizational improvements may help out lead the economy to a growth path, reaching international competitiveness. However, macroeconomic policies, as well as structural changes might be affected in the pathway of adopting IT to promote development and international insertion. Our approach leads to a diagnosis of the Brazilian path of growth on this matter.

Keywords: Information Technology; Productivity; Policy Implications

JEL Code: O14; O32; O38.

Resumo – A Tecnologia da Informação é conhecida como a grande novidade em termos de inovação no final do século XX e início do século XXI. A maneira pela qual um país é capaz de assimilá-la e fazê-la transformar idéias em novos produtos, serviços e melhorias organizacionais pode auxiliar a guiar uma economia em seu caminho de crescimento, alcançando competitividade a nível internacional. Entretanto, políticas macroeconômicas, bem como mudanças estruturais podem ser afetadas na adoção de TI para promover o desenvolvimento e a inserção internacional. Nossa abordagem leva a um diagnóstico do caminho de crescimento brasileiro nesse sentido.

Palavras-chave: Tecnologia da Informação; Produtividade; Implicações de Políticas

Código JEL: O14; O32; O38.

---

* Department of Economics, University of Brasilia, Brazil. Their e-mail addresses are <brunoffrocha@hotmail.com> and <joanilioteixeira@hotmail.com>, respectively. The latter thanks CNPq for financial support.

I. INTRODUCTION

Economic literature identifies two types of technical innovation: goods innovation and process innovation. Goods innovation happens when new services or products are created for the enterprise or for the market, while process innovation indicates a new way of producing goods and services. For at least the last 20 years, substantial research has been done and a bunch of material has been written over the issue. The concern is in the role of technical innovation on the aggregative macroeconomic context and its implications in determining growth.

The importance of this matter lies down on inner conditions of capitalism. In the constant quarrel for markets and profit, companies wish to differentiate products and services in order to seduce buyers, investing large sums of resources searching for new techniques, more efficient methods of production and brand-new goods. Our journey is: try to understand to which extension technical progress does matter and its implications in the Brazilian path of growth. Throughout our search, we shall analyze the causes of technical progress and some of its macroeconomic implications. Our discussion will lead us to a diagnosis of the Brazilian insertion in the world of competitiveness and how it is prepared to absorb and generate high-tech, specially the so-called Information and Communications Technology – ICT, which is believed to guide economic growth since the last two decades of the last century.

ICT, or simply Information Technology – IT, is here defined as hardware, computer software, and telecommunications equipment. From a broad stand point, technological change in this area guide advances in materials science, leading to increases in the power of semiconductors and microchips, in turn resulting in rapidly declining semiconductor and microchip prices, with consequences to producers, labour and users.

An important point about the economic development is related to the technological pattern that the country will adopt in the next years. There are two main options: the first is to follow the existing levels of technologies in developed countries. The second is to develop new technologies and try to catch up developed countries. In both cases, the New Economy, understood as the rapid advances of information and communication technology extending labour productivity, has been pointed as a major challenge for the insertion of the Brazilian economy in the global world.

Concerning the U.S. economy, Gordon (2000, p. 72) reported that "the New Economy, defined as the post-1995 acceleration in the rate of technical change in information technology together with the development of the Internet has been both a great success and a profound disappointment. The New Economy has created a dynamic explosion of productivity growth in the durable manufacturing sector. However, it has meant a little to the 88 percent of the economy outside of the durable manufacturing".[1]

Acemoglu (2002, p. 9) points out that "(…) despite the acceleration in skill bias, we are most likely not in the midst of a 'Technological Revolution'; what has changed is not

[1] Gordon's studies are based on the American economy.

necessarily the overall rate of progress, but the types of technology that are being developed".

On the other hand, for some authors information technology has been the primary force behind the sharp recent gains in productivity growth. Labour productivity reflects increases in the amount of capital per hour worked and growth in labour quality and multifactor productivity. According to Jorgenson & Stiroh (2000, p. 127), "it could be argued that this represents a new paradigm. In this view, the diffusion of IT improves business practices, generates spillover benefits, and raises productivity throughout the economy".

Bresnahan & Trajtenberg (1995, p. 84) question the possibility that ICT might be considered one of the General Purpose Technologies – GPTs, "characterized by the potential for pervasive use in a wide range of sectors and by their technological dynamism." Within this context, a GPT advance brings generalized productivity gains, spread throughout the economy. According to the same authors, "most GPTs play the role of 'enabling technologies', opening up new opportunities rather than offering complete, final solutions. (…) This phenomenon involves what we call 'innovational complementarities' (IC), that is, the productivity of Research & Development – R&D in a downstream sector increases as a consequence of innovation in the GPT technology. These complementarities magnify the effects of innovation in the GPT, and help propagate them throughout the economy." In this framework, advances in biotechnology, animation, computer graphics, networking, medicine and many other sectors would be effects of IT, due to its capacity to lead to innovational complementarities.

However, this study is not concerned whether Information Technology is a General Purpose Technology. We consider the power it has in creating ICs, but we analyze it in a more limited framework in order to concentrate in its capacity to generate technological development and the effects it is able to cause in an economy. Thus, just like Oliner & Sichel (2000, p. 4) did in their study, "to get a more complete picture of the role of information technology in the economy, we now group communication equipment with hardware and software."

Section II shows the stages of technical assimilation according to dominant economic literature. Section III presents parameters and indicators used in cross-country comparison. Section IV presents results for Brazil in terms of types of innovation and leading innovating sectors, based on a study conducted by the Brazilian Institute of Geography and Statistics – IBGE, a governmental organization. Section V indicates possible courses of action for policy makers in the attempt to take advantage of the use of IT to promote productivity gains and economic growth. Finally, Section VI brings out the conclusions of the study.

II. STAGES OF TECHNICAL ASSIMILATION[2]

Although Schmookler (1966) indicates that technical change is a question mark in modern economics, Mansfield (1968) believes that it is one of the most important reasons for economic development. Apart from the discussions that involved the aforementioned

[2] For further reference on this theme, see Jones (1979), Dosi (1985) and Aurea & Galvão (1998).

authors over the degree of extension that innovation affects economies, we are interested in understanding, in this section, the different stages of technical assimilation.

Technical assimilation is for our purpose understood as the capacity an economy has in absorbing technology as well as the capacity of generating innovation. Obviously, there is a huge gap between countries that are able to produce new goods and countries that import and merely reproduce technical development created abroad.

