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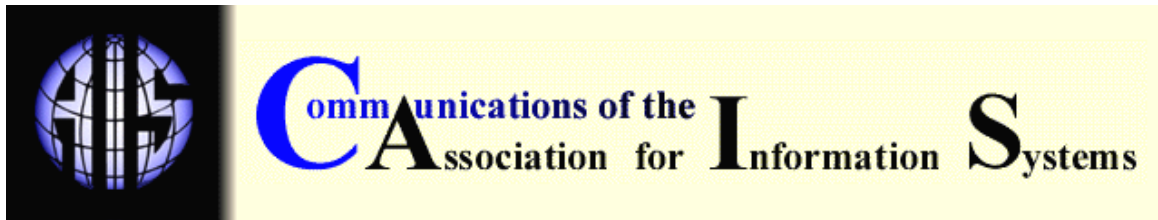
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GLOBALIZATION AND E-COMMERCE V: ENVIRONMENT AND POLICY IN BRAZIL

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SUMMARY

- In Brazil, high inflation rates and public policies for local information technology (IT) development encouraged the early adoption of IT, including electronic data interchange (EDI), especially in the banking industry.
- Starting in the early 1970s, Brazil developed capabilities both in the production and use of information technologies. Mexico and Brazil are the only Latin American countries with substantial IT hardware production.
- Since inflation control became the highest priority in economic policy in the 1990s, the Brazilian economy has grown at a relatively slow pace compared to historical growth rates. Brazil ranks third in the Americas in GDP value. However, in per capita terms, it falls behind the top five wealthiest countries in Latin America.
- Education levels increased substantially in the last decade. Primary education is almost universal (95.7%). 78.5% of the population in the secondary education age group is enrolled, compared to less than 60% in 1992.
- In 2000, investments in telecommunications as a percentage of the GDP were the highest in Latin America. In the last four years, fixed line teledensity doubled while cellular subscribers quintupled. In per capita terms, Brazil is now at the Latin American average, both in fixed lines and cellular phones. In 2000, teledensity was about 23 fixed lines per 100 people, 15% of whom were connected to the Internet.
- The development of the Internet in Brazil was somewhat similar to the NSF Net program in the United States. The National Research Network (RNP) began to operate a national backbone in 1991. In 1996, the backbone became available for commercial purposes.
- The government is active in promoting e-commerce diffusion, especially through the e-government initiative. This initiative includes on-line purchasing, government information, tax collection, and other applications. However, government programs lack coordination and resources.

- The use of the Internet as a business tool is most advanced in information- related sectors such as finance, communications, information services, and other services that can easily be digitized. The banking sector leads e-commerce diffusion, followed by government and retailing.
- Consumers in countries such as Brazil are increasingly demanding products from Web sites located in their own countries. To succeed in the Brazilian e-commerce market, multinational Internet companies need to invest in local content and distribution networks.
- Although the diffusion of the Internet presents many opportunities for social development, notably in the fields of education, health, and information, the future growth of e-commerce in Brazil may be limited by social and economic factors such as income level, income distribution, and education.

Keywords: globalization, e-commerce, Brazil, country statistics

I. INTRODUCTION

The diffusion of e-commerce in less developed countries is an uneven process, affecting different economic activities in different ways. Some sectors seem to benefit much more than others from the development of new communications technologies. Also, some regions and countries are more receptive to ICT innovations than others [Mansell and Wehn, 1998, Figure 2.4 to 2.6 pp. 28-29].

Considering the social and economic impact of new telecommunication technologies, it is important to identify the driving forces behind e-commerce diffusion properly. This paper analyses the diffusion of e-commerce in Brazil, based on hypotheses about driving forces and barriers. It looks at global and national environment and policy forces and identifies which factors are drivers or enablers and which are barriers or inhibitors to B2B and B2C e-commerce adoption. The paper:

- Describes the national environment for e-commerce diffusion, including macroeconomic policy changes, population and demographics, economy and wealth, human resources, industry structure and infrastructure (Section II)
- Focuses on national policies for IT and e-commerce, putting the diffusion process in perspective (Section III).
- Draws conclusions about the diffusion process that may also be relevant to other developing countries (Section IV).

DRIVERS

The paper presents three major hypotheses on how different environment and government policies are drivers that shape e-commerce diffusion.

1. The use of the Internet as a business tool is potentially higher in information- related sectors like finance, communications, information services, and other services that can easily be digitized.
2. The market power of large manufacturing and retailing firms commanding a network of suppliers may be more important as a driving force for e-commerce than globalization. The power to impose new business practices to suppliers may push smaller firms into B2B e-commerce, whether leading firms are oriented toward the global market or not.
3. Multilateral institutions like OECD in its policy papers argue that e-commerce diffusion depends on an appropriate legal framework for privacy, intellectual property, and security. The hypothesis here is that the role of government as a leading e-commerce user and facilitator may be much more relevant to inducing private agents to follow suit than its role in introducing and enforcing specific regulations.

INHIBITORS

In the case of Brazil, our hypothesis is that income level and income distribution are the major barriers to diffusion for both B2B and B2C e-commerce. Educational levels and telecom infrastructure costs and availability also play a negative but secondary role. Low-income levels affect not only B2C but also B2B. In countries like Brazil where unskilled labor is a relatively less expensive input than capital, firms may be more reluctant to invest in automation. IT equipment and software may also be harder to adopt for smaller firms that lack qualified people to apply new technologies. Consequently, a secondary hypothesis is that, in developing countries, e-commerce diffusion is a more selective process than in advanced countries. E-commerce probably will be limited to more competitive and advanced sectors within the Brazilian economy and would barely affect traditional industrial sectors in the near future.

The Brazilian case involves some idiosyncrasies, but may be relevant to other developing countries. As a large and populated country with relatively advanced IT capabilities, Brazil can pioneer e-commerce solutions appropriate to less developed environments.

II. NATIONAL ENVIRONMENT

MACROECONOMIC POLICY CHANGES

Since the beginning of the 1990s, Brazilian markets for goods and services became increasingly liberalized. Tariff and non-tariff barriers were lowered. Inflation rates declined from three digits in 1993 to one digit as a result of the Plan Real, a macroeconomic stabilization plan. Restrictions on foreign direct investment in sectors like banking, public services, and mining were relaxed. On most policy issues, Brazil followed international trends towards liberalization. The results of a decade of economic liberalization may be summarized as:

- Sharp increase in foreign investment together with a process of industrial restructuring and concentration.
- Import liberalization and reduction of both tariff and non-tariff barriers.
- Regulatory changes aimed at introducing competition in services and creating a more liberal environment for investment, funds transfer, and price setting.
- Adherence to major international agreements on trade (WTO) and intellectual propriety (TRIPS).
- Strengthening of the Mercosur trade zone, thereby creating a sub-regional free market linking Argentina, Brazil, Paraguay and Uruguay.

The impact of these structural changes on the development of e-commerce is mostly positive. The globalization of most economic sectors increased the demand for telecommunications services, especially data communications. Brazil's manufacturing industry became more integrated into international value chains. Within Mercosur, Brazil reinforced its role as regional production base for global manufacturing and service firms, which are usually information intensive.

POPULATION AND DEMOGRAPHICS

With 170 million inhabitants in 2001, Brazil is the fifth most populated country in the world. Despite its large territory (8 million square kilometers), more than 80% of its population lives in cities, 10 of which contain more than 1 million inhabitants. The population is predominantly young. 30% of the population is under 15 years old and 49 % of Brazilians are age 24 or younger [IBGE 2001]. These factors may play a positive role in the diffusion of the Internet for two reasons.

1. the diffusion of the Internet is easier in urban rather than rural areas, where a dispersed population makes building infrastructure less viable.

2. younger people's ability to acquire new skills is greater, if an adequate supply of equipment and training are provided.

In comparative terms, Brazil is second to the U.S. in population in the Americas. Table 1 shows that demographics indicators, such as urban population and age groups are more or less on par with Latin American averages.

Table 1. Demographics Indicators in the Americas

| Demographics | Population 2000 ^a | Urban population (% of total) | | % over age 65 1999 ^c | % under age 15 1999 ^c |
|----------------------------|---------------------------------|----------------------------------|--|---------------------------------------|----------------------------------------|
| | | 2000 ^b | | | |
| Argentina | 37,032,000 | 89.90 | | 9.58 | 27.91 |
| Brazil | 170,115,008 | 81.30 | | 4.89 | 29.56 |
| Canada | 30,750,100 | 77.10 | | 12.54 | 19.46 |
| Chile | 15,211,300 | 85.70 | | 6.99 | 28.56 |
| México | 98,881,000 | 74.40 | | 4.50 | 33.93 |
| United States | 275,129,984 | 77.20 | | 11.85 | 21.20 |
| Venezuela | 24,170,000 | 86.90 | | 4.31 | 34.42 |
| Latin America ^d | 345,409,308 | 80.83 | | 5.34 | 30.92 |
| OECD ^e | 1,115,304,202 | 77.55 | | 12.63 | 20.43 |

^aITU[2001] The data for population are mid-year estimates.

^bSource: World Bank Group, <http://www.devdata.worldbank.org/data-query> /. WDI definition: urban population is the midyear population of areas defined as urban in each country and reported to the United Nations. It is measured as a percentage of the total population.

^cSource: World Bank [2001].

^dLatin America here consists of: Argentina, Brazil, Chile, Mexico and Venezuela.

^eOECD denotes the OECD member countries, excluding Luxembourg, Slovakia and Iceland.

