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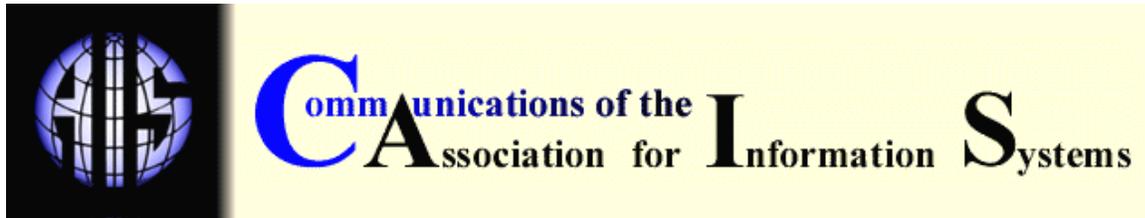
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GLOBALIZATION AND E-COMMERCE IV: ENVIRONMENT AND POLICY IN MEXICO

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ABSTRACT

This article examines Mexico as one of the countries in Latin America where e-commerce expanded the most, second only to Brazil, and where a digital economy is emerging as a result of a complex set of forces. Key environmental factors that exert an important influence on e-commerce diffusion include the performance and the sectoral and business structure of the economy, the size of the population, and the distribution of national income. It is hypothesized that two critical factors that determine the pace, quality and orientation of e-commerce are:

1. the work of private organizations devoted to promoting e-commerce practices, and
2. the political will the Mexican government demonstrated in recent years to improve the country's telecommunications infrastructure.

These two factors reinforce one another in the sense that promoting organizations operate by means of specialized working groups whose membership includes representatives from both the private sector and the federal government. Jointly, these organizations created a favorable environment and the required physical conditions for the development of both business-to-business and business-to-consumer e-commerce transactions.

Keywords: globalization, e-commerce diffusion, environmental factors, policy determinants, inhibitors, enablers, B2B, B2C, Mexico

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I. INTRODUCTION

The spread of Internet connections and networks around the world is opening the circuits of the World Wide Web (WWW) to conduct business, buy or sell products, procure inputs, or simply to learn about the existence of suppliers or competitors. The pace at which such electronic transactions penetrate domestic and local markets varies according to the particular conditions prevailing in each national setting. These conditions include many factors and characteristics that determine a country's predisposition to the growth of both digital networks and the volume of business conducted via the Web.

This article examines Mexico as one of the countries in Latin America where e-commerce operations expanded the most, second only to Brazil, and where a digital economy is emerging as a result of a complex set of factors. Factors are identified that can be considered critical, and then the likely implications for the growth of e-commerce in the near future are discussed.

Key environmental factors that exert an important influence include the performance of the economy, the sectoral and business structure of the economy, the size of the population, and the distribution of national income. It is hypothesized in this paper that two critical factors that determine the pace, quality and orientation of e-commerce are:

- the work of private organizations devoted to promoting e-commerce practices, and
- the political will the Mexican government demonstrated in recent years to improve the country's telecommunications infrastructure.

The first includes the systematic work and effective actions of specialized working groups in discussing vital issues so that firms and other organizations can embrace e-commerce as a new way of doing business. These issues and actions include:

- the passing of legislation to regulate and provide security to electronic transactions,
- the design of guidelines, and
- the spread of knowledge on the benefits and opportunities offered by e-commerce.

The will of the Mexican government is demonstrated in programs, projects, and initiatives, epitomized by the megaproject to build the "e-Mexico National System". Also of particular importance are programs aimed at providing technical and financial support to businesses, especially small- and medium-sized, for the adoption of information technologies (IT) to conduct business-to-government dealings, such as the fulfillment of fiscal obligations or the supply of goods and services. Since both these programs and the telecommunications networks under construction also benefit private individuals, consumer-to-government transactions are also being facilitated.

The two sets of factors reinforce one another. Promoting organizations' members include representatives from the federal government, often at the ministerial level. Jointly, these factors create a favorable environment and the required physical conditions for the development of both business-to-business and business-to-consumer e-commerce transactions.

This article is organized in two major sections.

1. Environmental factors of a demographic, economic and social nature are discussed in Section II.
2. Public and private policies and initiatives are examined in Section III.

The paper concludes with general remarks on the results of the different analyses presented, and a discussion of the prospects of these developments in the near future.

II. NATIONAL ENVIRONMENT

POPULATION AND DEMOGRAPHIC PROFILE

Mexico's population increased from 81.3 million in 1990 to 97.4 million in 2000, becoming the 11th most populated country in the world [INEGI, 2000b; 2001a]. These figures implied an annual average growth rate of 1.85% over the 1990s, which is slightly more than half that prevailing in the 1960s—3.4%—when the population used to double every 20 years; now it will require 46 years to do so [Ordorica Mellado, 2002]. Gender structure, in turn, shows a typical 48.8% female and 51.2 male population [INEGI, 2001a].

The National Population Council (CONAPO) estimates that by the end of 2002, the Mexican population will reach 103 million, on the basis of a mortality rate of 4.19 deaths and a birth rate of 20.5 children per 1000 inhabitants. On average, Mexican women give birth to 2.27 children in their lifetime. As a result of substantial improvement in health standards over the last three decades, child mortality dropped to 23.2 and life expectancy is now 73.7 years for women and 78 for men [Lloyd, 2002].

With a surface area of 1,947,156 square kilometers, Mexico is a rather large country, at least by European and Central American standards. According to the 2000 census, Mexico's overall population density tops 50 inhabitants per square kilometer. This figure, though, is as high as 5,563 in the Federal District, seat of Mexico City and the nation's capital, which concentrates as much as 18.5% of the total population [INEGI, 2001a].

As described in Table 1, 61 percent of the population lives in cities and towns of 15,000 or more inhabitants, which are classified as "urban" by the National Population Council (CONAPO)¹. This proportion is predicted to increase to 64.3% in 2010, while that of rural settlements is expected to shrink to 21.7% in the same year, while the population of semiurban localities remain unchanged [CONAPO, 2002b]. Since nearly half of the population lives in cities of 100,000 or more inhabitants, it can be said that Mexico is a predominantly urban population.

Table 1. Population Distribution by Settlement Size, 2000

Size Category	No. of localities	% of population
Total	199,369	100.0
Rural		
1–2,499	196,328	25.4
Semiurban		
2,500–14,999	2,528	13.7
Urban		
15,000–99,999	399	13.6
100,000–499,999	84	21.0
500,000 or more	30	26.4

Source: INEGI [2000c].

At the top of Mexico's skewed urban system is a group of nine cities with a population of over one million each, which jointly accounts for 19.3% of the country's total population (Table 2). It is in these large urban centers where most of e-commerce activity—both business-to-consumers (B2C) and business-to-business (B2B)—takes place in Mexico: transactions, promotion events, advertising campaigns, and business solutions consulting. Mexico City and seven neighboring metropolitan areas: Puebla, Toluca, Cuernavaca, Cuautla, Tlaxcala, Querétaro and Pachuca,

¹ CONAPO classifies as "rural" settlements of less than 2,500 inhabitants; as "mixed localities" those between 2,500 and 14,999; and as "urban" those with 15,000 or more inhabitants (CONAPO, 2002a)

make up a huge megalopolis up a huge megalopolis of over 20 million people making it the country's largest urban agglomeration.

Table 2. Cities over a Million

City	Population
Federal District	8,605,239
Guadalajara	1,646,183
Ecatepec	1,621,827
Puebla	1,271,673
Nezahualcóyotl	1,225,083
Ciudad Juárez	1,187,275
Tijuana	1,148,681
Monterrey	1,110,909
León	1,020,818
Total	18,837,688

The population is increasingly mobile and rural-urban migration is still a major propeller of urban growth. Thus, it can be expected that the urban character of the population will be reinforced, as over 80% of Mexico's demographic growth is predicted to take place in urban areas in the next 25 years [Poder Ejecutivo Federal, 2001]. Therefore, a substantial growth can be expected to take place in the proportion of people with access to the educational opportunities, cultural amenities, and telecommunications infrastructure that only urban areas can provide. As more Mexicans become "urban", the proportion of those likely to use a computer and the Internet to conduct business or buy on-line can be expected to increase concomitantly.

AGE STRUCTURE

In spite of the observed decline in growth rates, Mexico's population is still predominantly young. Over one-third is under 15 years of age, while more than a half is between 15 and 64 years (Table 3). Most of those in the group of 15-64 years correspond to what is regarded as the economically active population, which amounted to 58.09 million in 2000. Of these, 39 million were employed [INEGI, 2001a].

It is expected that some 1.2 million jobs will be demanded annually between 2000 and 2005, One million one hundred thousand between 2005 and 2010, and nearly one million between 2010 and 2015 [Poder Ejecutivo Federal, 2001].

Table 3. Population By Age Groups, 2000

Age group(in years)	Population	%
0-14	32,586,973	33.4
15-64	58,092,327	59.6
65 and over	4,750,311	4.9
Not specified	2,053,801	2.1
Total	97,483,412	100.0

Source: [INEGI, 2001a].

Although only 4.9% of the population is 65 years or older, this group is growing at an unusually high annual rate of 3.7%, unique in Mexico's demographic history. This growth rate could top 4.5% between 2020 and 2030, which would imply that this age group could double in only 15 years [Poder Ejecutivo Federal, 2001].