As far as technology is concerned, the way it affects economic growth varies according to the level of economic prosperity a country has already achieved. At early stages of economic development, a nation's ability to launch its economy on a steeper growth path depends primarily on the transfer of technology from abroad. This process of adaptation and adopting of technology that has been developed abroad is known as *technological diffusion*. Therefore, technological diffusion is a key step in the process of growth.

At more advanced stages of economic development, however, as Cornelius points out[3], "it becomes increasingly important that a country itself *innovate* new technologies in order to sustain rapid economic growth. In the high-income nations, each new technological innovation triggers yet further innovation, in a kind of chain reaction that fuels long-term economic growth".

The capacity of generating new tradable goods and processes and of promoting organizational improvements in various levels leads to market expansion and to the success of enterprises and industries. International competition represents a fine parameter of economic entrepreneurship. Aside from low-cost labour and cheap raw materials, competitiveness is increasingly a matter of level of technical capability or how fast the economy is able to turn ideas into marketable goods and services.

Broadly speaking, technical assimilation can be construed through four distinct faces:

i. goods and services imports;
ii. technology imports;
iii. innovation development, and
iv. learning by doing.

In order to change the technical foundation of productive sectors, a traditional approach adopted by a large number of peripheral economies is importing capital goods. By doing so, the economy amplifies its capacity to be inserted into international trade. Within this context, a fundamental point is concerning the static and dynamic features of cost advantages. The static aspect consists basically in taking advantage of existing differences in comparative costs that are larger than transport, storage, and risk insurance[4]. This is nothing but the celebrated principle exposed by Ricardo (1817, 1951). With some proviso, it asserts that trade is beneficial since it increases physical production. But there are other comparative advantages which may be acquired through the acquisition of technical

[3] The Global Competitiveness Report 2001-2002, et al. (2002, p. 13).
[4] Not to mention easier acess to energy sources, low-cost labour and abundance of raw materials.

knowledge. It is concerned with the comparative speed of productivity growth among countries. This has to do with what Pasinetti (1981, pp. 263-6) called the "general principle of comparative productivity change advantage". The acquisition of technical learning is the main channel to absorb the dynamic effects of technical progress from abroad.

The import of technology is a whole different process. It requires a relative stage of development, which includes industrial basis and infrastructure. In this case, the extension of results, taking into account the potential benefits, is linked to the degree of interaction of the productive structure, as well as technical capacity and the level of technological maturity. Again, this situation involves trade and learning. Gains from international trade and gains from international learning are both positive but, as pointed out by Teixeira and Sarquis (2002, p. 203), “under some conditions, the benefits from international trade are not as good as those deriving from technological diffusion”, confirming Pasinetti’s (1993) claim.

Technology imports may happen several ways:
i. through licensing of patents;
ii. through contracts of technology transfer; and
iii. through the creation of joint-ventures with companies that possess specific technology.

It is clear that each of these types mentioned bring out distinct implications over technology acquisition. As we move in the direction of the technological frontier, less access we have to this innovation package. Depending on how the process is managed, there is the possibility of a learning process, together with an own R&D effort. In consequence, this may well lead to the opening of a pathway so that the productive sector manages to produce results in terms of technology that may fulfill both market niches and competitive markets.

Within this context, the relationship between productive basis and scientific basis starts to make organized interactions and the learning process helps out articulate some classical functions of science and technology to the basic needs of the human beings and the productive sector, for instance, by furnishing human resources or new techniques. Then, science and technology (S&T) start working as a complementary and accelerative force to the productive sector.

The process of innovation development is connected to the innovation concept theorized and adopted in central economies. It guides the leadership of the world’s technological race, by allowing the creation of goods and services which are in the technological frontier, determining higher profits and capital accumulation that will be reinvested in S&T, generating a virtuous circle.

In the countries aligned with this process, goods and services imports, as well as technology imports also exist. But they assume a complementary role in face of the dynamics of the innovation development. On the other hand, innovation development implies hazard and uncertainty, which may lead profits from industries of less-advanced economies to the financial market or to more conservative areas of investment. Innovation presupposes going beyond the frontier of available high-tech knowledge, which implies large resources being invested in creativity and experimentation. Besides, there is the need

of trained human resources to operate the experiments. Then, the inner innovation conditions of a country imply education, R&D centers, S&T effort, available capital, public and private governance, macroeconomic stability and a sense of entrepreneurship[5].

It is also important to mention the concept of "learning by doing". Within the framework of endogenous technical progress, while "research and education are definitely results of deliberate economic decisions" (Wan, 1971), endogenous technical progress may be as well obtained through "experience" in production. Given the means of production in one's hands, a person is able to acquire knowledge from the production process. Focusing specifically in the work of Arrow, Wan (1971, p. 228) indicates qualitative results, emphasizing the welfare implications of learning:

> *The presence of learning phenomena enables investment to influence production in three ways: it provides capital input; it embodies the latest technological advances; it stimulates the innovative process.*

Furthermore, Pasinetti (1993, p. 176) claims that the development of a country deeply depends on knowledge and on the capacity it has in acquiring knowledge, as well as making it able to generate process or product improvement:

> *It is knowledge that has to be captured. It is the acquisition of knowledge that eventually makes the wealth of a nation.*

III. THE GROWTH COMPETITIVENESS INDEX AND INFORMATION TECHNOLOGY USE: THE BRAZILIAN CASE

Taking into consideration that technology affects economic growth at different stages of development and with different intensities, there is a need to set apart categories of countries, based on the technology-oriented effort the economy is able to raise. Cornelius (2002) distinguishes in his study the existence of two groups, using as a proxy for technical effort the amount of patents registered per million people. The results for 2001 distinguish a group of *core innovators*, which include economies that have registered at least 15 US utility patents per million people; and the group of *non-core innovators*, the ones that do not reach that level of patents. This criterion indicates the existence of 24 economies labeled as core innovators. According to the same study, empirical tests find out that technology plays a particularly critical role in core innovating countries.