ECONOMY AND WEALTH

GDP and Economic Growth

Brazil ranks among the top 20 largest economies in the world in GDP terms. Per capita income in US dollar terms is influenced by exchange rates. After the 1999 devaluation, Brazilian per capita income fell from US\$5000 to \$3500 a year (see Table 3 below), a figure that places the country below the Latin American average. In the last two decades, the economy grew at a relatively slow pace compared to its historical growth rates, which at one time were among the highest in the world.

Since the early 1990s, inflation control has been the highest priority in economic policy. At least four classes of anti-inflationary policies were adopted:

1. Keep a relatively stable and controlled exchange rate. This policy, however, was not flexible enough to avoid an overvaluation of the Brazilian currency and ended in 1999 when currency market liberalization was forced by "speculative attacks" against the overvalued Real. A more strict policy, anchoring the local currency to the dollar was adopted by Argentina and proved to be disastrous as recent events in that country show.
2. Tight monetary control based on very high interest rates and cuts in government expenses. This IMF-backed policy had to be reinforced after the Real devaluation in 1999 to curb new inflation threats.
3. Widespread reduction of import tariffs. This policy was intended to increase the supply of goods and boost competition in the domestic market. However, it had little impact on export growth since it was essentially unilateral opening.

4. Privatization, aimed at attracting foreign investment and changing the role of government involvement in the economy.

These policies bore fruit as inflation controls but were likely detrimental to economic growth. From 1995 to 2000 average GDP growth was 2% a year, a level that was insufficient to promote employment growth. Apparently, the Brazilian economy is caught in a trade-off between economic growth and inflation control. Foreign debt increased substantially after the Plan Real, because of high interest rates and current account deficits but stabilized since 1999. Total public debt (internal and foreign) represents 57% of GDP. The Balance of Services explains most of current account deficit. Part of the necessary funds to close the gap was obtained by foreign direct investment (FDI). However, the peak of FDI has already passed, since privatization programs, which attracted foreign investors, are mostly over. The balance must be obtained as loans in international financial markets. In July 2002, the country was facing another crisis in foreign accounts, which resulted in currency devaluation. These factors may impact e-commerce diffusion negatively, since slow growth reduces investments in telecommunication and IT infrastructure.

Openness to Foreign Trade and Investment

One of the remarkable phenomena in the Brazilian economy in the last 10 years was the rapid opening for international trade and foreign investment. In the late 1980s, foreign trade represented only 5% of GNP. The percentage almost doubled in 2000 to 9.4% (Table 2). Although this percentage is not large in world terms, it is typical of large countries where most business is done locally.

As a large continental country, Brazil historically was one of the most self-sufficient economies in the world, but it became much more integrated with the world economy in the 1990s. However, most of the foreign trade increase was on the import side. Between 1990-2000, Brazilian exports rose from US\$ 31.4 billion to US\$ 55.1 billion, an increase of 75%. During the same period, imports almost tripled, growing from US\$ 20.7 billions in 1990 to US\$ 55.8 in 2000 (figures not adjusted for inflation). This asymmetry in the rate of growth led to an inversion in the sign of the trade balance: A surplus of US\$ 10.7 billion in 1990 became a deficit from the mid 1990s as Table 2 shows. Brazilian foreign accounts are unbalanced mainly because of a structural deficit in services such as intellectual property (royalties, technical assistance), transport and insurance services, profits, and interest rate remittance. As a consequence, foreign debt increased. High foreign debt can be detrimental to e-commerce diffusion because it can restrain local capacity to import IT equipment, services, and components. During debt crises, import credits are in short supply and the value of the Real declines, which make imported equipment more expensive.

Table 2. Brazilian Foreign Account (millions of \$US)

| | 1996 | 1997 | 1998 | 1999 | 2000 |
|---------------------------|---------|---------|---------|---------|---------|
| Balance of Trade – FOB | -5,599 | -6,748 | -6,604 | -1,260 | -698 |
| Balance of Services (net) | -20,443 | -26,278 | -28,800 | -25,829 | -25,706 |
| Registered Foreign Debt | - | 167,760 | 220,350 | 219,196 | 215,415 |
| Trade as percent of GDP | 6.5% | 7.0% | 6.9% | 9.2% | 9.4% |

Source: Banco Central do Brasil,[2001] (www.mdic.gov.br/indicadores)

Income Distribution and Unemployment

Brazil ranks third in the Americas in GDP value. However, in per capita terms, Brazil falls behind the five wealthiest countries in Latin America. Also, its income distribution is one of the worst in the Americas. As Table 3 shows, while the share of income of the richest 20% of the population was 63.8%, the poorest 20% earned only 2.5%.

Comparative data provided by The Brazilian Institute of Geography and Statistics (IBGE) shows that while it is true that the poor became less poor in the last decade by increasing their absolute income, it is also true that the income distribution did not change much. From a comparison between data for 1992

Table 3. Wealth Indicators In The Americas

| Wealth | GDP in billions US\$ 2000 ^a | GDP per capita 2000 ^a | Share of income or consumption, richest 20% 1987-1998 ^b | Share of income or consumption, poorest 20% 1987-1998 ^b |
|-------------------------------|----------------------------------------------|----------------------------------------|-----------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| Argentina | \$285.04 | \$7,697.26 | N/A | N/A |
| Brazil | \$595.46 | \$3,500.33 | 63.80 | 2.50 |
| Canada | \$708.73 | \$23,048.11 | 39.30 | 7.50 |
| Chile | \$70.54 | \$4,637.67 | 61.00 | 3.50 |
| México | \$574.24 | \$5,807.43 | 58.20 | 3.60 |
| United States | \$9,962.65 | \$36,210.70 | 46.40 | 5.20 |
| Venezuela | \$120.48 | \$4,984.85 | 53.10 | 3.70 |
| Latin America ^c | \$1,645.78 | \$4,764.72 | 59.03 | 3.33 |
| OECD ^d | \$25,461.49 | \$22,829.19 | 40.19 | 7.71 |

^aSource: ITU [2001]

^bSource: United Nations Development Programme [2000], pp. 169-172. Dates for the data vary by country from 1987 to 1998. In each case, the latest available value was used.

^cLatin America consists of the following countries: Argentina, Brazil, Chile, Mexico and Venezuela.

^dOECD denotes the OECD member countries, excluding Luxembourg, Slovakia and Iceland.

and for 1999, we conclude that:

- The bottom 40% of workers increased their income by 40%, while the top 1% increased their income by 38%.
- More than 5% of the population jumped above the poverty line.
- The Gini coefficient remained stable, declining slightly from 0.571 to 0.567 (the closer to one, the more unequal the income distribution).
- The top 1% of workers kept their 13.1% share of total salaries while bottom 40% workers also kept their 14% total share.

Development in the 1990s created some opportunities for real salary increases but changing income distribution is a much harder task. The job market increasingly demands a highly qualified workforce for the most dynamic sectors of the economy. Since qualified people are in short supply in fast growing industries, the salary gap between the richest and the poorer workers remains wide open.

Despite an unbalanced income distribution and regional economic and social differences, Brazil middle and upper class market segments are relatively large, which encourages private investment in e-commerce. Per capita income of the top 20% of population (about 34 million people) is about US\$15,000 a year, equivalent to many European countries. At the same time, the bottom 40% of population survives with an average per capita income of US\$1,000. For its unbalanced income distribution, Brazil was nicknamed "Bel-India" by some economists for combining an upper class with a consumption level similar to Belgium and a lower class similar to India. The consequences of this wealth distribution pattern on EC diffusion are quite clear. EC growth might be quite fast up to a certain point and then stagnate.

Education is usually distinguished as a tool for improving income distribution. The higher the qualification of the worker the higher the salary. By all indicators, Brazil is increasing school

enrollment and literacy. However, the impacts of educational levels on income distribution are not yet visible.

The unemployment rate (7.1%) is below the Latin America average (Table 4). However, as in other parts of the continent, a higher percentage of the population works informally without social security coverage.

Potential E-commerce Participants

Brazilian industries are marked by heterogeneous and diversified networks consisting of millions of firms. The potential for e-commerce varies according to size of firm, industry sector, region, and business culture. Most firms are already linked to the Internet but only a small minority of firms (from 5% to 6%) is in an advanced transactional e-business stage [Tigre, 2001].

Table 4. Unemployment, Inflation and Economic Growth in the Americas

| Economy | Unemployment Rate 2000 ^a | Inflation, GDP Deflator (annual %) 2000 ^b | Average GDP growth, 1995-2000 ^b |
|----------------------------|-------------------------------------|---------------------------------------------------------|--------------------------------------------|
| Argentina | 15.00 | 1.13 | 1.79 |
| Brazil | 7.10 | 7.08 | 2.61 |
| Canada | 6.80 | 3.59 | 3.46 |
| Chile | 8.30 | 4.13 | 5.60 |
| México | 1.60 | 10.73 | 3.57 |
| United States | 4.00 | 2.05 | 4.01 |
| Venezuela | 14.00 | 26.84 | 1.19 |
| Latin America ^c | 9.20 | 9.98 | 2.95 |
| OECD ^d | 6.56 | 4.79 | 3.43 |

^aSource: ILO, 2002, LABORSTA (<http://www.laborsta.ilo.org>), Table 3A.

^bSource: World Bank Group 2002, <http://www.devdata.worldbank.org/data-query/>. WDI definition: Inflation as measured by the annual growth rate of the GDP implicit deflator. GDP implicit deflator measures the average annual rate of price change in the economy as a whole. Annual percentage growth rate of GDP at market prices is based on constant local currency. Aggregates are based on constant 1995 U.S. dollars.

^cLatin America consists of the following countries: Argentina, Brazil, Chile, Mexico and Venezuela.