Comparatively, Mexico's figures that do not differ substantially from other relevant countries in North and South America as to the proportion of population living in urban areas, though major differences exist in regard to absolute size and age structure (Table 4).

Table 4. Demographic Structure of Selected Countries in the Americas

Country/Region	Population 2000 ^a	Urban population (%)2000 ^b	Population over 65 (%) 1999 ^c	Population under age 15 (%) 1999 ^c
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
Mexico	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

^aSource: International Telecommunication Union, *Yearbook of Statistics 1991-2000*. Geneva: International Telecommunication Union, 2001. Geneva: International Telecommunication Union, January 2002. The data for population are mid-year estimates.

^bSource: World Bank Group, WDI Data Query located at <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, *World Development Indicators CD-Rom 2001*.

^d Latin America here and in ensuing tables consists of the following countries: Argentina, Brazil, Chile, Mexico and Venezuela.

^e OECD here and in ensuing tables denotes the OECD member countries, excluding Luxembourg, Slovakia and Iceland.

Language

The population of Mexicans aged five years or older was 89.4 million in 2000. Of those, 83.3 million spoke Spanish and 6.1 million spoke an indigenous dialect. Of the latter, 4.9 million spoke both Spanish and a dialect, and 1.2 million only spoke their native language [Inegi, 2001b]. Therefore, the existence of a large native population does not represent a barrier to the diffusion of it and e-commerce in Mexico, provided they can have access to a computer and to the internet.

III. IMPLICATIONS FOR E-COMMERCE

The above trends suggest that Mexico will continue to consolidate its urban character and its economic activities. As growth in rural areas slows down, mixed localities—those between 2,400 and 14,999—will remain unchanged. This rapid urbanization appears as one of the factors driving the growth of e-commerce in Mexico. More people and businesses can potentially use a computer and can access the Internet to engage in transactions on-line.

It is in urban areas, and especially in the country's largest cities—Mexico City, Guadalajara, Monterrey, and Puebla—where most of the new telecommunications infrastructure and possibilities for local businesses to get into on-line commercial transactions, are now and will be, located. These prospects will be strengthened with projects aimed at connecting all of the country's major cities and smaller towns in selected rural areas, which are under implementation by the present federal administration.

A drag on the process, however, may be the population of 65 years and more, which is growing at an unprecedented rate of 3.7% per annum, and already accounts for 5% of the total. This age group may double in 15 years should the growth rate reach 4.5% between 2020 and 2030, as

expected by the Mexican government. The problem is that the aging of the population is a typical trend as societies become more urbanized.

Again, language is not a barrier in Mexico to the development of e-commerce and the use of IT in general. Over 98% of the population speak the country's official language, Spanish. A large and growing proportion also have a varying command of English, which is taught as a second language in elementary, secondary and preparatory schools, as well as in most college-level education programs. In addition, numerous English institutes and schools operate in every major city.

ECONOMY

Macroeconomic Policy and Strategy

Over the last 30 years, Mexico went through a series of stages of economic strategy. It shifted its focus from import substitution between the 1930s and 1970s, through trade liberalization in the 1980s and 1990s, to export promotion in the last few years.

In the face of the 2001 recession, the strategy began to shift toward the domestic market, particularly to small, medium and micro enterprises (SMMEs), which make up most of the country's business establishments. This shift is evidenced by the high priority placed on SMMEs by the federal government, mainly through Nacional Financiera (Nafin)—Mexico's top development bank and the Ministry of Economics, one of whose under-ministries is entirely devoted to this echelon of Mexican businesses through several support and incentive programs.

Although export promotion will continue to be pursued, the domestic economy is becoming a parallel target. This shift is a result of a growing demand by some influential figures in the private sector, including Carlos Slim, Mexico's richest businessman, and, more recently, the Transformation Industry National Chamber Confederation (CONCAMIN). However, the domestic market is small and insufficient for both an efficient distribution of goods and services and the development of industrial supply chains, especially in rural areas and depressed regions.

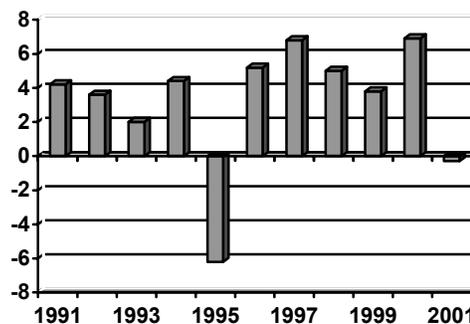
A low inflation rate, tight monetary policy, and a growing inflow of foreign direct investment are among the first priorities of the economic policy followed by the last four federal administrations, including the present one. Inflation dropped consistently from 18.6% in 1998 to 4.4% in 2001. Foreign direct investment increased consistently, too, from \$10.7 to \$14.0 billion in the same period [Banco de México, 1999; 2000].

Prospects for 2002 are modest, but more positive than in 2001. The economy is expected to resume growth at a rate of 1.5%, inflation will remain virtually unchanged at 4.5%, the fiscal deficit will stay quite low at 0.65% of GDP, and the trade balance will amount to 1.8% of GDP [Ortiz, 2002]. The peso was strong at around nine pesos per U.S. dollar for the last few years. This stable environment led companies to invest in imported technology to modernize their equipment and management systems [Jiménez, 2002].

Economic Growth

After an outstanding performance for over three decades, known as the "Mexican Miracle", in which an unusually high average growth rate of 6% was achieved, the Mexican economy began to slow down in the late 1970s and slipped into a series of recessive episodes in the 1980s and 1990s. From 1981 to 2001, the rate went down to a meager 0.5% per annum [Esquivel, 2002]. The average improved in the last six years, but growth performance continued to be erratic; for example, a drastic slump in 1995 was the result of the peso devaluation of December 1994, and a second fall in 2001 (Figure 1).

The fall in 2001 was due to a 3.5% drop in the industrial sector. Agriculture, in turn, grew by 2.5% and services by 1.1% [Banco de México, 2002].



Source: Prepared by the author with data from SHCP [2002b], p.

Figure 1. Gross Domestic Product Growth Rates, 1991-2001 (Percentages)

To give an idea of the magnitude of Mexico's GDP in absolute terms, Table 5 presents GDP figures in U.S. Dollars for the period 1994-2000. Each year is calculated using the respective GDP value in current prices and the corresponding average exchange rate for that year.

Table 5. Gross Domestic Product In Mexico, 1994-2000 (US\$)

Year	Value
1994	420,773
1995	286,184
1996	332,337
1997	400,870
1998	421,026
1999	479,446
2000	574,514

Source: Banco de México [2001], Table A6, p 121.

From an international perspective, Mexico presents a mixed picture. Its inflation rate was the second highest among the selected countries in the Americas and vis-à-vis the OECD. In GDP growth, Mexico outperformed all the other Latin American countries in the group during the period, and exceeded the average rate for both Latin America and the OECD (Table 6).

Table 6. Key Macroeconomic Variables in Selected Countries in the Americas,

Country/Region	Unemployment rate 2000 ^a	Inflation (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
Mexico	1.60	10.73	3.57
United States	4.00	2.05	4.01
Venezuela	14.00	26.84	1.19
Latin America	9.20	9.98	2.95
OECD	6.56	4.79	3.43

^aSource: International Labour Organization, LABORSTA (<http://www.laborsta.ilo.org>), Table 3A.

^bSource: World Bank Group, WDI Data Query located at <http://www.devdata.worldbank.org/data-query/>.

Sectoral Distribution

From a sectoral perspective, the Mexican economy presents a mixed picture. Services are the predominant sector, with over two-thirds of GDP corresponding to tertiary activities. Contrary to what could be expected in a developing country, less than 5% corresponds to agriculture and other primary activities. Industry accounts for a little over a quarter of GDP (Table 7).

Table 7. Sectoral Distribution of
Gross Domestic Product, 2000
(Billion US\$)

Sector	Value	%
Agriculture	24.7	4.3
Industry	160.8	28.0
Services	388.9	67.7
Total	574.4	100.0

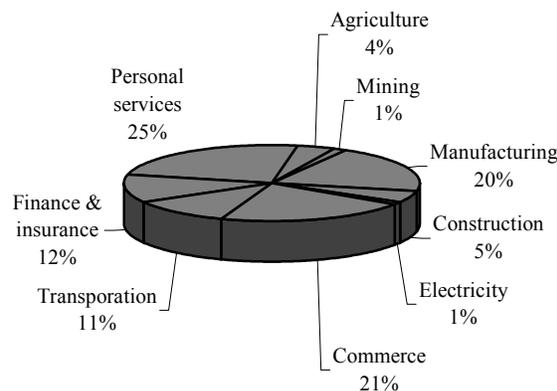
Source: INEGI (2001b).

Manufacturing ranks high accounting for one-fifth of GDP. The other two main areas are commercial activities and services, the latter including both communal and social services. Finance and insurance, and transportation, follow closely (Figure 2). The point is that the Mexican economy is overwhelmingly a service economy.

Trade Performance and Policy

The strong will of the Mexican government to open up the economy to the flows of international markets was implemented in the 1990s with the abolition of most barriers to trade and investment, subscription to nearly a dozen free trade agreements, and privatization of most of the nationalized segments of the economy.