The study of Cornelius produces a ranking according to what is called Growth Competitiveness Index – GCI. This measure is based on three broad categories of variables that are found to drive economic growth in the medium and long term: technology, public institutions, and the macroeconomic environment. Without technological progress,

[5] In most developing economies, the business sector is characterized as been rather made up of *renters* than *entrepreneurs*. The noticeable consequence is that money that could be used to promote R&D is invested in the financial market instead. In consequence, there is lack of production and high levels of unemployment. Furthermore, with less availability of capital for R&D, technological diffusion is met mainly through technology imports, especially equipment acquisition.

economies might achieve a higher standard of living, for example, due to a higher rate of capital accumulation. Institutions are crucial for the protection of some property rights and should be guided in the aim of avoiding red-taping and providing efficiency of government spending, as well as governmental transparency. Besides, if there is no governance, the division of labour is likely to be excessively constrained or even impeded, making the allocation of resources inefficient. Naturally, the long-term capacity to grow is also affected by monetary and fiscal policies, and the stability of financial institutions and markets. Needless to say, social concern involving fairer distribution of income and wealth should take a prominent role.

In the group of core innovators, according to the same study, empirical tests indicated that technology has a weight of 50% in overall GCI, while public institutions and macroeconomic environment have 25% each. Taking into account only the technology index, it is a simple average of the innovation subindex and the ICT subindex. In the group of non-core innovators, technology transfer has a relative more important role than innovation. ICT represents 50%; technology transfer responds for 37.5%; and innovation responds for solely 12.5%. Table 1 shows the position of Brazil, compared to some selected countries.

Table 1. Rankings on Growth Competitiveness Component Indexes – 2002 (Selected Countries)

Country	GCI Ranking	Technology Index Ranking	Public Institutions Index Ranking	Macroeconomic Environment Index Ranking
United States	1	1	16	2
Taiwan	3	2	27	6
Canada	8	8	9	12
Denmark	10	11	2	31
United Kingdom	11	15	6	16
Germany	14	12	14	22
Chile	20	33	19	13
Korea	21	18	32	10
Malaysia	27	26	33	20
France	30	28	29	28
South Africa	32	38	34	30
China	33	63	38	8
Italy	39	39	37	27
Mexico	45	47	58	21
Brazil	46	35	45	67
Argentina	63	44	66	65

Source: Cornelius (2002).

It is important to mention, though, that the public institutions index and the macroeconomic environment index are also made up of subindexes. McArthur, J. & Sachs (2002) remind us that the public institutions index consists of two components, one that reflects the perceived

degree of corruption and another that focuses on the role of contracts and law. Both components have equal weights and are based solely on survey evidence. But, it is questionable whether these indexes are really able to measure the proposed parameters, because they may reflect a high degree of subjectivity. The macroeconomic environment index includes a subindex on macroeconomic stability (reflecting, among other things, inflation, national savings, and real exchange rate developments) as well as country credit ratings and general government expenditure. Similarly, there is a high degree of subjectivity in deciding the weights of each parameter analyzed. Then, although institutions like the International Monetary Fund, the World Bank and the World Economic Forum adopt those indexes for analytical purposes, the methodology used for the construction of the results might be questioned.

Besides the considerations pointed out in the last paragraph, the Growth Competitiveness Index is just able to formulate a ranking to compare different countries. This approach permits the vision of which economies are ahead of your own, but is blind to the determining of a country's improvement, since it may be hidden by the movements of others. Within a period, a nation might choose to concentrate efforts in one specific area. Then, GCI might concentrate too much information and clearly does not offer detailed analysis for policy implementations. The subindexes might be considered for these purposes.

Another important question we might raise is the fact that international trade competitiveness is not necessarily linked to growth. Although it gives a good hint on how a country may benefit from competitive gains, growth depends on other factors, which may be analyzed from social, economic and distributive points of view.

Taking into consideration that the GCI has limitations, we shall search for other parameters that might be able to capture the impacts of IT in an economy. Table 2 is intended to provide additional information to help up go further in this analysis. It brings out a list of selected Developing Countries and Developed Economies, with distinct IT use indicators.

Within the period allotted, when we compare Brazil to other countries in terms of the percentage of investments in IT/GDP or IT per capita ratios, we notice that compared to other developing economies, Brazil loses for China and India. In absolute results, however, Brazil just loses for South Africa. It is even ahead of some developed economies. Obviously, the IT/GDP ratio in developed countries represents higher accumulation of capital.

Considering IT per capita, Brazil is over the average for developing economies, in terms of growth rate in the period 1992-99. Developed countries display lower growth levels. Therefore, when we consider absolute results, developing countries are far away behind developed ones. And Brazil does not bring out a leading result for 1999.

Taking into account Personal Computers – PCs per 100 people, the data for 2000 indicates that Brazil is behind Argentina, Chile, Korea, Malaysia and all selected developed countries. It shows a striking growth between 1990 and 2000, though. Just China had an increase in this indicator higher than Brazil in the period analyzed.

The growth of phone lines per 100 people was not very significant, compared to other countries. Developed economies show low increasing levels because they have already reached a large part of their societies. Developing countries, on the other hand, had to make huge efforts during the 1990s in order to offer phone access to the population. Brazil is not leading this indicator, though, even with the governmental efforts to make services universal. Then, in terms of number of telephone lines per 100 people – area which the government has stated as leader of transformations in the economy since Telebrás[6] was privatized – Brazil comes after Argentina, Chile, Korea, and Malaysia in terms of absolute results for 2000. Thus, in spite of the effort that has been done in the efficiency of these areas, Brazil is still behind many developing economies.