^dOECD denotes the OECD member countries, excluding Luxembourg, Slovakia and Iceland.

Large local and multinational firms are intensive users of B2B applications and are important drivers of e-commerce diffusion among smaller upstream suppliers. In hierarchical business networks, such as in the automobile and electronics industries, where a few assemblers control the value chain, use of e-commerce is already a necessary condition for participants. Leaders use their inherent bargaining power to induce their suppliers to adopt organizational tools compatible with their own information design, thus establishing standards and guidelines for expanding on-line business.

The potential for further diffusion still exists in small and micro firms. In the last decade, 2.7 million micro enterprises (with less than 10 employees each) have been established, according to the Support Service for Micro and Small Firms (SEBRAE). The micro and small firms are becoming increasingly important as the new information technology paradigm diffuses. In principle, medium and large firms are more equipped and employ more qualified human resources than small firms. However, firm size does not necessarily define e-commerce adoption rates. In many cases, small firms can be more flexible in introducing organizational changes than larger bureaucratic firms. One survey [Tigre, 2001] showed that small firms can operate more easily in market niches which have high innovation rates because of risk-taking behavior and better motivation of the workforce. One of the main findings concerning firm size is that the Internet opens opportunities to small firms to overcome barriers to market entry and access to information. The micro and small firms surveyed use the Web more intensely than

larger firms in activities like procurement, access to information, technical assistance, and customer service. The Internet facilitates communications with suppliers and clients that favors better supply chain integration, more value added, and more efficient operations.

Use of e-commerce by SMEs is small-scale relative to larger firms and SMEs are heterogeneous in terms of capabilities, financial resources and access to IT. Government programs such as the Internet Society aim at diffusing Internet access in small retailing businesses more widely. The program coordinators believe that post office facilities, grocery stores, news agents, lottery, and other small business could become Internet intermediaries to small businesses and the low-income population. Instead of shopping on-line directly, a customer can order available-to-order goods through a next-door shop. This strategy may be important for e-commerce diffusion in developing countries in general.

For B2C, the potential Brazilian market is now limited to about 30 million people who can afford IT and telecommunication expenses. The majority of the population lacks the resources and probably the required education to practice e-commerce. However, some community programs are aimed at facilitating access to e-commerce in poor areas. For example, an initiative in the periphery of Rio de Janeiro encourages local people to use a community computer to buy construction materials. With the assistance of volunteers, local buyers could save money by searching for best offers and sharing transportation costs.

HUMAN RESOURCES

By all indicators, education levels increased substantially in the last decade. These indicators include literacy and enrollment at all educational levels. By the turn of the century, primary education was almost universal (95.7%). 78.5% of the population from 15-17 years old was enrolled in secondary education versus less than 60% in 1992. Secondary education is usually considered a necessary condition for participating in e-commerce.

Table 5. Education Indicators

| Indicator | Source | Unit | 1992 | 1998 | 1999 |
|-----------------------|----------------------------------------------------------------------------------|-------------------------------------------------------|------|-------|------|
| Adult literacy | UNDP Human Development Report (2000) for 1998 and IBGE (2001) for 1992 and 1999. | % of over age 15 can read and write | 82.8 | 84.50 | 86.7 |
| Functional illiteracy | IBGE (2001) | % of people with less than 4 years of study | 36.9 | - | 29.4 |
| Primary education | IBGE (2001) | % of enrollment of children from 7 to 14 years of age | 86.6 | - | 95.7 |
| Secondary education | WDI (2000), for 1998 and IBGE (2001) for 1992 and 1999. | % of enrollment from 15 to 17 years of age | 59.7 | 61.5 | 78.5 |
| Adult Education | IBGE (2001) | % of enrollment of people from 20 to 24 years of age | 16.9 | - | 25.5 |
| Tertiary education | WDI (2000) | % of Tertiary enrollment of age group. | - | 15 | - |

Brazil has a large number of software professionals in absolute terms. There are 680 undergraduate courses in information technology-related subjects. In 1998, about 22,000 students received their degrees, while nearly 200,000 students were registered. In addition, other students from areas like applied sciences and mathematics also often become IT professionals.

Table 6. Graduates and Enrollment in IT University-level Courses

| Area | Courses | Graduates | Enrollment |
|-----------------------|---------|-----------|------------|
| | 1998 | 1997 | 1998 |
| Data Processing | 180 | 7,388 | 43,701 |
| Computer Sciences | 159 | 8,367 | 74,567 |
| Social Communications | 152 | 2,701 | 37,738 |
| Information Systems | 53 | 836 | 13,078 |
| Industrial Design | 40 | 1,242 | 9,811 |
| System Analysis | 35 | 582 | 9,829 |
| Others* | 61 | 1,167 | 9,168 |
| Total | 680 | 22,283 | 197,892 |

Source: Ministry of Education, [1998]

*Areas related to IT

Despite recent growth, the supply of qualified IT workers may not match future demand. By 2004, 403,000 job vacancies are expected in Brazil in the area of networks alone [UFRJ, 2001]. IDC estimates that only 155,000 people would be qualified to fill this demand, widening the gap between supply and demand for well-trained professionals. However, the shortage of qualified people was not mentioned as an important barrier for e-commerce diffusion in other studies mentioned here. It will become a major problem only if the pace of e-commerce diffusion speeds up.

INDUSTRY STRUCTURE

Firm Size and Industry Concentration

The structure of Brazilian business is shown in Table 7. While micro and small firms (MSFs) represent 99% of all business, they provide only 35% of total employment. By contrast, large firms employ 45% of total registered workforce. However, taking into account that informal workers, who represent more than one half of total Brazilian workforce, are mostly in small firms, the balance could, in fact, be quite different.

Table 7. Distribution of Business by Size of firms

| Distribution of Business by Size of firms | Unit | 1999 |
|-------------------------------------------|------|-------|
| Small: under 100 employees | % | 99.27 |
| Medium: 100-499 employees | % | 0.59 |
| Large: 500 or more employees | % | 0.14 |

Source: IBGE website

From the data collected from different reports on diffusion of e-commerce in individual sectors [Tigre, 2001 and FIESP, 2000], we propose the ranking of potential e-commerce participants shown in Table 8.

Table 8. Top E-Commerce Users In Brazil

| Sector | How E-commerce is Used: |
|----------------------------------------|--------------------------------------------------------------|
| Finance | Transactions, investments, B2C |
| Government services | Information services, tax collection, elections, procurement |
| Retailing | Procurement, logistics, B2C |
| Automobile industry | Supply chain management, components trade, on-line sales |
| Transport and Distribution | Auctions for idle capacity, transport supply sites |
| Construction | Bidding, subcontracting, material trade |
| Pharmaceutical | Supply chain and distribution to retailers |
| Electronics | Supply chain management, distribution, B2C |
| Agriculture and Food | B2B Marketplace, Equipment and parts supply |
| Petrochemicals | Sales of intermediary goods, plastics and chemical products |
| Office equipment, parts and stationery | Supply of stationery, computer supplies, spare parts |

Table 9 presents the sector data collected in Tigre [2001]. It shows that the use of the Internet as a business tool is more common in information-related sectors. Transactions realized within and among business areas like finance, communications, information services, and other services that can be easily digitized. Consequently, they are naturally high potential users. Diffusion of e-commerce is also relatively large in transaction-intensive sectors such as retailing. They rely on frequent data exchange and need on-line coordination among various agents within the value chain.

Table 9. Internet Usage Pattern According to Business Sector

| Internet Usage | Business Sector | | | | | Total |
|-----------------------|-----------------|---------------|----------------------|---------|--------|-------|
| | Retailing | Manufacturing | Information Services | Finance | Others | |
| Access to information | 94.8 | 96.9 | 96.1 | 85.7 | 95.8 | 95.9 |
| Electronic mail | 94.8 | 96.9 | 94.1 | 85.7 | 93.0 | 94.5 |
| Procurement | 37.9 | 23.1 | 25.5 | 21.4 | 39.4 | 31.4 |
| Intranet | 34.5 | 30.8 | 45.1 | 64.3 | 38.0 | 41.4 |
| Extranet | 10.3 | 18.5 | 5.9 | 28.6 | 11.3 | 13.2 |
| On-line sales | 29.3 | 18.5 | 33.3 | 21.4 | 26.8 | 27.7 |
| Information services | 32.8 | 23.1 | 56.9 | 71.4 | 40.8 | 38.6 |
| Technical services | 20.7 | 4.6 | 21.6 | - | 21.1 | 14.1 |
| Advertising | 43.1 | 36.9 | 39.2 | 35.7 | 40.8 | 37.7 |
| Average | 44.2 | 38.8 | 46.4 | 46.0 | 45.2 | 43.8 |

Source: Tigre [2001]

In Brazil, the financial sector is the largest IT and e-commerce user. While inter-sector comparative information is not available, there is plenty of evidence about the leading role of the banking sector in both IT and e-commerce development.

Since the days of the Information Policy during the 1980s, some of the largest Brazilian banks – like Itaú, Bradesco and Banco do Brasil – have developed internal technological capabilities in service automation. Speeding up financial information and transaction flows usually paid off in a scenario characterized by high inflation. These capabilities were further used to pioneer Internet banking. Today, more than two-thirds of all banking transactions done in Brazil (67.1%) are labeled as “electronic”, according to the national banking association [Febraban, 2001]. These include transactions done via the Internet, automatic teller machines and call centers. More than 5 million clients use Internet banking. In 2002, the Central Bank introduced a new “Brazilian System of Payments”, which permits nationwide on-line funds transfer among banks, business and consumers. It will gradually substitute for checks in business-to-business (B2B) and business-to-consumer (B2C) transactions. The Central Bank estimates that 14 million transactions a day, involving US\$7 billion, will migrate to the new system. The main advantages of the system are security and immediate transfer of funds from one account to the other.