In what constituted the most important trade liberalization initiatives, Mexico joined the General Agreement of Trade and Tariffs (GATT) in 1986, signed the North American Free Trade Agreement (NAFTA) in 1993, and joined another with the European Union in 1999. In addition, eight more arrangements were signed in the last decade. These agreements opened new markets for Mexican exporters in over 30 countries in three continents and turned Mexico into one of the most open economies in the world.



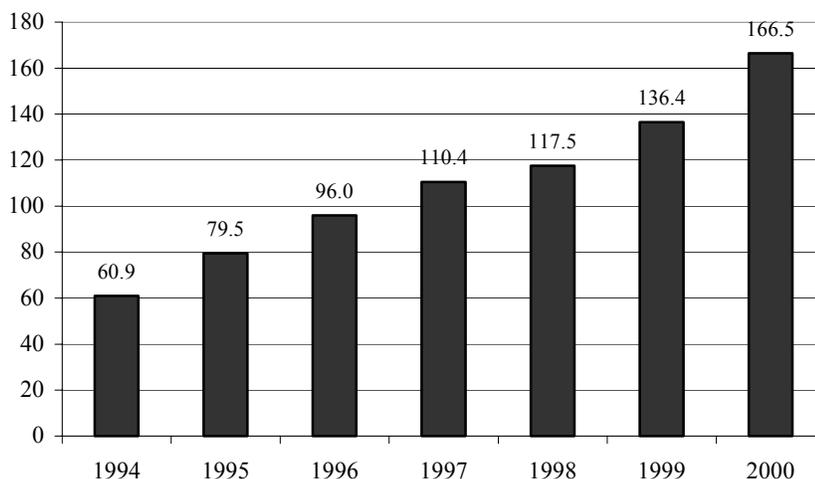
Source: INEGI [2002a].

Figure 2. Gross Domestic Product by Economic Division

An extensive program of privatization and economic deregulation was also implemented in the late 1980s and early 1990s. Most public enterprises were privatized and foreign investment rules were relaxed. The economy was left wide open to foreign capital, except for a few strategic areas

(mainly oil) explicitly reserved to the state [Palacios, 1992]. This new regime was consolidated during the remaining part of the 1990s by the Salinas and Zedillo administrations, which adopted a hands-off policy to liberalize trade in most major industries, particularly computers and information technologies [Dedrick, Kraemer, and Palacios, 2001].

The above, coupled with the dynamic performance of the Mexican economy and a favorable international environment, led to an outstanding performance of exports in the second half of the past decade. Total exports more than doubled from US\$61 to US\$166 billion, as a result of an annual average growth rate of 18.2% (Figure 3).



Source: SEC [2001], p. 15

Figure 3. Total Exports, 1994-2000

As a result, Mexico became the United States' second trading partner, the top exporter in Latin America, and the 13th largest exporter worldwide [OECD, 2000]².

Foreign trade constitutes a key activity in Mexico's economy. Exports amount to a substantial share of gross domestic product nearing 30%. This percentage remained virtually stable since the mid-1990s, except for the slump of 1994 (Table 8).

Table 8. Share of Foreign Trade in Gross Domestic Product, 1993-2000 (Percentages)

Year	Imports	Exports	Total
1993	19.2	15.2	34.4
1994	21.6	16.8	38.4
1995	27.7	30.4	58.1
1996	30.0	32.1	62.1
1997	30.4	30.3	60.7
1998	32.8	30.7	63.5
1999	32.4	30.8	63.2
2000	33.2	31.4	64.6

Source: INEGI [2002b]: *Oferta y Demanda Total* tables.

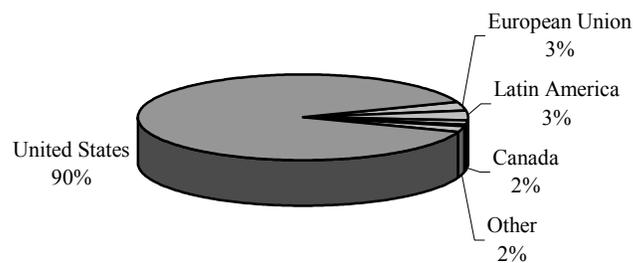
Also as a result of economic liberalization, Mexican businesses improved productivity, probed into new markets, attracted foreign capital, and learned about new technologies and new management methods.

² If the European Union is taken as a single exporter, Mexico occupies eighth place.

One feature that continues to plague Mexico's foreign sector is the overwhelming predominance of the United States as the destination market for its exports. As much as nine out of 10 dollars worth of exported goods and services go to its northern neighbor³ (Figure 4). A skewed structure was reinforced since the signing of NAFTA, with Canada failing to increase its position as a prime market for Mexican exports. As a result, the vulnerability of the Mexican economy vis-à-vis international competition, is extremely high, and tended to increase even more in the last decade.

Another point is that exports are heavily concentrated in a few sectors, mainly in manufacturing. Within the latter, the category of machinery, equipment and metallic products accounts for as much as two-thirds of total exports, of which the automobile industry comprises 28% and electric-electronic industries 20%. Distinct from previous decades, crude oil and natural gas only account for 8% and agriculture—which includes cattle, forestry and fishing—for just 3% of total exports [INEGI, 2002b].

In spite of both the good export performance observed in the last few years and the protracted strength of its currency, Mexico's trade balance became negative in 1998 and remained so through 2000. Likewise, current account and service balances are negative since the mid-1990s (Table 9).



Source: INEGI [2002B].

Figure 4. Top Export Markets, 2001

Table 9. Foreign Trade Accounts and Balances as a Percentage of GDP, 1997-2000

Balance	1997	1998	1999	2000
Current Account Balance	-1.9	-3.7	-3.0	-3.1
Trade Balance	0.2	-1.9	-1.2	-1.4
Foreign Debt	38.1	38.5	32.1	27.6
Capital Account Balance	3.9	4.1	3.0	3.1
International Reserves ¹	28.0	30.1	30.7	33.6

Source: Banco de México [2001], Table A1, p. 115.

¹ In billion US\$

³ Even within the United States, Mexican exports are concentrated in only four states: Texas, California, Florida and Illinois (INEGI, 2002b).

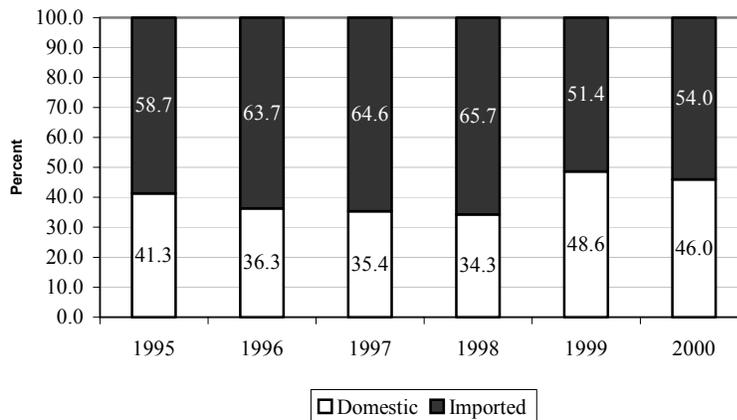
By sector, the composition of exports shows that non-oil goods account for over 90% of the total over the last three years. On the other hand, the lion share of imports in the same period was in intermediate goods (Table 10).

Table 10. Mexico: Trade Balance, 1999-2001 (Free on Board)(Million US\$)

Item	1999	2000	2001
Total Exports	136,391.1	166,454.8	158,546.8
Oil Exports	9,928.2	16,382.8	12,802.2
Non-Oil Exports	126,462.9	150,072.1	145,744.6
Agricultural Goods	3,925.9	4,217.2	4,014.7
Mining goods	452.5	520.7	388.5
Manufactured goods	122,084.5	145,334.2	141,341.5
In-bond industries	63,853.6	79,467.4	76,842.0
Other	58,231.0	65,866.8	64,499.5
Total imports	141,974.8	174,457.8	168,276.1
Consumer goods	12,175.0	16,690.6	19,766.6
Intermediate goods	109,269.6	133,637.3	126,013.7
In-bond industries	50,409.3	61,708.8	57,598.5
Other	58,860.3	71,928.5	68,415.2
Capital goods	20,530.1	24,129.9	22,495.7
Trade balance	-5,583.7	-8,003.0	-9,729.2

Source: SHCP [2002a].

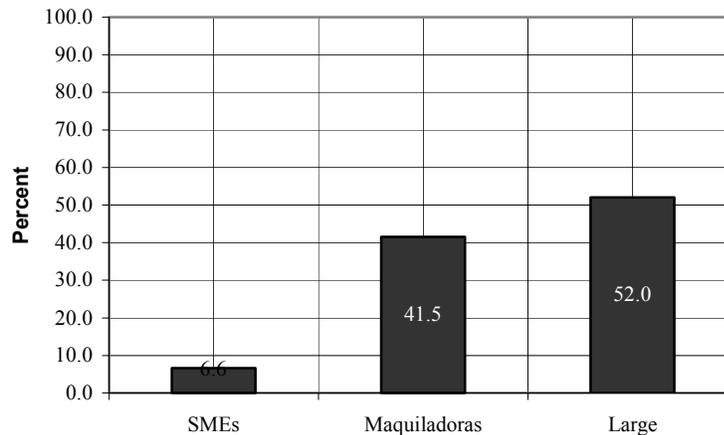
Over the years, exporting companies operating in Mexico developed significant links with the domestic market, as indicated by the sizeable domestic content of major export goods (Figure 5).