Table 2. Selected Economies: Indicators of Information Technology Use

	IT/GDP		**IT per capita**		**PCs per 100 people**		**Phone lines per 100 people**	
Country	**Growth 1992-99 (%)**	**1999**	**Growth 1992-99 (%)**	**1999**	**Growth 1990-2000 (%)**	**2000**	**Growth 1990-2000 (%)**	**2000**
Developing	**40.63**		**134.0**		**842.1**		**318.7**	
Argentina	41.7	3.4	78.0	294.3	628.5	5.1	129.0	21.3
Brazil	65.7	5.8	199.4	267.4	1366.6	4.4	129.2	14.9
Chile	23.9	5.7	121.8	321.0	681.8	8.6	234.8	22.1
China	157.8	4.9	465.7	37.9	1500.0	1.6	1333.3	8.6
India	105.8	3.5	220.8	15.4	400.0	0.5	433.3	3.2
Indonesia	-17.6	1.4	7.0	13.7	900.0	1.0	416.6	3.1
Korea	-10.2	4.4	53.8	521.5	413.5	19.0	49.6	46.4
Malaysia	61.7	5.5	61.8	168.4	1212.5	10.5	137.0	21.1
Philippines	50.0	2.7	82.6	33.6	533.3	1.9	290.0	3.9
South Africa	33.3	7.2	49.5	240.6	785.7	6.2	34.4	12.5
Advanced	**27.4**		**40.6**		**246.7**		**24.8**	
Canada	43.2	5.3	31.6	1,808.7	264.4	39.0	19.6	67.6
Denmark	28.5	4.5	45.3	2,540.3	274.7	43.1	24.3	70.5
France	26.6	3.8	27.5	1,706.6	329.5	30.5	17.1	58.0
Germany	28.1	4.1	29.4	1,699.9	229.4	33.6	36.2	60.1
UK	17.5	4.7	52.0	1,979.5	212.9	33.8	28.5	56.7
USA	20.9	5.2	57.9	2,792.1	169.5	58.5	23.4	67.3

Source: The percentages obtained for the indicators above were done with data displayed in the "ITU Statistical Yearbook, 1999; World Information Technology Services Alliances, *Digital Planet*, 2001"; *In: IMF, World Economic Outlook – The Information Technology Revolution* (p. 134, 2001).

[6] Before privatization, in 1998, telecommunications services in Brazil were a public monopoly, with the existence of two major companies: Embratel (Empresa Brasileira de Telecomunicações S.A.), which was responsible for long distance as well as international calls and Telebrás (Telecomunicações Brasileiras S.A.), which was made up of local incumbents in each state and operated local services.

In the area of telecommunications and number of computers a striking result is that it was expected that the developing countries, which started the process later, would experience higher rates than developed nations in which the process was in its maturity. The results show that for the period of 1990-2000 it effectively happened, but there is still a huge abyss between developing economies and advanced ones in terms of absolute results. However, developed countries still present high increasing rates, especially for the number of PCs. This situation may indicate that the process continues through time, meaning that it does not represent a *break* in the development path of developing economies. This result shows computer equipment plays an important role in the innovating process.

IV. NATIONAL DIAGNOSIS IN THE 1990'S AND EARLY 2000'S

The analysis of data from IBGE (2000), with about 70 thousand firms, indicates the type and the degree of innovations in Brazil for the period of 1998-2000. The study brings up a report on the conditions of technical innovation in the country. Concerning the type of innovations, 31.25% of the companies have made some kind of innovation. Investments in process innovations, which lead to efficiency and increase in productivity, respond alone for 13.94% of the participation of innovating firms. Goods innovations alone were implemented in only 6.30% of the cases and in 11.28% of the situations, there were goods and process innovations.

Table 3. Percentage participation of Innovating Firms (1998-2000)

Type of Innovation	**Only Goods**	**Only Process**	**Goods and Process**	**Firms which Implemented Innovations**
%	6.30%	13.94%	11.28%	31.52%

Source: IBGE (2000).

In the analysis of technical innovation, there are some more characteristics to be considered. First, there is a need to understand its reference: the enterprise or the gross market. On the former case, other companies had already implemented innovations in the country. On the latter, the enterprise promotes the development of new goods or processes, which can help sustain economic growth.

Table 4. Innovation Reference: National Market or Enterprise (1998-2000)

Innovation	**Percentage**
Process	25.22%
New Process for National Market	2.78%
New Process for Individual Firm	23.27%
Goods	17.58%
New Good for National Market	4.13%
New Good for Individual Firm	14.38%

Source: IBGE (2000).

Data from IBGE points out that in the period of 1998-2000, 17.6% of Brazilian enterprises generated new products or, at least, substantially improved goods. Only 4.1% of companies created new goods for the national market, while 14.38% generated new products for the firm. In terms of process, 25.22% have made innovations. However, only 2.78% created a new process for the national market. 23.27% of the firms implemented new processes for the enterprise. These results are in Table 4.

In terms of innovative activities, the main characteristic found by the IBGE study is the amount of firms that attributed high or medium importance to the acquisition of equipment and machinery. For the whole industry, this number is 76.6%, indicating that acquisition of technology embodied to capital goods has a key role in the technical change. Training also has great importance, with almost 60%. With less relevance, we find that external acquisition of R&D has high importance for only 8.21% of firms. Table 5 accounts for these results, as well as for other innovating activities.

The results in Table 5 indicate that there is a concern on training employees in order to deal with new technology. However, it also indicates that businessmen in Brazil see technical diffusion not as an inner effort, in which money should be risked. The study shows that rather than managing to develop technology, Brazilian businessmen wish to promote technical change through the import of machinery and equipment. Training is not primarily intended to promote S&T. It is given in order to teach employees how to operate the capital goods acquired.

Table 5. Importance of Accomplished Innovating Activities (1998-2000)

Innovation Activities	**Percentage**
External R&D Acquisition	8.21%
Acquisition of other External Knowledge	16.36%
Introduction of Technical Innovations on Market	27.78%
Internal R&D Activities	34.14%
Industrial Project and other Technical Preparations	44.08%
Training	59.06%
Acquisition of machinery and equipment	76.63%

Source: IBGE (2000).

Another important indicator we may analyze is innovation rate in different industrial sectors. The industrial average innovation rate in Brazil is 31.5%. Higher innovation rates are observed in the production of computer equipment, communications equipment and electronic equipment, followed by chemical products and the production of medicines. Areas with low taxes include the production of wooden goods, recycling and extractive industry. Innovation taxes per area of production are in Table 6.

The results indicate Information and Communications Technology is a leading innovation process in Brazil, following a global rule. Traditional sectors that were often viewed as innovative leaders come right after ICT. The point is whether this change in leadership is bringing benefits to firms, users and consumers and which macroeconomic impacts are

going on. Brynjolfsson & Hitt (2000) argue that IT generates new business processes, new skills and new organizational and industry structures. Thus, these complementary benefits should be committed to further study.

Table 6. Innovation Rates per Area of Production (1998-2000)[7]

Industries	**Innovation Rate (%)**
Average	**31.5**
Wooden Products	14.3
Recycling	13.1
Extractive Industry	17.2
Steel Metallurgy goods	19.7
Vehicles	36.4
Chemical goods	46.0
Medicine	46.8
Communications equipment	62.1
Electronic equipment - market	62.5
Basic Electronic equipment - infrastructure	62.9
Computer equipment	68.5

Source: IBGE (2000).