Recently, most major banks have adopted e-commerce, taking advantage of their existing infrastructure. They are diversifying the service range available on their sites to include both B2C and B2B. In addition, banks are taking over many cash-starved dot coms. The financial sector in Brazil invested in 136 sites and 34 Internet services providers (ISPs) during the last two years. The banks are reputed to be more solid and trustworthy than start-up Internet firms and are following a strategy designed to use these advantages to obtain a competitive edge in e-commerce.

Among business sectors, financial institutions have the highest percentage of advanced forms of usage. About 43% of the surveyed financial institutions may be classified as in a transactional stage (conducting transactions online). The financial sector, which accounts for 19% of GDP (Table 10) is a leader in intranet, extranet, and information services.

The federal government is the second largest e-commerce user, due to the value of procurement through reverse auctions and tax collection through the Internet. Also, information provided through the Internet about government activities, legislation, statistics, and services are now widely available on official sites. Government involvement in e-commerce will be further explored in the discussion of policy in Section III.

Retailing is probably the third larger user. While B2C is still at an early stage of development, major supermarkets and stores (such as Pão de Açúcar, Carrefour, and Lojas Americanas) are already heavy users of e-commerce to manage their procurement and logistics operations. Manufacturing is next, especially in the automobile, electronics and petrochemical industries. Transport and distribution are also intensive users, since they play a key role as supply chain integrators. Agriculture is rapidly increasing e-commerce operations, mainly in commodities markets. Finally, non-hierarchical networks, dealing with standardized products such as construction materials, office equipment, parts and stationary suppliers, are discovering the Web as an important marketplace.

Table 10. Sector Distribution of GDP

| Sector | 1995 (%) |
|-------------------------------------------------------------|----------|
| Agriculture, hunting, forestry and fishing (%) | 12.86 |
| Mining and quarrying (%) | 1.10 |
| Manufacturing (%) | 23.32 |
| Electricity, gas and water (%) | 2.67 |
| Construction (%) | 8.50 |
| Wholesale and retail trade and restaurants and hotels (%) | 7.16 |
| Transport, storage and communication (%) | 5.78 |
| Financing, insurance, real estate and business services (%) | 18.95 |
| Community, social and personal services (%) | 19.64 |

Source: United Nations [1999]

Importance of Foreign MNCs

The role of foreign direct investment (FDI) in the Brazilian economy rose greatly during the 1990s. Kupfer [2001] attempted to measure the changing role of MNCs in the Brazilian industry. He analyzed the top 365 Brazilian industrial firms and concluded that foreign MNCs' participation increased from 14.8% to 36.4% from 1991 to 1999. Part of the explanation for these effects lies in the privatization of state-owned companies. Also, the opening of the Brazilian market to imports in a context of an overvalued local currency exposed locally owned firms to stiffer competition. As a consequence, many important local groups were taken over by foreign counterparts.

New foreign investments occurred largely in specific sectors like automobiles and public services. Despite the slowdown in investment estimates for 2001, Brazil continued to be the primary focus for Internet and other new economy investment in Latin America, because of its lead in e-commerce. In 2002, however, FDI was sharply reduced due to international investors' fears about emerging markets performance in a period characterized by an unstable international environment.

The role of MNCs in e-commerce diffusion is related not only to global competitive pressures but also to their management practices worldwide. In Brazil, global competitive pressure may play less of a role than in other countries like Singapore and Taiwan, where firms are more interlinked with the world market. However, despite the lack of external competitive pressures, the opportunities offered by B2B e-commerce to reduce costs and improve supply chain management may be a strong incentive to adopt. Some MNCs in durable consumer goods are pioneers and leading users of e-commerce in Brazil. On the other hand, MNCs operating in service fields like retailing and banking seem to be less advanced e-commerce users than locally-owned leaders.

INFRASTRUCTURE

Telecommunications Infrastructure

Teledensity has increased rapidly since 1995 (Table 11). In per capita terms, Brazil is now at the Latin American average, both in fixed line and cellular phones. Teledensity in late 2000 was about 23 fixed lines per 100 people, 15.5% of which were connected with the Internet. The quality of services improved substantially and in most areas connections no longer drop with noticeable frequency as before. ANATEL (Agência Nacional de Telecomunicações) constantly monitors quality indicators (Table 11). World class standards are now required for issuing new operational concessions to existing telephone companies.

Table 11. Teledensity Evolution in Brazil

| Teledensity per 1,000 people | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 |
|------------------------------|-------|-------|--------|--------|-------|------|
| Main phone lines | 85.12 | 95.69 | 106.57 | 120.51 | 148.7 | 232* |
| Cellular subscribers | 8.25 | 15.82 | 27.52 | 46.8 | 89.5 | 141* |

Source: ITU [2001]

*Source: ANATEL [2002] <http://www.anatel.gov.br/estatisticas>

The experience of most developed countries shows that price and availability of telecommunications infrastructure are clearly associated with competition and market access. Along with new regulation, technology change plays a key role in shaping new market structure in telecommunications services. Technology convergence in different media and forms of transmission opens new opportunities both for competition and market concentration. Technology boosts competition by providing alternatives to data, voice and image transmission at higher speed and better performance. By choosing among cable, radio, satellite connections, eventually provided by different service firms, users can bargain for better prices and services. Technology and regulatory reform eliminated most natural monopolies, lifting entry barriers and enabling multiple companies to supply these services.

Liberalization of public switched telecommunication markets in Brazil enabled new firms to enter the market and encouraged the development of new ways of buying and selling capacity. New carriers are bypassing the established method of connecting calls between telecommunication carriers in major cities. New alternatives for trading transmission capacity and alternative rates for leasing a circuit are now available. These alternatives include discount prices from the telecommunications carriers, which face competition from new market entrants, lower market prices for leased capacity, and wholesale prices from infrastructure providers with excess capacity.

In Brazil, competition is already present in cellular phones, international calls, and value-added services. However, in fixed mainlines and long distance data communications, competition proved slower to take off for both technical and economic reasons. A natural monopoly still seems to work in basic infrastructure services, and established firms retain overwhelming competitive advantages. Fixed commuted telecommunications services fall into this category in most countries in the world. In Brazil, the state-owned telecommunication holding company (TELEBRAS) was split into three different regional companies and one long-distance company. These firms now hold considerable capital. Their access to the final user is a key competitive advantage not easy to replicate by new entrants.

The newly privatized companies benefited from this “natural monopoly”, granted by the acquisition of existing network capacity. The price paid for acquiring the PTOs in privatization bids were, in some cases, below the reproduction cost – that which would be necessary to duplicate the capacity—since the risks, either technical, political and/or financial of investing in emerging markets were considered high. Consequently, new competitors face entry barriers, since they have to pay a high cost to interconnect to local backbones.

The so-called *mirror firms*—authorized telecommunication public service providers - pursued a new technology strategy combining fixed and wireless through wireless local loop (WLL). The technology is cheaper to install, since it is based on radio and does not require a cable network, and is considered a short cut alternative to wired networks. However, the WLL technology is not as mobile as cellular phones. Also, it is not suitable for the Internet, which severely limits its market growth potential. Brazil now has the largest WLL installed base in the world (600,000 terminals) but unless further technological efforts to solve interference and other technical problems are undertaken by equipment and systems suppliers, this technology could be pushed to small market niches such as remote villages.

Cable TV is another technology that has not yet become a major Internet infrastructure. Unlike Argentina, Canada and the U.S. where cable TV is widespread in urban residences, Brazil only has 13.7 subscribers per 1,000 people. Globo, the largest Brazilian communication group, provides Internet services through cable TV in a few large cities and its competitors in the paid-TV market use satellite and other wireless transmission systems.

Table 12 compares the telecommunications indicators among Western Hemisphere countries and with OECD.

In some segments of the telecommunications market, especially fixed lines and cross-national backbones, market mechanisms alone are not sufficient to grant widespread access to the network, since a large part of the population lack the required income level to subscribe to individual telephone services. The universal service program sponsored by Agência Nacional del Telecomunicações (ANATEL) is designed to increase public phone facilities in low-income areas and expand the services to small and remote communities. The universal service obligations for incumbent carriers include areas where telecom companies usually do not provide full access because of the small size of the market. Also, the telecommunications companies are required to contribute 1% of their total revenues to a fund aimed at providing services to those excluded from the market.

Table 12. Telecommunication Indicators

| Telecommunications Infrastructure | Telecomm Investment as % of GDP, 2000 ^a | Main phone lines per 1,000 population, 2000 ^a | Cell phone subscribers per 1,000 population 2000 ^a | % Digital phone lines, 2000 ^a | CATV subscribers per 1,000 population 2000 ^a |
|-----------------------------------|----------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------------|------------------------------------------|---------------------------------------------------------|
| Argentina | .67 | 213.17 | 163.37 | 100.00 | 159.32 |
| Brazil | 1.49 | 181.80 | 136.31 | 92.50 | 13.70 |
| Canada | .57 | 676.51 | 284.60 | 99.70 | 259.41 |
| Chile | 1.56 | 221.22 | 223.62 | 100.00 | 45.20 |
| México | .89 | 124.72 | 142.33 | 99.98 | 23.11 |
| United States | .29 | 699.74 | 397.91 | 91.60 | 252.13 |
| Venezuela | .24 | 107.80 | 217.46 | 80.00 | 40.21 |
| Latin America ^b | 1.05 | 165.38 | 150.46 | 95.02 | 35.25 |
| OECD ^c | .73 | 524.53 | 457.27 | 94.82 | 145.37 |

^aSource: ITU [2001]

^bLatin America consists of the following countries: Argentina, Brazil, Chile, Mexico and Venezuela.