Source: SEC [2002], p. 18.

Figure 5. Domestic Content of Manufacturing Exports

Small, medium and micro enterprises (SMMEs) account for only a small proportion of total exports. This figure was as low as 6.6% in 1999, while large exporting companies accounted for 52% and in-bond assembly plants, known as *maquiladoras* accounted for 41.5% (Figure 6).



Source: Secretaría de Economía [2002], *Programa de Desarrollo Empresarial 2001-2006*, p. 17.

Note: SMMEs stands for Small, Medium and Micro Enterprises.

Figure 6. Share in Total Exports by Company Size, 1999

Large companies operate in diverse business areas, including automobiles, oil and gas, communications, cement, glass, air transportation, and food. Table 11 presents the first 30 of the 500 largest firms operating in Mexico in 2000, and their respective business activity. Most of them export a large part of their products, especially in automobiles, cement, oil and gas, beverages, and glass.

The Mexican government is pursuing a mixed strategy of export promotion and diversification of export markets and products through Nafin and the Ministry of Economics with a special emphasis on SMMEs [SEC, 2002a].

As a result of economic liberalization, the proportion of domestic inputs decreased, as imported goods tended to offer better quality and lower prices. This trend was reinforced by the overvaluation of the Mexican peso up to 1994. Imports reached high proportions, particularly in some industries like computers, electric parts, and engines. Conversely, domestic inputs account for proportions as low as 3%, as in the case of computers (Figure 7).

Potential of the Mexican Economy for E-commerce

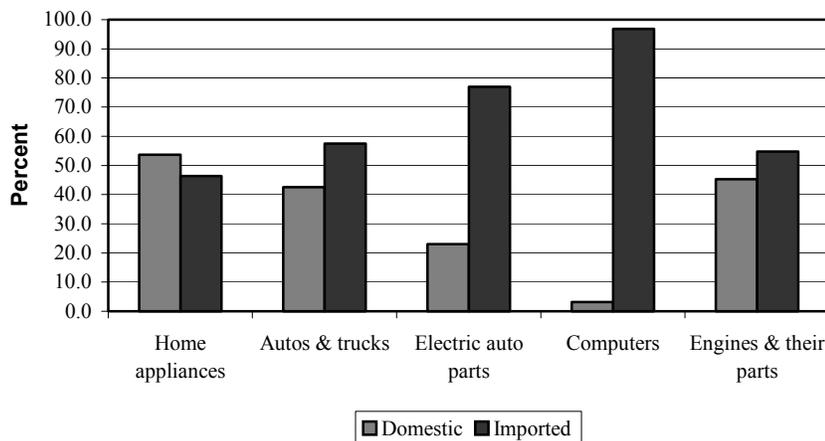
With a per capita GDP of US\$5,807, Mexico is among the 10 largest economies in the world, and offers large opportunities for the development of e-commerce. Considering that 59% of the Mexican population is between 15 and 65 years of age, this segment might, in principle, be regarded as the universe of people that are or can potentially become users of e-commerce services, or engage in e-commerce related activities.

As a result of economic liberalization, the proportion of domestic inputs decreased, as imported goods tended to offer better quality and lower prices. This trend wasAccording to the 2000 Population Census, the employed population was 33.7 million, or nearly 35% of the total. Of these people, 14.7 million reported incomes equivalent to two minimum wages or more [INEGI, 2001a]. This segment of the population is most likely to have access to a computer and the Internet, and to engage in electronic commercial transactions.

Table 11. The Largest 30 Companies in Mexico, 2000

Rank	Name	Business
1	Petróleos Mexicanos	Oil and Gas
2	Carso Global Telecom	Communications
3	Teléfonos de México	Communications
4	Daimler-Chrysler de México Holding	Automobiles
5	General Motors de México	Automobiles
6	Volkswagen de México	Automobiles
7	Wal-Mart de México	Self-service Commerce
8	Cementos Mexicanos	Cement
9	Ford Motor Company	Automobiles
10	Grupo Carso	Various
11	Alfa	Various
12	Fomento Económico Mexicano	Beverages
13	Grupo Bimbo	Food
14	Controladora Comercial Mexicana	Self-service Commerce
15	Cintra	Air Transport
16	Vitro	Glass and derivatives
17	Savia	Agriculture
18	Grupo Modelo	Food
19	GE de México	Home Appliances and Various
20	DESC	Various
21	Gigante	Self-service Commerce
22	Organización Soriana	Self-service Commerce
23	Grupo Televisa	Entertainment and Sports
24	Grupo México	Various
25	Grupo Imsa	Various
26	Nestlé México	Food
27	Femsa Cerveza	Beverages
28	Hewlett-Packard de México	Computer Hardware
29	Gruma	Food
30	Empresas Ica	Construction

Source: Grupo Expansión [2000].



Source: SEC [2002b]: 19.

Figure 7. Domestic Input Content in Production of Selected Industries, 2002

However, the country's income distribution is highly skewed, resulting in correspondingly low purchasing capacity. Over two-thirds of the Mexican population is unable to afford regular access to an Internet-enabled computer. In the end, the outcome will depend on the extent to which income distribution can be improved so that the potential for e-commerce can be actually tapped.

WEALTH

The actual volume of a country's aggregate product is assessed only when weighted by the relative size of the population that generates it. Table 12 shows the figures for a number of relevant countries in the Americas for 2000, with the OECD as a reference. Mexico does well compared to other Latin American countries, except for Argentina, whose GDP per capita was about 70% higher than Mexico's until its recent economic crash.

Table 12. Gross Domestic Product In Selected Countries In The Americas, 2000

Country/Region	GDP in billions US\$ 2000 ^a	GDP per capita 2000 ^a
Argentina	\$285.04	\$7,697.26
Brazil	\$595.46	\$3,500.33
Canada	\$708.73	\$23,048.11
Chile	\$70.54	\$4,637.67
Mexico	\$574.24	\$5,807.43
United States	\$9,962.65	\$36,210.70
Venezuela	\$120.48	\$4,984.85
Latin America	\$1,645.78	\$4,764.72
OECD	\$25,461.49	\$22,829.19

^aSource: International Telecommunication Union, Yearbook of Statistics 1991-2000. Geneva: International Telecommunication Union, 2001.

^bSource: United Nations Development Programme, Human Development Report 2000. New York & Oxford: Oxford University Press, pp. 169-172. Dates for the data vary by country from 1987 to 1998.

If we consider that total GDP amounted to US\$574 billion and the population reached 97.4 million in 2000, Mexico's per capita GDP grew to US\$5,807, nearly 17% higher than the figure for 1999—US\$4,966—and much higher than those of other countries like China (US\$853) and India (US\$450)⁴.

INCOME DISTRIBUTION

Beneath the overall average represented by per capita GDP figures, the distribution of income in Mexico presents quite a skewed structure that did not improve in the last two decades, in spite of the notable performance in exports and the absolute growth of the economy itself.

Dividing income earners in tenths, the proportion of income captured by the lower four brackets decreased from 29% in 1984 to 25% in 1998. Conversely, the share received by the highest tenth increased from 32% to 38% (Table 13).

After a sizeable improvement between 1977 and 1984, income inequality started to increase from 1984 and did not improve by 2000. A Gini coefficient of 53.4 was estimated for 1992, and the figure for 2000 was only 54.7, thus indicating that inequality remained practically unchanged over the 1990s [Székely, 2002].

⁴ These two figures were calculated by the author with data from The World Bank's Country at a Glance Tables (<http://www.worldbank.org>).

Table 13. Income Distribution by Income Brackets, Selected Years

Year	Income Brackets			Total
	I-VI	VII- IX	X	
1984	28.9	38.7	32.4	100.0
1989	26.0	36.0	37.9	100.0
1992	25.5	36.3	38.2	100.0
1994	25.4	36.2	38.4	100.0
1996	26.9	36.5	36.6	100.0
1998	25.5	36.4	38.1	100.0
Average	26.4	36.7	36.9	100.0

Source: INEGI, *Encuesta Ingreso Gasto de los Hogares*, various years.

Thirty-eight percent of households in Mexico are poor, as defined by the Economic Commission for Latin America (ECLA)⁵; the proportion becomes as high as 49% in rural areas. Nearly 20% lack piped water, 33% sewage system, and 6% electricity inside the house. In addition, poor people usually can't access credit and financial services [De la Torre, 2002]. Therefore, this substantial segment of the Mexican population is not likely to engage in e-commerce practices in the near future. It constitutes a major barrier, at least to the spread of the B2C economic activity.

On a comparative perspective, Mexico's income distribution did not look much worse at the end of the 1990s relative to other countries. The share captured by the richest 20% of the Mexican population in 1999 was smaller than Brazil, Chile, and the average for Latin America as a whole (Table 14). The opposite occurs in the case of the share received by the poorest 10%.