It is important to mention that the study of IBGE used the same methodology implemented in European and Asian countries in order to be able to produce results that can be analyzed in a cross-country study. Of course cross-country studies have some limitations, since no country follows the strict path of another, due to its own particularities. Thus, it has to be linked to other substantial indicators and parameters in order to be able to lead to conclusions that might point out a development path.

V. POLICY IMPLICATIONS

Structural Policies

The first question we may raise is how the increasing use of IT may affect employment. Modern economic theory describes the various types of technical change as labour-saving, capital saving or neutral. The neoclassical framework supposes technology plays a neutral role in employment, based in different studies, for instance, the works of Harrod (1963) and Hicks (1965).

Groll & Orzech (1990, p. 9) show that in the Marxian model of social dynamics "technological change is always labour-saving or capital-using". Within this context,

[7] The methodology used by IBGE to calculate innovation rates follows the process described in the Manual of Oslo, and is also used by European and Asian economies. Brazilian researches adapted the questionnaire described in the manual and led person-to-person interviews with the managers or directors in charge of the production department of all the 72,000 firms involved in the study. From the answers collected, they were able to classify process or goods innovation in each area and produce the rates. Thus, the results are comparable with results from other countries.

technological change under capitalism is in favor of the increase of surplus-value, otherwise no technological change would be introduced. Therefore, with capital deepening, unemployment may rise and wages fall relative to the new value unit. The aforementioned authors also suggest that Hicks and Harrod were not concerned to assert that technical progress is in fact neutral, but to attempt to define neutrality so that the actual path of technical change could be investigated.

This discussion leads us to some important considerations. On one hand, employment practices, such as official regulations, union rules, or institutions can restrict firms from offering appropriate incentive compensation, changing the tasks of existing employees, or dismissing workers. On the other hand, theoretical work has emphasized the importance of workers continually taking on new tasks to enhance the accumulation of human capital through "learning".

The second question to be raised lies down on the organization of the legal and institutional arrangements[8]. Developed economies often declare that innovative activity is stimulated by the development of a patent system and antitrust policy, especially with the growth of intermediaries (lawyers and agents) who should specialize in trading patent rights in order to create conditions to the rise of large scale-businesses and the founding of R&D laboratories. In developing countries, experience has shown that smuggling high-tech products into a country is an important action to allow technological diffusion and international learning. It was a key pattern for the development of Japan and it happens in many developing countries, including Brazil. Each year huge amounts of electronics, software, computer games, CDs and videos are smuggled into the country. Obviously, there is no available official data to reinforce this idea. But, in Brazil, even biotech contraband plays a large role in the increase of crop production[9].

Third, the advent of high-tech requires human resources that are able to deal with new products, services and manage the resulting improvements. Within this frame, the reorganization of economic activities due to the use of IT creates new challenges for educational systems. Lucas (1993) emphasizes the importance of on-the-job learning (training) in human capital accumulation.

Fourth, IT enables "complementary organizational investments" that lead to "productivity increases". It happens due to cost reduction. Furthermore, it permits that firms increase output quality "in the form of new products or in improvements in intangible aspects of existing products like convenience, timeliness, quality, and variety" (Brynjolfsson & Hitt, 2000, pp. 24-25). Again, a system of patents must be working in order to promote innovation and guarantee industrial rights.

[8] It is also raised in IMF (2001, p. 137).

[9] The best-known case is contraband of genetically modified soybean seeds from Argentina to be used in farms in the south of Brazil. It also happens with cotton and corn.

Macroeconomic Policies

The uncertainty about the precise magnitude and likely duration of the acceleration in productivity due to technical progress has implications for macroeconomic policies. The assessment of the sustainability of the external current account position and potential output suffers impacts from the uncertainty about the acceleration. With regard to the external current account, economic theory tells us that a country-specific positive productivity shock tends to increase the external current account deficit, causing investment to rise – reflecting the increased marginal product of capital – and saving to fall, as families anticipate greater future income. IMF (2001) has empirical work on IT for the US supporting this effect, but results for other major advanced countries are mixed. Therefore, it is questionable whether global current account imbalances reflect structural or cyclical factors related to the uncertainty about the impact of IT on productivity growth.

With regard to medium-term fiscal objectives, increased uncertainty about productivity growth calls for prudence in budget projections, because the political economy of the budget process indicates it is easier to spend unexpected windfalls than to make up for unexpected deficits.

Long-term Effects on Macroeconomic Policies

In the long run, as IMF (2001) reinforces, ICT may affect fiscal, monetary and financial policies. IT has the potential to transform the way governments work, because it might be used to improve procurement of goods and services, the quality of government services and information, as well as the efficiency in tax payments and the filling-in of applications. However, Information Technology might make it more difficult to tax the sale of digital goods, such as music, photos, medical and financial advice, and educational services.

The adoption of IT by the financial services industry will demand new responses for the regulation and supervision of financial systems. It is a reality that financial institutions are offering new products and developing new processes; and that computation and communication is producing numerous changes. Thus, banks' management will have to adapt to greater risks in operations (complex technology requires extremely specialized human resources), and to systemic risk (sabotage, computer viruses, action of hackers).

Oliner & Sichel (2000) also indicate that we shall look not only on the contribution from the *use* of information technology. "An additional growth contribution can come through efficiency improvement in the *production* of computing equipment." Besides, as it was already pointed out, there is a need to promote sustained integration between IT firms and enterprises that generate innovational complementarities. This phenomenon, as stated by Bresnahan & Trajtenberg (1995) is the one capable of generating a widespread productivity increase in downstream sectors of the economy. Then, investments in infrastructure as well as the organization of regulatory rules to encourage a trend towards competitive market should be considered.

In terms of international interaction, IT might make the abyss between central economies and peripheral ones deeper. Capital-intensive goods generated by Information Technology

will increase the North X South dilemma, since sophisticated technology creates huge monetary barriers to incoming firms, which may be excluded from the market because of the power of international corporations. Then, developing countries will have to import goods and services rather than produce them and will be able to offer only less value-added goods. This situation will sustain the conflict between development and underdevelopment.[10]

We may not forget the so-called process of "desindustrialization", though. Jobs connected to the area of knowledge are being transferred to countries in which labour cost is reduced in comparison to central economies. Therefore, nations like India, Russia, China, Phillipines, South Africa or Poland are receiving industrial plants due to their capacity of generating cheap labour with similar quality to leading innovators. This phenomenon allows technical assimilation and the process of "learning by doing", with all its consequences to a nation's economy. Therefore, further study is necessary in order to discover how these two last effects are affecting the North X South gap.