^cOECD denotes the OECD member countries, excluding Luxembourg, Slovakia and Iceland.

Ongoing international traffic reflects different levels of regional and international economic integration. While in Mexico, a country characterized by an intense trade and immigration flow with the U.S., telephone subscribers spend an average of 153 minutes in international calls, in Brazil only 21 minutes a year is spent per subscriber. This disparity occurs despite tariff differences, which are 40% lower in Brazil. However, a more careful analysis is required, since other costs (like fixed telephone fees) may alter the real costs. In most countries, tariffs have increased substantially after privatization, along with quality improvements. Tariffs vary widely across Latin America, reflecting different levels of competition and regulations.

Mobile telephone use is expanding rapidly in all of Latin America, since it is relatively inexpensive and accessible. In Chile, Mexico and Venezuela the number of mobile phones is greater than the number of fixed telephony mainlines, a tendency that will probably be followed by other countries. Moreover, in an increasing number of Latin American countries, digital mobile services provide opportunities for more advanced Internet-based services.

Table 13 indicates that most households in Latin America own television sets. The almost 300 TV sets per 1,000 people represent the main communication means in Latin America. This penetration must be taken into account when introducing new interactive technologies such as digital TV. In most Latin

American countries, TV sets, rather than computers, could be the most important vehicle for Internet diffusion. With a relatively small investment,¹ existing TV sets could be transformed into Internet terminals.

INFORMATION TECHNOLOGY INFRASTRUCTURE

Starting in the early 1970s, Brazil developed capabilities both in production and use of information technologies. Prior to liberalization in the early 1990s, Brazil's domestic IT industry was larger and more technologically advanced than it is today, and produced a wide range of systems, peripherals and even components. Despite setbacks, the country is one of the few developing countries with extensive capabilities in both software design and hardware manufacturing.

¹ A set top box costs about US\$300, but alternative innovative solutions could eventually reduce prices to a fraction of this amount if the market demand is high enough.

Table 13. Telephone Infrastructure and Access Costs (2000)

| Indicator/Country | Argentina | Brazil | Chile | México | Perú | Venezuela | Latin América |
|---------------------------------------------|-----------|--------|-------|--------|------|-----------|---------------|
| Telephone mainlines | | | | | | | |
| - Per 1,000 people | 213 | 182 | 221 | 125 | 64 | 108 | 148 |
| - In largest city (per 1,000 people) | 247 | 165 | 318 | 142 | 132 | 329 | 175 |
| - Revenue per line (\$) | 1,267 | 823 | 754 | 1,065 | 850 | 1,385 | 889 |
| - Cost of local call (\$ per 3 minutes) | 0.09 | 0.03 | 0.12 | 0.14 | 0.06 | 0.10 | 0.06 |
| Mobile phones (per 1,000 people) | 163 | 136 | 222 | 142 | 48 | 217 | 123 |
| <i>International telecommunications</i> | | | | | | | |
| - Outgoing traffic (minutes per subscriber) | 56 | 21 | 64 | 153 | 68 | 72 | 106 |
| - Cost of call to U.S. (\$ per 3 minutes) | 2.80 | 1.80 | 2.90 | 3.01 | 2.40 | 5.20 | 3.20 |
| Television sets (per 1,000 people) | 293 | 343 | 242 | 283 | 148 | 185 | 269 |

Sources: ITU World Telecommunication Indicators. [2001].

Mexico and Brazil are the only Latin American countries with substantial IT hardware production. However, Brazil produces mostly for the internal market and is also a heavy importer, while Mexico is a large exporter. In 2001, Brazil's trade deficit in electronics products reached US\$8.5 billion. As Table 14 shows, IT spending represented 2.38% of total GDP, a level well above the Latin American average, and behind only the U.S. and Canada in the Americas.

Table 14. IT Infrastructure in the Americas

| IT Infrastructure | IT as % of GDP, 2000 ^a | PCs per 1,000 population 2000 ^b | IT Hardware Production, US\$M 2000 ^c | IT Hardware Exports, US\$M 1999 ^c |
|----------------------------|-----------------------------------|--------------------------------------------|-------------------------------------------------|----------------------------------------------|
| Argentina | 1.29 | 51.31 | N/A | N/A |
| Brazil | 2.38 | 44.09 | \$9,083.78 | \$321.00 |
| Canada | 3.83 | 390.24 | \$3,361.73 | \$4,496.64 |
| Chile | 1.67 | 166.80 | N/A | N/A |
| México | 1.00 | 50.57 | \$10,281.00 | \$6,950.00 ^f |
| United States | 4.56 | 585.18 | \$88,488.62 | \$38,488.00 |
| Venezuela | 1.30 | 45.51 | \$254.02 | \$2.00 ^f |
| Latin America ^d | 1.60 | 52.22 | \$19,618.79 | \$7,273.00 |
| OECD ^e | 3.60 | 312.01 | \$231,341.80 | \$182,730.10 |

^aSource: International Data Corporation [2000]. IT is defined as "the revenue paid to vendors (including channel mark-ups) for systems, software, and/or services."

^bSource: ITU [2001]

^cSource: Reed Electronics Research [2000].

^dLatin America consists of the following countries: Argentina, Brazil, Chile, Mexico and Venezuela.

^eOECD denotes the OECD member countries, excluding Luxembourg, Slovakia and Iceland.

^f1998 data

With an IT market of about US\$20 billion, Brazil offers opportunities for start-ups to target niche markets at home, as government programs actively support local entrepreneurs through incubator programs. And as Dedrick et al. [2001] put it, the existence of a domestically-owned computer industry before liberalization meant that many Brazilian professionals gained experience in managing their own companies.

Internet Infrastructure

Internet infrastructure in Brazil is heterogeneous. Usually subscribers in more developed regions enjoy options between various Internet packages. It is normally possible for users to establish a good dial-up connection to a local ISP. Few urban areas offer higher bandwidth solutions such as DSL (digital subscriber line) and cable modem access. In “teleports” and newly developed business centers, customers can tailor services to meet different demands for speed, service, security, quality and cost. A competitive and sophisticated Web design market exists, incorporating the latest development technology. Also, major international suppliers of software and e-commerce service such as ASP and ICP services, are already present in larger cities. Table 15 compares Internet indicators in different countries in the Americas.

Table 15. Internet Infrastructure in the Americas

| Internet Infrastructure | Internet hosts per 1,000 population 2000 ^a | Internet users per 1,000 population 2000 ^a | Access cost, 30 hours, peak, US\$ 2001 ^b | Access cost, 30 hours, off-peak, US\$ 2001 ^b |
|----------------------------|-------------------------------------------------------|-------------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------|
| Argentina | 7.30 | 67.51 | \$92.02 | \$91.59 |
| Brazil | 5.15 | 29.39 | N/A | N/A |
| Canada | 76.88 | 413.01 | \$24.87 | \$24.87 |
| Chile | 4.91 | 166.80 | N/A | N/A |
| México | 5.65 | 27.43 | \$30.78 | \$30.78 |
| United States | 292.83 | 346.58 | \$22.05 | \$22.50 |
| Venezuela | .67 | 39.30 | N/A | N/A |
| Latin America ^c | 5.20 | 39.66 | \$61.40 | \$61.19 |
| OECD ^d | 91.76 | 256.03 | \$39.43 | \$29.66 |

^aSource: ITU[2001]

^bSource: ITU[2002].

^cLatin America consists of the following countries: Argentina, Brazil, Chile, Mexico and Venezuela.

^dOECD denotes the OECD member countries, excluding Luxembourg, Slovakia and Iceland.

An important e-commerce diffusion indicator is the availability of secure servers, a necessary condition for transactions on the net. Brazil has a relatively high diffusion of these servers in relation to other Latin American countries although well behind the United States and Canada (Table 16).

Transport Infrastructure

The transport system in Brazil depends heavily on roads. Air transportation also plays an increasing role, due to the country's large size. Railways received little investment in the past four decades, as government attention was directed to integrating the country through roads. This policy is often referred to as a driving force to the development of the automobile industry. However, since the 1980s the investment in roads has faded out, as stabilization policies became a priority. Brazil's extensive road network links most of the country, except in the Amazon where water and air transportation are the only reliable routes. Only 9.7% of Brazilian roads are paved and most of them do not receive sufficient maintenance. The concentration of the population in cities will facilitate the delivery of goods ordered on-line, and in part compensate for the vast distances that separate Brazil's many urban centers. Ground package delivery services are provided by both international firms, such as UPS and FedEx, and by local companies, like Varig and the Post Office.

Table 16.E-Business in the Americas

| E-Commerce | Secure servers per 100,000 population 2000 ^a | Secure servers with strong encryption per 100,000 population 2000 ^a | B2B trade in US\$M 2000 ^b | B2C trade in US\$M 2000 ^b | % E-commerce Sales of GDP 2000 ^b |
|----------------------------|---------------------------------------------------------|--------------------------------------------------------------------------------|--------------------------------------|--------------------------------------|---------------------------------------------|
| Argentina | .66 | .35 | \$634.99 | \$52.58 | .24 |
| Brazil | .59 | .34 | \$1,720.78 | \$202.86 | .32 |
| Canada | 15.73 | 14.97 | \$12,923.30 | \$2,649.52 | 2.20 |
| Chile | .87 | .43 | \$228.61 | \$15.86 | .35 |
| México | .25 | .13 | \$1,753.86 | \$82.35 | .32 |
| United States | 28.30 | 25.11 | \$118,457.20 | \$44,084.29 | 1.63 |
| Venezuela | .41 | .27 | \$285.44 | \$9.10 | .24 |
| Latin America ^c | .50 | .28 | \$4,623.66 | \$362.74 | .30 |
| OECD ^d | 10.09 | 8.39 | \$268,500.30 | \$69,146.65 | 1.33 |

^aSource: Netcraft. <http://www.netcraft.com>. Strong encryption is defined as having a key length greater than 40 bits (systems limited to a 40-bit key are classified as 'weak' since it has been shown that messages encoded using a 40-bit key with RC4 can be broken in about a week by a good computer science student using facilities available in a good computer science lab).