Table 14 Income Distribution in Selected Countries in the Americas, 1999 (in percent)

Country/Region	Share of income or consumption, richest 20%	Share of income or consumption, poorest 20%
	1987-1998 ^a	1987-1998 ^a
Argentina	N/A	N/A
Brazil	63.80	2.50
Canada	39.30	7.50
Chile	61.00	3.50
Mexico	58.20	3.60
United States	46.40	5.20
Venezuela	53.10	3.70
Latin America	59.03	3.33
OECD	40.19	7.71

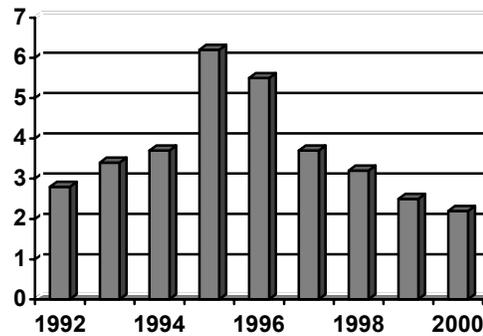
^aSource: United Nations Development Programme, *Human Development Report 2000*. New York & Oxford: Oxford University Press, pp. 169-172.

Dates for the data vary by country from 1987 to 1998.

Unemployment and the Informal Economy

After the slump of 1995, when GDP dropped sharply as a consequence of the drastic peso devaluation of December 1994, a period of prosperity ensued in the second half of the 1990s. As one reflection of this situation, the unemployment rate consistently declined in those years from over 6% in 1995 to 2.2% in 2000 (Figure 8).

⁵ According to ECLA, a person is poor if he/she has a monthly income of less than US\$120 in urban areas and less than US\$78 in rural areas.



Source: INEGI, *Encuesta Nacional de Empleo Urbano*, various years.

Figure 8. Open Unemployment Rates in Mexican Urban Areas, 1992-2000

The trend, however, topped off in 2001 due to the economic slump in the U.S. and its impacts on Mexico. Using data from INEGI and the Ministry of Labor, some analysts estimated that as many as 388,000 jobs were lost that year. About 600,000 people joined the ranks of the economically active population and the number of unemployed only increased by 290,000 workers⁶. The discrepancy is explained by the fact that many of the new unemployed transferred themselves to the informal side of the Mexican economy. In this way, the number of workers in informal activities increased by 500,000 in 2000, reaching 18.9 million; this latter figure accounted for as much as 46% of the total employed population. Thus, over two-fifths of the employed population engaged in the informal economy [Carrillo, 2002].

Another analyst [Quintana, 2002] estimates that the number of informal workers in 2001 was only 15.2 million, of whom seven million were in agriculture and 8.2 million in urban activities. He explains that while 740,000 jobs were lost between November 2000 and January 2002, and 640,000 people joined the economically active population, official statistics only recognized some 1.3 million unemployed. The trick again is performed by the informal economy as a "miraculous" mechanism that has prevented unemployment from exploding [Quintana, 2002].

Whatever estimate is considered, the unavoidable point is that official economic statistics account for only one part of the picture. Another quite significant economy exists below those official figures in the underground circuits of the Mexican economy. It is estimated to contribute 12.7% of GDP [Rincón and Cabadas, 2002] and absorb 48% or 39% of the economically active population, depending on which of the above estimates is used.

On a comparative perspective, Mexico's unemployment rate for 2000, as calculated by the International Labour Organization, was the lowest of the major countries in the Americas, including the averages for Latin America and the OECD as wholes (Table 15)

⁶ The estimates were made recently by the Analysis Department of *Mural*, a major newspaper that circulates in the Jalisco and neighboring states of West Central Mexico. It is part of one of the largest news organizations in this country, which includes other newspapers like *Reforma* in Mexico City [Carrillo, 2002].

Table 15. Unemployment Rates in Selected Countries in the Americas, 1999 (Percentages)

Country/Region	Unemployment Rate 1999 ^a
Argentina	15.0
Brazil	7.1
Canada	6.8
Chile	8.3
Mexico	1.6
United States	4.0
Venezuela	14.0
Latin America ^b	9.2
OECD ^c	6.6

^aSource: International Labour Organization, LABORSTA (<http://www.laborsta.ilo.org>), Table 3A.

^bArgentina, Brazil, Chile, Mexico and Venezuela.

^cOECD member countries, excluding Luxembourg, Slovakia and Iceland.

Implications for E-Commerce

With a per capita GDP nearing US\$6,000 in 2000, up from US\$5000 in 1999, Mexico became a major economy capable of substantially increasing the average product each of its inhabitants is able to generate in one year. Therefore, the Mexican economy has enough potential for the emergence and development of new activities such as e-commerce, both B2C and B2B.

Official employment statistics only present a partial picture. In addition to those employed in the formal economy, a whole army of economically active people dwell in the underground world of informal activities in both rural and urban areas. This "surplus" working population constitutes an additional slice of potential consumers and traders of goods and services over the Internet.

Being "informal" does not necessarily imply that business establishments cannot access a computer and the Internet. There is no impediment for informal businesses to deal with "formal" companies and, vice versa. Formal companies can deal with "informal" customers via the Web when acting as sellers. It is more complicated when formal companies play the role of buyers, given that they require official invoices from their suppliers, which informal suppliers generally do not produce.

Although no statistics are available, it can be inferred that many companies in the formal economy procure inputs from informal suppliers and, vice versa, that many underground businesses sell to formal companies. Therefore, the estimates for the growth potential of e-commerce in Mexico underestimate the actual size of the domestic market that can be tapped for extending commercial transactions over the World Wide Web.

Such encouraging prospects are hindered, though, by the highly skewed income distribution prevailing in Mexico where 40% of households are poor, while the highest tenth of income earners increased their share from 32% to 38% between 1984 and 1998.

Industry Structure

Given the diverse criteria and purposes for the classification of business establishments up to the late 1990s, the Mexican government, in 1999, issued a decree that established categories to be used officially in the formulation of promotion policies and the treatment of fiscal matters. Table 16 shows the four categories that were instituted to accommodate the innumerable sizes of business enterprises, where size is measured in number of employees.

Table 16. Classification of Business Establishments by Number of Employees

Category	Sector		
	Industry	Commerce	Services
Micro	0-30	0-5	0-20
Small	31-100	6-20	21-50
Medium	101-500	21-100	51-100
Large	>500	>100	>100

Source: *Diario Oficial de la Federación*, March 30, 1999.

This classification was used in the 1999 economic censuses, which once again showed the pyramidal, highly skewed structure of Mexican businesses. As much as 96% corresponded to micro establishments with less than 30 employees (Table 17). Although small businesses are predominant in most economies, including in some highly industrialized ones like Germany, Italy, and Taiwan, the proportion in Mexico is really overwhelming.

Table 17. Business Establishments by Size, 2000

Category	Establishments	
	Number	%
Micro	2,722,365	95.7
Small	88,112	3.1
Medium	25,320	0.9
Large	8,474	0.3
Total	2,844,308	100.0

Source: INEGI [2000a].

What makes such a heavy presence of small businesses problematic is that size in Mexico, as in developing countries in general, tends to bear an inverse relationship with the degree of inefficiency, and lack of resources for firms to invest in technology and to improve productivity. Nonetheless, others argue that SMMEs are not simply a burden for an economy. For example, Cristina Hernández, an analyst close to AMECE, pointed out that

“when people speak about small and medium enterprises, there is a certain ‘protection’ tone, but to me a country with many SMMEs is one with an independent and creative population” [Hernández, 2002].

She added that the OECD reported 99% of companies in its member countries are small and medium enterprises and that SMMEs not only generate much of the jobs, but also are indicative of the effort and entrepreneurship of individuals. Hence the fact that major government agencies and the e-Mexico System, as well as makers, developers, and marketers of both IT equipment and software, are all focusing on SMMEs as the target of their projects and programs. [*El Financiero*, January 24, 2002; www.amece.com.mx/emexico]. In effect, micro, small and medium enterprises generate 68% of total employment in the industrial sector (Table 18).

Table 18. Employment in Industrial Sector by Economic Division and Firm Size
(Percentages)

Economic division	Firm size				Division share
	Micro	Small	Medium	Large	
Metallic products, machinery & equip.	14.8	7.8	23.1	54.3	30.21
Textiles, apparel & leather	21.0	15.4	35.6	28.0	20.52
Food, beverages and tobacco	42.2	9.7	22.9	25.5	18.16
Chemicals, plastic & rubber	27.5	16.2	25.9	20.4	11.01
Paper, printing & editing	34.6	17.1	35.2	13.1	5.11
Wooden Manufactures	55.6	16.3	22.2	6.0	4.91
Non-metallic minerals	45.6	12.3	20.5	21.6	4.61
Basic metallic industries	38.8	16.0	28.7	16.5	3.94
Other industries	29.7	13.0	32.7	24.7	1.52
Total employment	28.1	12.1	27.9	32.0	100.00

Source: INEGI [2000a].

Accordingly, industrial production is, highly concentrated. Three divisions account for nearly three-fourths of the total value of industrial output: metallic products, machinery and equipment; food, beverages and tobacco; and chemicals, plastic and rubber. The first accounts by itself for nearly one-third of the total, and is the one with the significantly highest participation of large companies: 54.3% (Table 19).

Table 19. Mexico: Value of Production in the Industrial Sector
(Percentages)

Economic division	Firm size				Division share
	Micro	Small	Medium	Large	
Metalic products, machinery & equipment	8.8	7.4	21.7	62.2	31.60
Food, beverages and tobacco	12.1	7.1	33.7	47.1	20.69
Chemicals, plastic & rubber	17.5	12.7	38.1	31.7	19.19
Textiles, apparel & leather	17.5	13.5	35.2	33.8	8.42
Basic metal industries	13.9	6.7	30.8	48.6	6.37
Non-metal minerals	12.2	10.0	48.2	29.6	6.03
Paper, printing & editing	17.7	11.6	50.4	20.3	5.18
Wooden Manufactures	38.2	19.6	32.9	9.3	1.75
Other industries	14.7	11.3	36.9	37.1	0.77
Total	13.4	9.5	32.4	44.7	100.00

Source: INEGI [2000a].