VI. CONCLUDING REMARKS

The Information and Communications Technology changes raise at least three important questions for policymakers. First, how are countries able to promote the use of ICT and maximize its impact on growth? Second, how should macroeconomic policies take into account the uncertainty over any acceleration in productivity? And, finally, but not less important, what are the implications of IT for fiscal, monetary, and financial policies in the long run?[11]

As we have also discussed, it is questionable whether ICT promotes sustainable productivity gains. Has Information Technology affected only the durable manufacturing sector or has its effects spread to other sectors of the economy? Thus, has the New Economy really created productivity acceleration? In other words, does it represent a revolution or is it merely a transitory path?

We have tried to cover some suggestions of how these issues can be studied and answered for the Brazilian case. There is much work ahead to be done in order to evaluate the impact of IT in developing and developed economies. We understand that the methodology used for the group of advanced economies and the developing ones might be differentiated, due to distinct weights of innovation efforts done in each category of countries.

Besides, future work should also worry about inter and intra-sectorial analysis. The interactions of the productive sectors along with infrastructure and their impacts on the growth path would also make an important line of study. Furthermore, the analysis of the neutrality of IT over employment might help policymakers guide their courses of action in order to sustain economic growth and promote distributional improvements. Within this

[10] See Teixeira & Araujo (2003). They develop an analysis that attempts to capture the main aspects of the North-South interdependence.
[11] These questions are also raised in IMF (2001, p. 136).

context, unemployment, fiscal policy, monetary policy and financial policy are all linked together, as well as welfare improvement.

In the area of employment, themes like training impact, and the importance of education might be linked to studies on the level of jobs and their qualification. The discussion of having the opportunity of being able to get a specialized job rather than being limited to handmade work is the basis of the discussion upon social exclusion and digital exclusion.

Finally, this study raised some aspects of the discussion of the implications of Information Technology on the Brazilian pathway to growth. Much more than furnishing a complete package of solutions, we proposed suggestions of lines of work as well as some thoughts based on the available data and historical evidence. We also pointed out some criticism to the benefits shouted out by central economies on the adoption of IT by peripheral nations. Technological diffusion might be used for economic development or for the maintenance of the *status-quo*.

Nevertheless, the search for new goods, services and techniques is the basis for the achievement of economic development and life quality improvement. Naturally, it depends on how well the process is managed.

VIII. REFERENCES

1. Acemoglu, D. *Technical Change, Inequality, and the Labor Market*. Journal of Economic Literature XL, pp. 7-22, 2002.
2. Aurea, A. & Galvão, A. *Importação de Tecnologia, Acesso às Inovações e Desenvolvimento Regional: O Quadro Recente do Brasil*. IPEA, Brasília, 1998.
3. Bresnahan, T. & Trajtenberg, M. *General Purpose Technologies – Engines of Growth?* Journal of Econometrics, Vol. 65, no. 1, pp. 84-106, 1995.
4. Brynjolfsson, E. & Hitt, L. *Beyond Computation: Information Technology, Organizational Transformation and Business Performance.* Journal of Economic Perspectives, Vol. 14, no. 4, pp. 23-48, 2000.
5. Cornelius, K. *Executive Summary*. In: The Global Competitiveness Report 2001-2002. Oxford University Press, New York, 2002.
6. Dosi, G. *Technological Diffusion: The Theory and Some Methodological Suggestions for the Study of the Brazilian Case*. IPEA, Brasília, 1985.
7. Gordon, R. *Does the "New Economy" Measure up to the Great Inventions of the Past?* Journal of Economic Perspectives, Vol. 14, no. 4, pp. 49-74, 2000.
8. Groll, S. & Orzech, Z. *Marx's Social Dynamics and Neutral Technical Progress: a Contradiction?* Australian Economic Papers. Flinders Press, Adelaide, 85 – 100, 1990.
9. Harrod, R. *Themes in Dynamic Theory*. Economic Journal, vol. LXXIII, pp. 401-421, Sept. 1963.
10. Hicks, J. *Capital and Growth*. Oxford University Press, Oxford, 1965.
11. IBGE – Brazilian Institute of Geography and Statistics. *Pesquisa Industrial de Inovação Tecnológica – PINTEC*. Rio de Janeiro, 2000.
12. IMF – International Monetary Fund. *World Economic Outlook – The Information Technology Revolution*. Washington, 2001.
13. Jones, H. *Modernas Teorias do Crescimento Econômico*. Atlas S. A., São Paulo, 170 – 219, 1979.
14. Jorgenson, D. & Stiroh, K. *Raising the Speed Limit: U.S. Economic Growth in the Information Age*. Brooking Papers on Economic Activity, 1, pp. 125-235, 2000.
15. Lucas, R. *Making a Miracle.* In Econometrica, vol. 61 (March), pp. 251-272, 1993.
16. Mansfield, E. *The Economics of Technological Change.* Norton, New York, 1968.
17. McArthur, J. & Sachs, J. *The Growth Competitiveness Index: Measuring Technological Advancement and the Stages of Development*. In The Global Competitiveness Report 2001-2002. Oxford University Press, New York, 2002.
18. Oliner, S. & Sichel, D. *The Resurgence of Growth in the Late 1990s: Is Information Technology the Story?* Journal of Economic Perspectives, Vol. 14, no. 4, pp. 3-22, 2000.
19. Pasinetti, L. *Structural Economic Dynamics – A Theory of the Economic Consequences of Human Learning*. Cambridge University Press, Cambridge, Mass., 1993.
20. Pasinetti, L. *Structural Change and Economic Growth: A Theoretical Essay on the Dynamics of the Wealth of Nations*. Cambridge University Press, Cambridge, Mass., 1981.