^bSource: IDC, Internet Commerce Market Model, Version 8.1 (2002).

^cLatin America consists of the following countries: Argentina, Brazil, Chile, Mexico and Venezuela.

^dOECD denotes the OECD member countries, excluding Luxembourg, Slovakia and Iceland

Financial Resources

Use of Credit Cards, Debit Cards and Stored Value Cards. Credit card use in Brazil has grown rapidly since the early 1990s (Table 17). Two factors were key driving forces for the boom.

1. The liberalization of the use of credit cards by Brazilians traveling in foreign countries.
2. Stabilization of the national currency, which improved the acceptance of credit cards by retailers.

Table 17.Credit Card Use in Brazil

| Year | Number of Credit Cards in Use (millions) | Number of Transactions (millions) | Value of Transactions (R\$ billions) |
|-----------|------------------------------------------|-----------------------------------|--------------------------------------|
| 1992 | 7.8 | 151.6 | 5.1 |
| 1993 | 8.4 | 199.9 | 6.3 |
| 1994 | 11.2 | 210.3 | 10.3 |
| 1995 | 14.3 | 319.0 | 21.3 |
| 1996 | 17.2 | 437.1 | 25.5 |
| 1997 | 19.3 | 516.7 | 27.8 |
| 1998 | 22.0 | 641.2 | 32.0 |
| 1999 | 23.6 | 770.0 | 41.6 |
| 2000 | 27.9 | 1,038 | 50.4 |
| 2001(Feb) | 29.6 | - | - |

Source: ABECS. www.abecs.org.br/indices.htm (last accessed Oct. 1, 2002)

Brazilian consumers are now the largest users of credit cards in Latin America and the country ranks eighth worldwide, with about 30 million cards issued and over one billion transactions a

year. In 2000, overall purchases by credit cards reached US\$26.5 billion, equivalent to 7% of total private domestic consumption in Brazil .

The correlation between income level and the use of credit cards is significant. According to a survey conducted by Credicard [Gazeta Mercantil Latino-Americana, 2001] about two-thirds (65%) of consumers with an income level above US\$1250 a month hold a card while only 19% of people with an income level between \$150 to \$250 do so. About 34% of the Brazilian population over 16 years old living in metropolitan areas with an income level above US\$150 a month hold a credit card.

The use of debit cards was pioneered by Banco do Brasil. Their diffusion is slow, since the system requires a special terminal installed in shops and it does not provide credit.

Several versions of stored value cards are being tested. Metrocard is one of the most advanced and is being used on an experimental basis in the São Paulo transportation system. However, a widely accepted stored value card system is not yet in general use in Brazil.

Venture Capital

Latin Venture Partners [2000] reports that private equity investment in Brazil's "new economy" more than tripled to \$3.5 billion in 2000 from the year before. Despite the slowdown in investment estimated for 2001, Brazil remains the region's leader for technology initiatives. Latin Venture Partners estimates Brazil will continue to be the primary focus for Internet and other new economy investment in Latin America because of its lead in e-commerce. Its report cites that more than half of Latin America's on-line e-commerce transactions in 2001 were done in Brazil. Mobile e-commerce, for example, is expected to boom in the next few years, the company says, though current wireless devices are still far from replacing personal computers for Internet access in Brazil. Most investment earmarked for those initiatives will come from outside the country, the report says. It can be noted, however, that since mid-2002, foreign direct investments and venture capital are becoming increasingly difficult to obtain, especially for small start-ups. After the NASDAQ crises and Brazilian external financial problems, investors are much more cautious concerning risky entrepreneurships.

A recent study on venture capital in the Brazilian IT sector [Basques, 2001] collected a wide range of information about mergers, acquisitions and investments, both from foreign and local capital. It covers the period from January 1999 to May 2001. As Table 18 shows, of 406 transactions classified by type, 144 were the issue of shares to the general public, 108 were acquisitions, and 106 were direct investment by one or more investors. Fewer than 50% of these transactions were above US\$10 million.

Table 18. Venture Capital, Acquisitions, and Share Issues in the Brazilian IT sector

| Type of Transaction | Number | % |
|---------------------|--------|--------|
| Acquisition | 108 | 26.60 |
| Concession | 5 | 1.23 |
| Merger | 9 | 2.22 |
| Shares Issue | 144 | 35.47 |
| Joint Venture | 34 | 8.37 |
| Investment | 106 | 26.11 |
| Total | 406 | 100.00 |

Source: Basques [2001]

Table 19 (from [Basques, 2001]) shows sectors of both receivers and investors. While the financial sector is the major investor (about 40% of cases), Internet sites are the main receivers

(54% of cases). It can be noted that investment strategies include horizontal integration (acquisitions in the same sectors), diversification, vertical integration and portfolio investments.

Table 19. Investors and Receivers N Brazilian IT by Sector

| Investors | Receivers → | Communications | Equipment and Infrastructure | Finance | holding internet | IT Services | Not available | ISP | Sites | Telephone Services | Traditional | Total |
|------------------------------|-------------|----------------|------------------------------|---------|------------------|-------------|---------------|-----|-------|--------------------|-------------|-------|
| Communications | | 4 | 0 | 0 | 0 | 1 | 0 | 5 | 6 | 0 | 0 | 16 |
| Equipment and Infrastructure | | 2 | 10 | 0 | 0 | 4 | 1 | 4 | 4 | 0 | 0 | 25 |
| Finance | | 4 | 14 | 3 | 4 | 29 | 5 | 34 | 136 | 4 | 0 | 233 |
| Holding Internet | | 0 | 1 | 0 | 0 | 2 | 1 | 0 | 8 | 0 | 0 | 12 |
| IT Services | | 1 | 0 | 0 | 0 | 19 | 1 | 1 | 9 | 0 | 0 | 31 |
| Internet | | 0 | 1 | 0 | 0 | 2 | 0 | 1 | 7 | 0 | 0 | 11 |
| Independent | | 0 | 0 | 4 | 0 | 2 | 0 | 2 | 10 | 0 | 0 | 18 |
| Not Available | | 1 | 1 | 2 | 2 | 6 | 4 | 9 | 51 | 2 | 0 | 78 |
| Portfolio | | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 5 | 0 | 0 | 9 |
| ISP | | 0 | 1 | 0 | 0 | 1 | 1 | 15 | 5 | 1 | 0 | 24 |
| Sites | | 1 | 0 | 4 | 1 | 1 | 0 | 2 | 34 | 0 | 1 | 44 |
| Telephone Services | | 2 | 1 | 0 | 0 | 2 | 0 | 10 | 2 | 24 | 0 | 41 |
| Traditional | | 2 | 1 | 0 | 2 | 0 | 0 | 1 | 45 | 1 | 0 | 52 |
| Total | | 18 | 30 | 14 | 9 | 70 | 13 | 85 | 322 | 32 | 1 | 594 |

III. NATIONAL POLICY

E-commerce promotion, regulation, and use by government institutions involve different policy instruments, discussion forums, technical skills, and international commitments. As a result, several government and private institutions are in charge of national policies. Their financing sources differ, but some initiatives lack both resources and authority to make things happen. Most initiatives involve coordination committees with representatives of different government agencies, the private sector, and the academic community. However, initiatives by different agencies still lack coordination to improve effectiveness.

POLICY INSTITUTIONS

Ministry Of Communications/National Telecommunications Agency (Anatel)

ANATEL is the agency in charge of telecommunications regulations. It was established in 1998 to conduct the privatization program, fix universalization goals, authorize telecommunications services, control tariffs and enforce the implementation of policies by incumbent service providers. It is an independent agency organized after the United States FCC model. ANATEL regulates data transmissions, ISPs, and other related matters.

ANATEL administers the two main government funds for IT development: the Telecommunications Universalization Fund (FUST) and the Fund for the Technological

Development of Telecommunications (FUNTTEL). FUST is oriented toward financing information and communication technologies for social purposes. It is financed by an additional charge of 1% in telecommunication bills and by concession fees obtained by ANATEL. The other fund, FUNTTEL, is directed to R&D financing in the telecommunication industry. It was created in 2001 and has several financial sources including revenue from annual budget allocations and a sum equivalent to 0.5% of telecom service operating companies' income. The FUNTTEL 2002 budget is about US\$150 million, of which 30% will be directed to CPqD (see below) and the balance to private firms, universities and other public R&D centers.