Business establishments are also heavily concentrated in a geographic sense. Only five states, namely the Federal District, Mexico State, Jalisco, Veracruz and Puebla, account for more than 40% of the national total [INEGI, 2000a]. It is in these states, therefore, that the bulk of Internet connections and e-commerce activity will tend to be concentrated.

Multinational Corporations and Production Networks

Since the infrastructure required to access Internet markets is quite basic and thus fairly inexpensive, SMMEs represent a large potential for B2B e-commerce. Most of them can afford to buy a personal computer and connect it to the Internet, provided they are properly induced to. Internet connections are reinforced by large companies requiring their smaller suppliers to acquire the technological resources that enable them to go on-line. These resources help them become part of the broader supply chains [Grupo Expansión, 2001].

Internet connectivity occurs particularly in the electronics and computer, and the auto and auto parts industries, which in 2000 accounted for 20% and 28.4% of total exports, respectively (Vidal, 2000).⁷ Most of the companies that manufacture automobiles, trucks, electronics, and computers in Mexico are subsidiaries of multinational corporations. . The top firms are listed in Table 20.

Table 20. Largest Auto and Truck Makers in Mexico

Company	Nationality
Daimler-Chrysler de México, S. A. de C. V.	Germany/USA
Ford Motor Company, S. A. de C. V.	USA
General Motors de México, S. de R. L. de C. V.	USA
Nissan Mexicana, S. A. de C. V.	Japan
Volkswagen de México, S. A. de C. V.	Germany
Honda de México, S. A. de C. V.	Japan
BMW de México, S. A. de C. V.	Germany
Volvo Bus de México, S. A. de C. V.	Sweden
Daimler-Benz de México, S. A. de C. V.	Germany
Kenworth Mexicana, S. A. de C. V.	USA
Grupo Dina. S. A. de C. V.	Mexico

Source: SIEM [2002]. For BMW and Honda, Vidal [2000].

Another 61 companies are engaged in the manufacture and/or assembly of automobiles and trucks and a total of 1,218 firms make up the industry's entire supply chain (Table 21).

Table 21. Company Composition of the Auto and Truck Industry Supply Chain

Industrial activity	No. of companies
Manufacturers and assemblers of automobiles and trucks	69
Major Suppliers	1218
Manufacture and assembly of car bodies and trailers for automobiles and trucks	251
Manufacture of engines and their parts for automobiles and trucks	351
Manufacture of parts for transmission system of automobiles and trucks	42
Manufacture of parts for suspension system of automobiles and trucks	60
Manufacture of parts for brake system of automobiles and trucks	99
Manufacture of other parts and accessories for automobiles and trucks	<u>415</u>
Total	1287

Source: SIEM ([2002])

Many of the suppliers to the automakers are established domestic companies that prospered due to the location and established operations in Mexico of the subsidiaries of large corporations. An intricate web of customer-supplier networks formed in the more than half a century since these

⁷ For a detailed analysis of the local and transnational production networks that developed in Mexico's most important electronics and computer hub, see Palacios [2001a].

subsidiaries started operations in Mexico. As was shown in Figure 7, the inputs supplied by domestic companies in this industry account for over 40% of the total inputs.

Ford Motor Company is developing a global e-business supply chain known as Auto-Xchange using Oracle e-Business solutions. Auto-Xchange is a virtual channel for managing procurement and outsourcing with Ford's 30,000 plus suppliers worldwide [Oracle, 2001]. This development suggests that Ford's Mexican affiliates are pulling their domestic suppliers into the company's Mexican supply network. The same result can be the case for other automakers operating in Mexico.

The incorporation of domestic suppliers into the supply networks of foreign corporations in both the electronics and auto industries was driven by their subsidiaries requiring some type of ISO certification from suppliers, because their own ISO certification requires them to do.

SMMEs are facilitated by small companies in general tending to be more flexible and more likely to engage in e-commerce [Palacios, 2001a], but also to entirely transform their management structures and strategies to embark on e-business. Larger domestic companies tend to be less flexible, and therefore, less likely to do business on-line [FINSAT, 2000a].

Historically, large amounts of foreign capital were involved in the Mexican economy. By 1970, the subsidiaries of U.S.-based multinational corporations already controlled most, or at least quite significant segments, of key industries (automobile, 57%; oil and coke, 49%; mining and metallurgy, 53.6%; copper and aluminum, 72%; industrial chemicals, 50%; chemicals and pharmaceuticals, 86.4%; and computers and office equipment, 88%) [Cockcroft, 1983]. Since 1993, average foreign direct investment (FDI) amounted to 2.4% of GDP and 12.3% of gross capital formation. The figures fluctuated from a low of 1.8% and 8% in 1998 to a peak of 3.4% and 17% in 2001 (Table 22).

The weight of U.S. firms in the Mexican economy may be highlighted by considering that 67.5% of exports were made by subsidiaries of U.S.-based multinational corporations operating in Mexico in 2001 (according to the U.S. Department of Commerce). Companies with majority Mexican stock only account for 15%. Top car assemblers like General Motors, Ford, Daimler-Chrysler, and Volkswagen account for 18% of total exports. Other major exporters include IBM, Hewlett-Packard, and Kodak in the electronics industry, Bayer in chemicals and John Deere in agricultural equipment [Orozco, 2002].

Table 22. Foreign Direct Investment Flows as a Percentage of GDP and Gross Capital Formation, 1994-2001(percentages)

Year	Gross capital formation	GDP
1994	10.98	2.11
1995	17.85	2.91
1996	10.88	2.07
1997	12.99	2.66
1998	8.3	1.76
1999	10.6	2.25
2000	9.88	2.12
2001	17.3	3.4
Average	12.35	2.41

Source: Calculated by the author with data from INEGI [2002b].

Implications of Industry Structure for E-Commerce

The overwhelming presence of SMMEs is a doubled-edged sword for the development of e-commerce in Mexico. In the short run, it constitutes a major barrier, given that smallness implies lack of know-how, resources, and the required business culture to fully embrace IT and engage in Internet-based commercial transactions. An additional drag is the rather large investment and relatively long time (eight months to one year) required to install IT infrastructure and equipment and set up a Web site, let alone a whole portal.

On the other hand, the very existence of that mass of business units represents a large pool of opportunities for e-commerce to flourish, given the declining prices in computing equipment, and the growing availability of access to the Internet. This trend is reinforced by the tendency for large firms to pull small firms by into their supply networks and value chains. Moreover, the limitations of SMMEs to acquire IT and have access to the Internet are being overcome with the work of a growing number of ASPs offering low cost access to software and business solutions to SMMEs [Castelán, 2002].

Another driving factor is the large presence of subsidiaries and affiliates of multinational firms, which are the main practitioners of e-commerce and also the most active and effective technology transfer agents that are inculcating in Mexico. They facilitate the adoption of electronic data interchange (EDI), enterprise resource planning (ERP), customer relationship management (CRM), and Internet-based technologies and management systems.

HUMAN RESOURCES

Literacy

Literacy levels are on the rise in Mexico, particularly in the last 50 years. The overall illiteracy rate dropped from over 12% in 1990 down to less than one out of 10 Mexicans, reaching a literacy rate of 90.5% in 2000 (Table 23). Most significantly, the sharpest decline occurred among women, where the rate dropped nearly four percentage points.

Table 23. Education Levels, 1990 and 2000 (Percentages)

Category	1990 ^a	2000 ^b
Illiterate population 15 years and older	12.4	9.5
Illiterate male population 15 years and older	9.6	7.4
Illiterate female population 15 years and older	15.0	11.3
Population from 6 to 14 years old not attending school	14.2	8.2
Population 15 years and older with no instruction and/or with incomplete elementary instruction	37.0	28.2
Population 15 years and older with post-elementary education	43.4	51.8
Population 18 years and older with higher education	9.4	12.1
Average schooling of population 15 years and older (years)	6.6	7.6

Source: INEGI [2000b] for 1990; INEGI [2001a] for 2000.

^aAs of March 12.

^bAs of February 14.

Table 23 reflects a decline in the percentage of the population from 6 to 14 years of age not attending school, and those 15 years and older with no instruction and/or with incomplete elementary instruction. Conversely, the figures for the population with post-elementary or higher education improved in all counts (Table 23).

School Enrollment

Enrollment in education institutions, in general, reached high levels and shows a modest, though consistent growth in the last few years. Except for technical schools, the figures for all the other

levels have been on the rise. As shown by Table 24, 1.6 million were enrolled in professional education programs, while well over one-quarter million were attending technical schools in the 1999-2000 school term. It is intriguing, however, that enrollment in technical schools decreased in the last three terms.

Table 24. Enrollment by Education Level, 1997/1998 - 1999/2000^a

Education Level	School Term		
	1997-1998	1998-1999	1999-2000
Elementary	14,647,797	14,697,915	14,765,603
Secondary	4,929,301	5,070,552	5,208,903
Technical	390,828	392,812	374,845
Preparatory	2,323,069	2,412,722	2,518,001
Teachers	206,292	210,544	215,506
Professional	1,414,043	1,516,093	1,629,158
Postgraduate	107,149	111,247	118,099
Total	24,018,479	24,411,885	24,830,115

Source: SEP [2000a].