21. Ricardo, D. *Principles of Political Economy and Taxation*. In P. Sraffa (ed). Works and Correspondence of David Ricardo, I. Cambridge University Press, Cambridge, England, 1817, 1951.
22. Schmookler, J. *Invention and Economic Growth*. Harvard University Press, Cambridge, Mass., 1966.
23. Teixeira, J. & Araújo, R. *A Structural Economic Dynamic Approach to Technological Gaps*. Department of Economics Working Paper 298, University of Brasilia, July 2003.
24. Teixeira, J. & Sarquis, J. *Technological Diffusion and Trade as Sources of Gains from International Relations in a Pure-labour Model without Learning Cost*. In Growth, Redistribution and Structural Change. Universa Editora, Brasília, 2001.
25. Wan, H. *Economic Growth*. Harcourt Brace Jovanovich, Inc. New York, 1971.

The ECO/UnB Working Paper Series

The Department of Economics of the University of Brasilia publishes its Working Papers Series since April 1972. On August 30, 2002 the series was renewed with the on-line publication of the papers. All Working Papers may be freely downloaded from the Department site: http://www.unb.br/ih/eco.

Working papers published since August 2002:

231 Posse de escravos e estrutura da riqueza no agreste e sertão de Pernambuco: 1777-1887. Flávio Rabelo Versiani and José Raimundo O. Vergolino, 30 August 2002, 29p.

232 On the natural rates of unemployment and interest: the Robertson connection. Mauro Boianovsky and John R. Presley, 30 August 2002, 34p.

233 Contas Nacionais e o meio ambiente: reflexões em torno de uma abordagem para o Brasil. Charles C. Mueller, 30 August 2002, 25p.

234 Economics of air pollution: hedonic price model and smell consequences of sewage treatment plants in urban areas. Sérgio A. Batalhone, Jorge M. Nogueira and Bernardo P. M. Mueller, 30 August 2002, 25p.

235 The Brazilian depression of the 80s and 90s. Mirta Bugarin, Roberto de G. Ellery Jr., Victor Gomes and Arilton Teixeira, 30 August 2002, 30p.

236 Informal employment in Brazil – A choice at the top and segmentation at the bottom: a quantile regression approach. Maria Tannuri-Pianto and Donald M. Pianto, 30 August 2002, 23p.

237 False contagion and false convergence clubs in stochastic growth theory. Stephen de Castro and Flávio Gonçalves, 30 August 2002, 20p.

238 Spot and contract markets in the Brazilian wholesale energy market. Paulo C. Coutinho and André Rossi de Oliveira, 30 August 2002, 19p.

239 Tributação da renda e do consumo no Brasil: uma abordagem macroeconômica. Valter Borges de Araújo Neto e Maria da C. S. de Sousa, 30 August 2002, 31p.

240 Vote splitting, reelection and electoral control: towards a unified model. Maurício S. Bugarin. 30 August 2002, 26p.

241 Shadow-prices in payment systems. Rodrigo Peñaloza, 6 September 2002, 31p.

242 Welfare implications of the Brazilian social security system. Roberto de G. Ellery Jr. and Mirta N. S. Bugarin, 13 September 2002, 28p.

243 Os agentes econômicos em processo de integração regional – Inferências para avaliar os efeitos da ALCA. Renato Baumann and Francisco Galrão Carneiro, 13 September 2002, 29p.

244 Leading by example: a simple evolutionary approach. André Rossi de Oliveira and João R. O. de Faria, 20 September 2002, 25p.

245 The role of institutions in sustainable development. Bernardo Mueller and Charles Mueller, 20 September 2002, 25p.

246 Incentivos em consórcios intermunicipais de saúde: uma abordagem de teoria dos contratos. Luciana Teixeira, Maria Cristina MacDowell and Mauricio Bugarin, 27 September 2002, 19p.

247 Liquidity constraints and the behavior of aggregate consumption over the Brazilian business cycle. Mirta Bugarin and Roberto de G. Ellery Jr, 27 September 2002, 19p.

248 Pricing water and sewage services in urban areas: Evidences of low level equilibrium in a developing economy. Ricardo Coelho de Faria, Jorge M. Nogueira and Bernardo Mueller, 4 October 2002.

249 Wrong incentives for growth in the transition from modern slavery to labor markets: Babylon before, Babylon after. Stephen de Castro, 4 October 2002, 23p.

250 Vintage capital, distortions and development. Samuel Pessoa and Rafael Rob, 11 October 2002, 40p.

251 Consórcios intermunicipais de saúde: uma análise à luz da teoria dos jogos. Luciana Teixeira, Maria Cristina MacDowell and Mauricio Bugarin, 11 October 2002, 30p.

252 Preços de escravos em Pernambuco no século XIX. Flávio R. Versiani and José Raimundo O. Vergolino, 18 October 2002, 20p.

253 A model of capital accumulation and rent seeking. Paulo Barelli and Samuel de Abreu Pessoa, 18 October 2002, 47p.

254 Anchors away: the cost and benefits of Brazil's devaluation. Edmund Amann and Werner Baer, 25 October 2002, 20p.

255 Um seguro agrícola "eficiente". Aércio S. Cunha, 25 October 2002, 57p.

256 Campaign contributions with swing voters. Manfred Dix and Rudy Santore, 1 November 2002, 15p.

257 Incentivos para os administradores de empresas estatais: O papel dos dividendos mínimos obrigatórios e o desenho ótimo de salários. André Luís G. Carcia and Maurício Bugarin, 1 November 2002, 28p.

258 Impostos e a História. Aércio S. Cunha, 8 November 2002, 12p.

259 Determinantes do endividamento dos estados brasileiros: Uma análise de dados de painel. Isabela Fonte Boa Rosa Silva e Maria da Conceição Sampaio de Sousa, 8 November 2002, 27p.

260 Technology adoption: On the nonequivalence of tariffs and quotas. Arilton Teixeira, 15 November 2002, 25p.

261 Constitutional regimes, growth and stagnation in the Brazilian economy: 1947-1999. Marco Antônio Campos Martins, 15 November 2002, 39p.

262 Price caps and electoral cycles. César Mattos, 22 November 2002, 16p.

263 Os pobres que levantem a mão (mas será que são mesmo pobres?) - Uma tentativa de validar o cadastro único. Carlos Alberto Ramos and Ricardo Santana, 29 November 2002, 100p.

264 Relative earnings of immigrants and natives under changes in the US wage structure, 1970-1990: A quantile regression approach. Maria Tannuri-Pianto, 29 November 2002, 40p.