Ministry of Planning

This ministry coordinates several government actions. *The electronic government project aims to provide universal access to public services, more transparency to government actions, achieve more efficiency in the use of information technology and integrate communications networks of public administration. By the end of 2001, more than 30% of all public services that did not require the citizen's physical presence were available on the Internet. A showcase is the national elections, which are almost fully digitalized. In 2000 county polls, which involved more than 80 million voters, the results were known in a few hours after elections closed down all over the country.*

Another successful project is government procurement. The Comprasnet program is reputed to be saving up to 25% through Internet reverse auctions and supporting transparency in public goods and services supplies management. In 2002, about 160,000 suppliers were registered on the site and 29,000 calls for offers were issued (www.comprasnet.gov.br/). However, Internet-based purchases still account for only 3% of total government purchases. In June 2002, new legislation was issued (Law 10.520) to facilitate state and federal government on-line purchases. The federal government has more than 4,000 purchase points, an excessive amount, which leads to mismanagement. The government hopes to better control its purchases through centralized e-procurement. At the state level, São Paulo is leading e-procurement with 9% of its total purchases already undertaken on the Internet.

Ministry of Science and Technology

MCT has been responsible for the development of Internet and IT infrastructure since the 1980s. It coordinates several public-private programs such as the Information Society and National Research Network (RNP). The Information Society program's main project is linking about 10,000 libraries through the Internet. It is funded with FUST money, but still lacks a more reliable and stable source of financing. RNP is now planning a high-speed experimental network aiming at providing a testing ground for Internet hardware and software developments. It is supported by FUNTTEL financial resources.

MCT plays an important role in high-level education and academic research through CNPq, Brazil's main financial agency for university R&D and postgraduate training. Policies are oriented toward postgraduate and academic research. In 2000, about 3,000 students were undertaking postgraduate courses in computer science, of which 20% were pursuing a doctoral degree. In 1999, 461 students obtained a MSc and 65 a PhD degree in computer science.

Ministry of Industrial and Trade Development

The MDIC became involved in e-commerce promotion recently. It established the Executive Committee of Electronic Commerce, aimed at resolving existing technical and legal problems and at proposing new policies. MDIC is also in charge of intellectual property issues through the Intitut National de la Propriété Industrielle (INPI). MDIC represents Brazil in several international e-commerce forums, but it lacks both the authority and financial resources to play a more prominent role.

Ministry of Finance

The Ministry of Finance is responsible for implementing the on-line taxation system, for maintaining the national electronic funds transfer system (through the Central Bank) and for proposing legal actions to facilitate fiscal procedures on the Internet. It runs a data processing center (SERPRO), which handles most of the IT services for the federal government. The technologies underlying e-commerce offer significant opportunities for improved taxpayer services. The Brazilian tax system is progressively moving on-line. In 2001, 90% of the income tax declarations received by the Federal Tax Authority were handled through the Internet³. Taxpayers either file directly from a home computer or take a floppy disk to a nearby bank or post office and transmit from terminals especially installed for this purpose. Several other taxes and contributions are migrating to the Internet, but some state taxes have yet to be regulated to legalize operations.

Table 20. Evolution of Income Tax Declarations Handled Through the Internet

| Year | Number of declarations (1,000) | Percentage of total declarations |
|------|-----------------------------------|-------------------------------------|
| 1997 | 706 | 6% |
| 1998 | 4,422 | 30% |
| 1999 | 11,296 | 62% |
| 2000 | 13,500 | 90% |

Source: Receita Federal [2001] www.receita.fazenda.gov.br

Table 21 summarizes e-commerce stakeholders and issues in Brazil.

Table 21. E-Commerce Stakeholders and Issues

| Stakeholders | Electronic Signatures | Telecom Regulations | Intellectual Property | Cryptography | Government Purchase | Internet Infrastructure |
|--------------------------|--------------------------|------------------------|--------------------------|--------------|------------------------|----------------------------|
| ANATEL | | X | | | | X |
| Ministry of Industry | X | | X | | | |
| Ministry of Planning | | | | | X | |
| Ministry of Finance | | | | | X | |
| Ministry of S&T | | | | X | | X |
| Business Associations | X | | | X | | |
| National Congress | X | X | | X | | |

ENABLING POLICIES

Telecommunications Liberalization and Private Investments

Since 1998, when Brazil's telecommunications infrastructure was privatized and the market re-regulated, telecom services has been the most attractive sector in Brazil for investment. In 2000,

³ Only 14.5% of Brazilians are obliged to declare income taxes. People earning less than US\$5,000 a year (which constitute the majority of population) do not pay income taxes.

telecom investments, as a percentage of the GDP (2.38%), were the highest in Latin America. In that year, total investment in telecom infrastructure reached US\$9 billion—77% in fixed mainlines and 23% in mobile. As a consequence, the availability of telecom services increased significantly in a wide range of services.

Unlike the early 1990s, when unfulfilled demand for telephone lines constituted a major problem, fixed or cellular lines are no longer in short supply in metropolitan areas. Rather, from 2002, telecommunication companies' problems are mainly non-payment of bills by low-income, recently acquired customers. Some companies are actually disconnecting more telephone lines than installing new ones. They believe that the Brazilian domestic telecommunication market has already reached a ceiling estimated at less than 25% of total households. New investments are now oriented toward a "cream-skimming" strategy to introduce value added services to further serve the more sophisticated and reliable corporate and high income markets. These services include high-speed multimedia using a variety of radio, cable and satellite networks.

Financial Deregulation

The 1990s witnessed significant financial deregulation and liberalization of investment and trade. These changes contributed to promote e-commerce development for at least four reasons.

1. Import liberalization facilitated on-line shopping overseas. Import taxes now average less than 20% and mail orders costing up to US\$50 are imported duty-free.
2. Prior to liberalization, credit cards were valid in Brazil only. International credit cards are of fundamental importance for e-commerce, since about 90% of B2C transactions adopt this form of funds transfer.
3. Foreign direct investment and profit remittance are no longer restricted. This change encouraged new foreign ventures, both in e-commerce and associated services.
4. Liberalization strengthened trade links between local and international supply chains. Consequently, there is an increasing demand for B2B e-commerce.

Private and Community Initiatives

Two classes of private and community initiatives can be distinguished. One is the national research network (RNP⁴), which provides high-speed backbones to universities, hospitals and other social institutions by wholesale purchasing and reselling of spare capacity available from private infrastructure providers. The other includes NGO (nongovernmental organization) initiatives such as the committee for informatics democratization and viva rio, aimed at providing internet training to youth in low-income communities.

E-COMMERCE POLICY

Legal Framework

In Brazil, the e-commerce boom occurred in the absence of a specific legal framework. In 2001, Congress approved the first legislation on e-commerce, which concerns authentication of digital signatures. It includes certification of electronic signatures by a public notary and their annexation to electronic documents and the use of a cryptographic system based on public or asymmetric key. The system permits a codified message to be received using a private key de-codified by the correspondent's public key. The law established that foreign certified documents would only be accepted if Brazilian contracts receive the same treatment overseas.

The rules governing on-line sales are the same applied to the "Code of Customers Defense". Within Brazilian federal government agencies, official document exchange is already done electronically using a Public Key Infrastructure. Presidential decrees 3585 and 3587 established that, as of January 2001, official documents for normative acts must be transmitted electronically.

⁴ Rede Nacional de Pesquisas in Portuguese.

Cross-country legislation may be a necessary condition for e-commerce, especially in free-trade areas like Mercosur. In Argentina, Decree n. 427/98 is already in force, regulating digital signatures and cryptographic system based on an asymmetric key. However, its application is restricted to public administration.

Relation to International Legal Frameworks

Several international initiatives discuss and unify legal frameworks for e-commerce development. Among multilateral and international institutions, the OECD, ITU UNCITRAL and GATT/WTO are the most active in providing guidelines and promoting agreements to develop a comprehensive legal and trade framework for e-commerce. The major concern of these institutions is to build an international regulatory framework.

For Brazilian entrepreneurs seeking to break into world markets via the Internet or by more traditional means, lack of trust is an important barrier. As a developing country Brazil has a reputation, whether warranted or not, for weak laws and law enforcement. Local firms lack internationally known brand names and cultural differences may stand in the way of trust, which is one reason why networks of overseas nationals can be exceedingly valuable to establishing a toehold in foreign markets. Paradoxically, e-commerce suffers from more serious information asymmetries and adverse selection problems than more traditional means of commerce, at least during this initial learning period. To overcome these barriers, Brazilian firms, business associations and government agencies must comply with international agencies' guidelines for contractual terms, adopt standard delivery and payment practices, enforce rules honouring confidentiality of client information and protect transactions from unauthorized "snooping". UNCITRAL e-commerce contract models and OECD Cryptography Policy Guidelines are examples of successful international cooperation for building trust.

E-commerce taxation is not yet agreed upon among different countries. The World Trade Organization Secretariat proposes a widespread liberalization of trade in services. Within WTO, developing countries raised concerns about possible tariff revenue implications resulting from a ban on customs duties on electronic transmissions. Any decisions that Brazil may make on modifying its tax legislation to accommodate e-commerce will have to take into account the significant role of tax and tariff revenues in its national budget, as well as bilateral concessions in other trade areas. Local taxes on e-commerce activities are also controversial issues not yet settled among different states in the Brazilian federation. E-commerce is now treated as a telecommunication service paying up to 25% of value added tax.

IV. CONCLUSIONS

DRIVERS AND BARRIERS FOR E-COMMERCE DIFFUSION

The growth of e-commerce as a business tool is creating new opportunities for market access and organizational innovations. Brazil, being a large developing country characterized by a heterogeneous economic and social environment, may well illustrate how environment and policies interact as drivers and barriers for IT diffusion. The role of barriers and drivers are usually different for B2B and B2C and are discussed separately.

Business to Business

B2B e-commerce has grown heterogeneously in Brazil, varying by sector and region. As shown in this paper, e-commerce is biased toward information intensive sectors, which are drivers of B2B e-commerce. Transactions realized within and among business areas like finance, communications, information services, and other services can easily be digitized. Consequently, they are naturally high potential users. Business sectors where the diffusion of e-commerce is relatively large have in common the fact that they are transaction-intensive sectors. They rely on frequent data exchange and need online coordination among various agents within the value chain.