^a School term

Male students outnumbered women in professional and postgraduate education. In the case of technical schools, however, females accounted for 52% of the student population (Table 25).

Table 25. Schools, Instructors and Enrollment by Education Level and Gender, 1999/2000^a

	Student population			No. of instructors	No. of schools
	Total	Male	Female		
Technical	374,845	180,720	194,125	33,249	1,711
Professional (Bachelors')	1,629,158	863,291	765,867	167,049	2,172
Postgraduate	118,099	67,550	50,549	17,004	1,036

Source: SEP [2000b].

^a School term.

IT and Engineering Skills

The number of Mexicans with skills relevant to information technologies increased consistently over the last decade. The pool of human resources in science and technology (S&T) activities amounted to 6.6 million people in 2000—nearly 7% of the population—of which two-thirds were working in an S&T occupation (Table 26). As to gender, men outnumbered women: 55% and 45%, respectively.

Table 26. Human Resources (HR) in Science and Technology, 2000

Category	Total	Female	Male
HR in a S&T occupation	4,283,800	1,909,000	2,374,800
HR with completed third level education in a S&T occupation	2,358,000	981,800	1,376,200
Total HR in S&T	6,557,600	2,995,000	3,602,600

Source: CONACYT [2002b].

The large number of graduates from public engineering and technical schools that pour into the pool each year (375,000 in the 1999-2000 school term) should be added to the above [SEP 2000a], as well as those trained in the private computing schools that have mushroomed in every

major Mexican city. Private computing schools include students, housewives, senior citizens, and clergymen.

According to the National Council of Science and Technology (CONACYT), a growing number of graduates are produced each year by postgraduate engineering programs. The number of engineering graduates increased threefold between 1991 and 1999, though the share of total graduates only grew slightly (Table 27). On the other hand, the number of graduates from social sciences almost quadrupled and their share went up from 44% to nearly two-thirds of the total over the same period. This pattern is characteristic of Latin American countries, where mathematics and the study of hard sciences are not among the first preferences of young people that go to college, nor of those that go on to graduate school.

Table 27. Graduates from Postgraduate Programs by Field, Selected Years

Field	1991		1999	
	No.	%	No.	%
Natural Sciences	637	5.5	1,256	4.1
Agricultural Sciences	326	2.8	864	2.8
Engineering Sciences	1,315	11.4	4,063	13.4
Social Sciences & Humanities	5,080	44.0	19,426	63.9
Health Sciences	4,185	36.3	4,800	15.8
Total	11,543	100.0	30,409	100.0

Source: CONACYT [2002a].

Nonetheless, the number of people earning doctoral degrees in science and engineering per million people also rose, and at a much faster rate than in the social sciences and humanities. In the former, the number increased almost fivefold between 1990 and 2000 to nearly seven per million, while in the social science and humanities, the number only grew by a factor of 3.7 (Table 28).

Table 28. Doctoral Degrees by Field per Million People, Selected Years

Year	Field		Total
	Natural Sciences & Engineering	Social Sciences & Humanities	
1990	1.4	1.1	2.5
1995	2.8	1.6	4.4
2000	6.8	4.1	10.9

Source: CONACYT [2002a].

Implications for E-Commerce

Mexico has a literacy rate of 90.5%, and a population 18 years and older with higher education comprising 12% of the total. The instruction level among Mexico's population is sufficient for acquiring IT skills, in general, and computing and Internet use, in particular.

In absolute numbers, the pool of Mexicans with S&T skills seems large enough for supporting the development of Internet-based activities like e-commerce. The number increases every day, as more students graduate from computing and technical schools, as well as from university programs in those fields. Moreover, most students in professional and postgraduate university programs acquire the basic skills for computer use and browsing the Internet, which strengthens Mexico's capabilities for e-commerce growth and use. In the 1999-2000 school year, over 4.8 million students were enrolled in schools—technical, preparatory, teachers', professional, and postgraduate—where some form of training in computing and informatics is taught.

The above prospects are dimmed, however, by the tendency of Latin American students to prefer social science disciplines (64%) over science and engineering (36%). It is promising, however, that the number of students earning doctoral degrees in science and engineering is increasing much faster than that of doctoral graduates in social sciences and humanities.

In summary, the pool of human resources with engineering and IT skills Mexico possesses up to now are consistent with the extent to which e-commerce activities, both B2B and B2C, grew in Mexico over the last decade. The present size of the pool and the rate at which more young people are educated in degree programs and trained in IT and computing each year, point to a continuing growth in the number of Mexicans able to embrace and use new technologies and the Internet—either as consumers to buy or as managers to conduct business on-line. Mexico's proximity to the United States, and the heavy U.S. exposure this circumstance implies for its inhabitants and its businesses alike, particularly under NAFTA, strengthens such trends.

INFRASTRUCTURE

Physical Infrastructure

Although it is still insufficient and of varied quality, Mexico's physical infrastructure is reasonably acceptable and fairly efficient in most areas. It grew in reach and developed in quality and scale of operation, particularly over the 1990s (Table 29).

The extension of federal toll roads quadrupled, topping 7,000 kilometers in 2000, while that of non-toll roads correspondingly decreased during that period. The railroad network, in turn, remained virtually unchanged and, as expected, the number of passengers consistently declined in those years. Similarly, the number of both airports and maritime ports, and the respective number of passengers, all grew substantially thus extending the respective coverage.

Table 29. Physical Infrastructure, Selected Years

Item	1990	1996	1997	1998	1999	2000 ^a
Roads (km)	239,235	310,591	313,604	319,792	329,532	331,635
Federal toll roads (km)	1,761	6,356	6,394	6,388	6,429	7,005
Federal non-toll roads (km)	45,743	41,014	41,411	41,653	41,765	41,943
Paved roads (km)	83,925	98,717	102,250	104,023	108,086	110,918
Railway network (km)	23,361	26,622	26,622	26,622	26,622	26,622
Transported passengers (millions of passengers/km)	5,336	1,799	1,508	460	254	91
Commercial cargo transported (millions of tons/km)	36,417	41,723	42,442	46,873	47,273	48,916
International airports (number)	42	53	54	55	55	56
Passengers (thousands)	20,449	26,493	28,896	30,922	32,662	33,864
Cargo transported (000's of tons)	164	285	335	388	407	422
No. of ports (maritime and river)	85	85	107	107	108	108
Passengers (millions)	3.8	6.4	6.2	7.2	7.9	8.9
Shipping (000's of tons loaded and unloaded)	169,139	208,581	219,653	237,380	231,440	241,115

Source: Banco de México [2001]: Table A3, p. 117.

^a Preliminary

Telecommunications Infrastructure

By international standards, Mexico presents a mixed picture regarding infrastructure in the various modalities of telecommunications (Table 30). Investment in this area, as percentage of gross domestic product, exceeds that registered in the Americas' most developed countries, Canada and the United States, and in the troubled economies of Argentina and Venezuela.

Canadian and US telecommunications infrastructure is already far more developed and so investment is more at the margin there.

Table 30. Comparative Telecommunications Infrastructure in Selected Countries,

Country/Region	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
Mexico	.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: International Telecommunication Union, *Yearbook of Statistics 1991-2000*. Geneva: International Telecommunication Union, 2001.

^bArgentina, Brazil, Chile, Mexico and Venezuela.

^cOECD member countries, excluding Luxembourg, Slovakia and Iceland.

As to phone lines and cell phone subscribers per 1,000 population, Mexico's figures are low with respect to other Latin American countries in the group, except for Venezuela. In the case of the number of CATV subscribers, Mexico is second lowest (Brazil is lowest, which is rather surprising in that the latter leads Latin American countries in other key aspects of IT development).

In absolute terms, the most significant developments in the 1990s were the solid growth of fixed phone lines from 5.4 to 12.4 million, the explosion of cellular phone lines, and the sharp decline in the number of both telegraph service offices and installed telex lines (Table 31).

According to the Ministry of Transport and Communications, the number of fixed phone lines per 100 population reached 13.7 in 2001 and the goal is to increase it up to 25 by 2006 [SCT, 2001].