265 Bidding strategies in the Brazilian Treasury auctions. Anderson Caputo Silva, 6 December 2002, 34p.

266 Crises cambiais e ataques especulativos no Brasil. Mauro Costa Miranda, 13 December 2002, 26p.

267 Poverty and environment degradation: the Kuznets environmental curve for the Brazilian case. Fabio G. e Barros, Augusto F. Mendonça and Jorge M. Nogueira, 20 December 2002, 27p.

268 On shadow-prices of banks in real-time gross settlement systems. Rodrigo Peñaloza, 20 December 2002, 31 p.

269 A characterization of renegotiation-proof contracts via random fixed points in Banach spaces. Rodrigo Peñaloza, 20 December 2002, 9 p.

270 Existence of time-invariant settlements in FEDWIRE-like payment systems. Rodrigo Peñaloza, 27 December 2002, 13p.

271 Principal-Agent problem with continuum of constraints: the infinite dimensional approach. Rodrigo Peñaloza, 27 December 2002, 43p.

272 Structural analysis of multiple-unit auctions: recovering bidders' valuations in auctions with dominant bidders. Anderson Caputo Silva, January 3, 2003, 18 p.

273 Financiamento público de campanhas eleitorais: efeitos sobre bem-estar social e representação partidária no Legislativo. Adriana C. Portugal and Maurício S. Bugarin, January 10, 2003, 25p.

274 Wicksell on technical change, real wages and employment. Mauro Boianovsky and Harald Hagemann, January 17, 2003, 28p.

275 Quão pobres são os pobres. Brasil: 1992-2001. Carlos Alberto Ramos and Ricardo Santana, January 24, 2003, 20p.

276 Dois anos da Lei de Responsabilidade Fiscal do Brasil: uma avaliação dos resultados à luz do modelo do fundo comum. Selene Peres Peres Nunes and Ricardo da Costa Nunes, January 31, 2003, 45p.

277 Políticas de geração de emprego e renda: Justificativas teóricas, contexto histórico e experiência brasileira. Carlos Alberto Ramos, February 7, 2003, 28p.

278 Long run implications of the Brazilian capital stock and income estimates. Victor Gomes, Mirta N. S. Bugarin and Roberto Ellery Jr., February 14, 2003, 25p.

279 Taxation on intergenerational bequest and redistribution of wealth in a class-setting. Mauro Baranzini, Sheila Oliveira Benjuino and Joanílio Rodolpho Teixeira, February 21, 2003, 23p.

280 On portfolio management. Paulo Coutinho and Benjamin Miranda Tabak, February 28, 2003, 21p.

281 Decentralized portfolio management. Paulo Coutinho and Benjamin Miranda Tabak, March 7, 2003, 22p.

282 The IS-LM model and the liquidity trap concept: From Hicks to Krugman. Mauro Boianovsky, March 14, 2003, 43p.

283 À espera da reforma orçamentária: um mecanismo temporário para redução de gastos públicos. Carla G. Protásio, Maurício S. Bugarin and Mirta N. S. Bugarin, March 21, 2003, 31p.

284 A dívida pública interna e sua trajetória recente. Flávio Rabelo Versiani, March 28, 2003, 16p.

285 Investment and capital accumulation in Brazil from 1970 to 2000: a neoclassical view. Roberto Ellery Jr., Mirta N. S. Bugarin, Victor Gomes and Arilton Teixeira, April 4, 2003, 20p.

286 Setting the right expectations: a note on Carl Walsh's market discipline paper. Fábia Carvalho and Maurício Bugarin, April 11, 2003, 33p.

287 The fifth consumer's surplus: An extension of the concept of Marshallian surplus to preferences with non-null income effects. Cassia Helena Marchon and André Luís Rossi de Oliveira, April 18, 2003, 32p.

288 Volume, composição e sustentabilidade da dívida pública de liquidez brasileira no período 1994-2002. Fernando de Aquino Fonseca Neto and Joanílio Rodolpho Teixeira, April 25, 2003, 25p.

289 A tarifa de acesso na indústria de telecomunicação quando a hipótese de monopólio natural é quebrada. Rafael de Melo Silveira and André Rossi de Oliveira, May 2, 2003, 20p.

290 Metas de déficit: transferências intergovernamentais e o controle do endividamento dos estados. Henrique A. Pires and Maurício Bugarin, May 9, 2003, 19p.

291 Jackstrapping DEA scores for robust efficiency measurements. Borko D. Stošić and Maria da C. S. de Sousa, May 16, 2003, 20p.

292 Monopoly rights can reduce income big time. Berthold Herrendorf and Arilton Teixeira. May 23, 2003, 33p.

293 Property rights, violence and the State. Lee J. Alston and Bernardo Mueller. May 30, 2003, 26p.

294 Technical efficiency of the Brazilian municipalities: correcting non-parametric frontier measurements for outliers. Maria da C. S. de Sousa and Borko D. Stošić, June 6, 2003, 23p.

295 Violence in the capital of Brazil: an analysis based on the economic model of crime. André Luís Rossi de Oliveira, June 13, 2003, 15p.

296 Steady state analysis of an open economy general equilibrium model for Brazil. Mirta Noemí Sataka Bugarin, Roberto de Goes Ellery Jr, Victor Gomes Silva, Marcelo Kfoury Muinhos, June 20, 2003, 29p.

297 Benefit sharing: an incentive mechanism for social control of government expenditure. Maurício S. Bugarin, Laércio Mendes Vieira, Leice Maria Garcia, June 27, 2003, 22p.

298 A structural economic dynamic approach to technological gaps. Ricardo A. Araujo and Joanilio R. Teixeira, July 4, 2003, 18p.

299 Accounting for the hidden economy: barriers to legality and legal failures. António R. Antunes and Tiago V. Cavalcanti, July 11, 2003, 24p.

300 Stock-price based regulation. Rafael Di Tella and Fabio Kanczuk, July 18, 2003, 17p.

301 Economia política da formação de consórcios intermunicipais de saúde: efeitos da heterogeneidade de renda e preferências entre municípios. Luciana Teixeira, Maurício Bugarin and Maria Cristina Mac Dowell, July 25, 2003, 25 p.

302 Implications of information technology in the Brazilian path of growth. Bruno F. F. da Rocha and Joanilio R. Teixeira, August 1, 2003, 25p.