Within these information-related sectors, history counts. In Brazil, about 30 years of high inflation rates gave rise to a trajectory of increasing demand for financial services. Overnight deposit accounts boomed since cash rapidly lost value. Even after inflation was curbed, checks and credit cards were widely used and a network of agencies provides a wide range of services all over the country. As a consequence, the market for IT in the financial sector was important and the three major banks invested in hardware and software manufacturing. This strategy was successful, since they could rely on innovative tailor-made solutions not available in the international market. Today, more than two-thirds of all banking transactions done in Brazil are labeled as “electronic”, a similar level to advanced countries like the U.S. Brazil is an exporter of banking automation software and equipment and is reputed to be one of the most advanced countries in the world in this respect. Banking automation technology was also adapted for retailing and other service sectors.

The case of Brazil suggests that, in developing countries, e-commerce constitutes a more selective process than in advanced countries where business practices in different industry branches, regions, and firm sizes are more homogeneous. Firms outside the “modern sectors” (which are oriented to less developed and competitive markets and use vintage equipment and outdated business practices) face important barriers for B2B. Opportunity costs for capital and labor are different in developing countries than in developed countries. While capital is usually expensive and inaccessible, semiskilled labor such as telephone attendants, clerks, and other professionals, who eventually could be replaced by e-commerce practices, are cheap. Consequently, firms are more reluctant to invest in automation. The investment required to introduce e-commerce is an important diffusion inhibitor since equipment and software are relatively unaffordable for smaller firms and employees are usually unqualified to use and maintain information technologies.

Multinational firms are important driving forces for B2B diffusion. However, we are inclined to argue that more important than the origin of the firm *per se*, is the market power to command a network of suppliers. Large manufacturing companies, nationwide banks, and wholesale and retail firms commanding hierarchical business chains have the capabilities to adopt and power to impose new business practices to their suppliers. These firms are drivers of B2B e-commerce diffusion, regardless of whether they are foreign or locally owned. Unfortunately, the evidence collected in this research is not conclusive about the role of local MNCs in e-commerce diffusion. On the one hand, locally owned large banks are more intensive e-commerce users than their foreign-owned competitors. On the other, in manufacturing industry, MNCs lead e-commerce diffusion. These leading e-commerce users are also leaders in their respective industries.

The evidence provided in this paper tends also to challenge the role of globalization as a key driver to e-commerce diffusion. For example, Brazil and Mexico engage in a similar level of B2B trade (about US\$1.7 billion in 2000), even though Mexico, a NAFTA partner, is much more globalized. Mexico exports twice as much as Brazil, yet the GNP level is approximately the same. However, Brazil operates three times more secure servers with strong encryption per unit population (which is a good indicator of B2B development) than Mexico.

Business to Consumer

For B2C, the evidence found in this study shows that good supply alone could not create demand outside of the upper income segments of society. Low income levels and unequal income distribution are major barriers for IT diffusion. Probably, B2C e-commerce will be limited to less than a third of the population and would barely affect the other two-thirds in the near future. The poorer people lack not only buying power but also the access to telephone lines and the educational level required for IT use. E-commerce saturation is likely to affect developed countries too. Hammond (2002) estimates that in North America and northern Europe a saturation point of about 80% of domestic households will be reached by 2010. Southern and eastern European countries would probably reach 56%. For Brazil, we estimate a saturation point of 35% by 2010.

Low income levels and unequal income distribution are major barriers for telecom infrastructure development. In Brazil, telecommunications infrastructure improved substantially since 1998, due to privatization and legal requirements for universal service by telephone companies. From 1998 to 2002, the availability of fixed telephone lines more than doubled, from 22.7 million to 50.7 million. However, telephone companies claim that the market has reached its ceiling already and that there are no longer additional families that can afford to pay a telephone bill. Telephone bills in arrears increased substantially after the network expansion and some companies are now cutting off more lines than installing new ones. Expansion depends on the installation of additional lines to higher-income domestic users. For low-income users, companies are introducing pre-paid⁵ services in a strategy designed to curb uncollectible bills.

Despite differences in income levels, Brazil's B2C market is the largest in Latin America with estimated sales of US\$200 million in 2000. More than 15 million people are already linked to the Internet using digital lines and alternative communications links for e-commerce. Cable modem access is not widely diffused in Brazil (only 13.7 per thousand people), but radio and mobile phone (136 per thousand) present a higher penetration. Cell phones could eventually be used for e-commerce, especially when 2.5 and 3rd generations become widely used. However, the high cost of online time and low transmission speed are barriers for B2C. Larger urban areas offer higher bandwidth solutions based on radio, leased lines, and DSL.

The Role of Government Policies

The conventional wisdom holds that e-commerce diffusion depends on an appropriate legal framework concerning privacy, intellectual property, and security. The point made in this paper is that the role of government as a leading e-commerce user and facilitator may be more relevant to induce private agents to follow suit than just introducing and enforcing specific regulations. Brazil shows that relatively high diffusion may occur in the absence of specific laws. As Latin America's largest e-commerce market, Brazil is much more advanced in this respect than countries with detailed specific legislation such as Peru. In the absence of legal protections, consumers evolved their own strategies to protect themselves from negligence, fraud, or simply poor service. The use of informal networks to share information about experience with specific products and their suppliers is a common strategy, one that is certainly compatible with e-commerce. Customer brand loyalty is another, but one that may disadvantage new entrants.

The findings of this study concerning government policies show that public agencies may play an important role as drivers and enablers of e-commerce practices. By purchasing on-line, for example, the federal and some state governments created a strong incentive for suppliers to go on-line. A wide range of public services and information are now available on the Internet in sharp contrast with the usually bad service provided by brick-and-mortar government agencies. Even individuals feel compelled to deal with new technologies in order to vote or pay taxes.

The development of technological capabilities is also an important enabler for e-commerce development. In Brazil, an early public policy towards computer R&D and manufacturing, dating from 1970s stimulated the development of internal technological capabilities in IT [Tigre and Botelho, 2001]. Although most locally-owned hardware manufacturing firms disappeared in the early 1990s after the end of the protectionist policy, the accumulated technological capability and entrepreneurship capacity was key for IT diffusion. These capabilities were further used to pioneer the Internet.

Another driving force was the liberalization and privatization of the telecom sector. Competition and private investments improved telecom services both quantitatively and qualitatively. Improved and more reliable telecom services, including high-speed connections, boosted both B2B and B2C. By separating regulation from direct management of the telecom services, the Brazilian

⁵ In Brazil, prepaid service is the most common payment method for mobile phones but is not yet offered for fixed lines.

government through the National Agency for Telecom Services (ANATEL) is in a position to demand improved quality standards from private telecom companies.

Implications for E-commerce Diffusion

From the discussions in the first three sections these general implications for Brazil and other developing countries' policies emerge:

1. The social and economic barriers to e-commerce diffusion could only be removed through successful long-run development and income distribution policies. Meanwhile, e-commerce policies designed to cope with problems, which are typical of developing countries, could play a positive role. These policies include making IT universal based on shared facilities and subsidies for smaller firms. Standard solutions such as private PCs are probably not adequate for the majority of the Brazilian population. Instead, telecenters, programs to provide Internet in schools, libraries, post offices and other shared facilities are needed to make IT universally available. The use of less expensive hardware, based on the network computer concept, and less costly software such as LINUX can also be a sound policy.⁶
2. Government "demonstration projects" designed to show the viability of e-commerce innovations to the private sector might constitute a sounder policy than simply adopting a "legalist" role. Instead of simply introducing policies for specific problems such as privacy, security, and authentication, government should go further in e-commerce promotion, playing a facilitating and enabling role. As a key user, it must innovate and demonstrate the viability of solutions appropriate to local conditions.
3. Brazil must follow international debates closely and adjust its own legislation to accommodate international e-commerce agreements, preserve tax revenues, and build trust. Even though e-commerce legislation is not an important driver in Brazil, compliance with international rules and agreements may help entrepreneurs seeking to break into world markets via the Internet to build trust. Developing countries need to build, from scratch, a reputation of compliance with internationally agreed guidelines for contractual terms, delivery and payment practices, confidentiality and security, in addition to efficient law enforcement. However, the needs and problems posed by leading countries and multinational corporations should not necessarily dictate the policies in less developed countries, since problems may be of a different nature.

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Editor's Note: This article was received on October 15, 2002 and was published on February 4, 2003. It is the fifth in a series of papers that are products of the Globalization and Electronic Commerce Project, an ongoing study being conducted by the Center for Research on Information Technology and Organizations (CRITO) at the University of California, Irvine. This project examines the global diffusion of Internet-based

⁶ The advantage of using open, low cost software, such as LINUX is twofold. First, the operating system cost is smaller and applied programs usually cost much less than proprietary software. In addition, users will not be exposed to frequent changes in versions and thus not obliged to buy new software and hardware as happen to proprietary software users. Second, the use of open software gives more freedom to users to change programs and adapt them to their own needs, since the source code is freely available. It may also become a tool for local firms to enter in the international markets.

e-commerce, how national environments and policies influence e-commerce use within countries, and the economic and social impacts of e-commerce. The series is under the editorship of Kenneth L. Kraemer and Jason Dedrick of CRITO.

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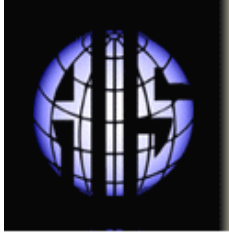
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