Table 31. Telecommunications Infrastructure, Selected Years

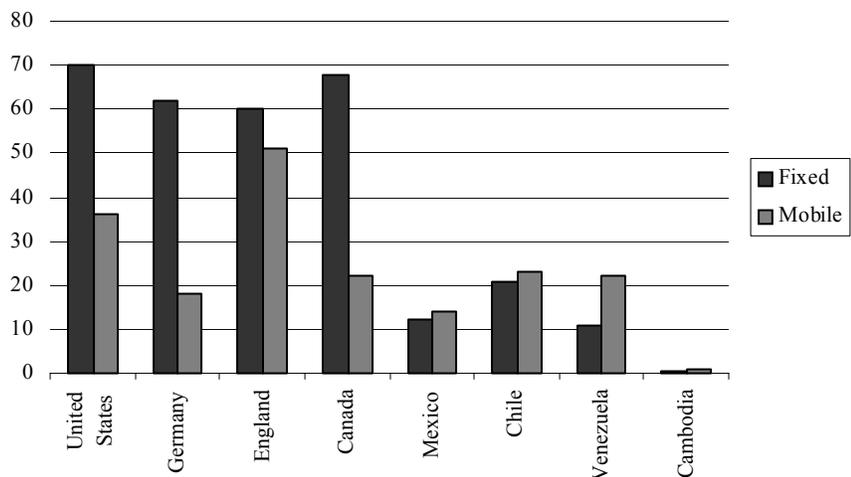
Item	1990	1996	1997	1998	1999	2000 ^a
Telephone lines in service (thousands)	5,355	8,826	9,254	9,927	10,927	12,376
Cellular telephones (thousands of subscribers)	64	1,022	1,741	3,350	7,732	12,000
Telegraph service (number of offices)	2,604	1,771	1,813	1,868	1,878	1,878
Postal service (locations served)	22,000	30,828	31,167	31,515	32,015	32,126
Radio stations	1,045	1,325	1,342	1,351	1,369	1,410
Television stations	540	545	580	584	593	663
TELEX service (installed lines)	24,718	19,625	18,915	18,765	12,280	11,536

Source: Banco de México [2001]: Table A3, p. 117.

^aPreliminary

It is expected that so-called third generation technologies will be available soon in Mexico, which will further boost the use of cell phones. It is estimated that 50% of e-commerce that will take place in Mexico by 2006 will be m-commerce, and users of mobile devices are expected to increase from the current 15 million to 40 million by that year [AMECE, 2002; *El Financiero*, June 21, 2001]

There is an inverse relationship between the degree of development of a country and the degree of penetration of cellular telephony in its territory. Figure 9 illustrates this trend for a group that includes both developed and developing countries, Mexico among them.



Source: *Tecnología y Negocios*, No. 45, June 18, 2001

Figure 9. Telephone Line Density in Selected Countries(Percentages)

This tendency occurs in Mexico, where mobile telephony is most extended in regions that contribute less to GDP, exceeding fixed phone in coverage [*Tecnología y Negocios*, No. 45, June 18, 2001]. The number of mobile lines exceeded that of fixed lines by the end of 2000: 12.7 and 12 million, respectively. It is expected that by 2004 the former will reach 33 million and the latter only 15 million [Jiménez, 2001].

The extent of penetration of mobile telephony in both businesses and households increased rapidly and consistently since the mid-1990s, so that over 21 people out of 100 were cell-phone users in 2001, up from only 0.8 six years earlier (Table 32).

Table 32. Mobile Telephony Penetration, 1995-2001
(Users per 100 people)

Year ¹	%
1995	0.8
1996	1.1
1997	1.8
1998	3.5
1999	8.0
2000	14.2
2001	21.5

Source: COFETEL (2002).

Information Technology Infrastructure

The picture is different in the case of infrastructure for information technologies. Although it increased in the last years, the total PC installed base is still limited. In late 1999, only one million PCs were installed in homes and 3.9 million in offices. The degree of penetration was just 4.2% of Mexican in homes [Select-IDC, 2000a].

By the end of 2000, the proportion of Mexican homes with at least one PC increased to 10%, the corresponding figure for the United States being 50% [Select-IDC, 2000b]. In January 2000, over 70% of installed PCs in companies could access the Internet [Torres Chávez, 2000].

The installed-PC base will increase as IT infrastructure is extended and improved by both the private telephone companies operating in Mexico and the federal government, mainly as part of the e-Mexico mega-project (see below). The Ministry of Transport and Communications (SCT) is building the first Network Access Point (NAP) in Mexico, a huge data management center intended to manage the traffic of government digital services in education, health, and commerce (Aguilera, 2002).

Mexico presents a contrasting case in terms of IT production and use (Table 33). It shows the lowest rate of investment in IT as a proportion of GDP in the group of selected countries in the Americas, but at the same time a figure higher than Canada's and Brazil's in exports of IT hardware. In producing IT hardware, Mexico outperforms Canada, Venezuela and Brazil. In the number of PCs per 1000 population, Mexico is ahead of Brazil and Venezuela but behind the rest of countries in the group. Thus, Mexico is a major producer and exporter of computer hardware, but its own investment in IT is somewhat low compared to other countries in the region.

Table 33. Information Technology Infrastructure in Selected Countries in the Americas

Country/ Region	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
Mexico	1.00	50.57	10,281.00	6,950.00 ^d
United States	4.56	585.18	88,488.62	38,488.00
Venezuela	1.30	45.51	\$254.02	2.00 ^d
Latin America	1.60	52.22	19,618.79	7,273.00
OECD	3.60	312.01	231,341.80	182,730.10

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

^bSource: International Telecommunication Union, *Yearbook of Statistics 1991-2000*. Geneva: International Telecommunication Union, 2001.

^cSource: Reed Electronics Research, *The Yearbook of World Electronics Data, 2000*. Surrey, UK: Reed Electronics Research, 2000.

^d1998 data

It is important to point out, however, that, as stated by the Under Secretary of Domestic Trade, Ministry of Economics, Mexican investment in IT amounts to 1.4% of GDP in 2000, in contrast to a world average estimated at 4.1%, in early May 2002 [Notimex, 2002].

Internet Use

The number of Internet users in Mexico increased significantly in the second half of the 1990s (Table 34), rising from 39,000 in 1994 to 2.7 million in 2000 [COFETEL 2002]. In absolute terms, the bulk of that growth occurred in the business sector, where the number multiplied by a factor of 73 while that in education only grew by a factor of 16.

Table 34. Internet Users, 1994-2000(Thousands)

Year	Government	Education	Homes	Businesses	Total
1994	2	17	4	16	39
1995	3	33	10	47	93
1996	5	69	29	84	187
1997	14	142	141	299	596
1998	31	154	297	740	1222
1999	167	166	478	1010	1821
2000	193	276	1066	1177	2712

Source: COFETEL (2002).

Therefore, since 1,066,000 users were connected from homes, and a total of 21,513,235 housing units in Mexico were registered in the 2000 census, it can be estimated that the extent of Internet penetration into Mexican households is 5%, assuming that only one PC was in operation in those homes. Likewise, considering that 1,177,000 Internet users were business establishments in 2000, and knowing from Table 17 that the number of the latter was 2,844,308 in that same year, an upper bound on the rate of Internet penetration in business was 41.4% if it is assumed that each business user corresponds to one establishment. This percentage is notably high taking into account that the number of Internet users per 1,000 population in Mexico is lower than in all the other relevant countries in Latin America, as will be discussed shortly.

Select-IDC estimated that the number of Internet users at the end of 2000 was 2.9 million, of which 60% were men and 40% women. Thirty percent were under 25 years old and 17% were under 18 years old [Select-IDC, 2001b]. In March 2001, IBM's Business Vice President for Latin America declared that "of the 40 million economically active people [in Mexico], 3.5 million have access to the Net" [Notimex, 2002]. Finally, Empresa-e, a magazine specializing e-commerce, estimates that the number of Web users reached seven million in January 2002 [Empresa-e, 2002b].

While NetValue estimates that the most frequent users in Mexico are between 15 and 24 years of age, Select-IDC asserts that 20% of Mexican users are "mature" (44-year or older males) [Empresa-E, 2002b: 48].

In another study, Select-IDC found that only 6% of the 3.1 million business establishments operating in Mexico in mid 2001 had implemented an Internet-based strategy. Nonetheless, about 1.3 million—42% of the total pool—were considering to apply one in the following months [Mejía Guerrero, 2001a, p. 1].

The Internet trend will be reinforced by initiatives like the one taken by Telecom & Soft, an IBM business partner, which established in Guadalajara the first Center for E-Commerce Solutions in May 2002. Focusing on SMMEs, this center offers small firms access to IT and to Telecom & Soft's Internet-based e-business solutions. Two more of these centers are scheduled to be set up in the following months in Mexico City and Monterrey [Orihuela, 2002c].

Internet Infrastructure

In 2002, some 300 Mexican cities are already connected to the Internet through fiber-optic cable networks built and managed by the main telephone companies operating in this country: Telmex, Avantel, Terra, and Alestra.

Broadband, high-speed Internet access was offered only in the last few years⁸ mainly via cable television networks and digital subscriber lines (DSL). Cablevision and Megacable, now the two

⁸ This article uses OECD's definition of 'broadband' as those networks with the capability of supporting a bandwidth wider than 200 kilobits per second (kbps) in the last mile, in both the provider-to-consumer (downstream) and the consumer-to-provider (upstream) directions. This rate is approximately four times faster than the Internet access received through a standard phone line at 56 Kbps or 64 Kbps (OECD, 2001).

leading cable television service providers, started to offer high-speed Internet access in late 1999 in Mexico City (Cablevision), and in Guadalajara and 13 other cities (Megacable). Megapo, another cable television service provider, started in late 2000 in Cuernavaca, Morelos in Central Mexico, while Cable California, a subsidiary of Las Americas Broadband, Inc., covered Tijuana, Baja California. All these services include unlimited Internet access, bundled with a premium cable television service [OECD, 2001].

By the end of 1999, cable television coverage was limited. Only 32% of households were passed and just 10% were connected to those networks. In general, Mexico was ranked 24th in broadband network penetration by the end of 2000, only ahead of those countries where commercial services had not yet

In August 2001, Telmex, via América Movil, which owns 49% of Cablevision, launched an ADSL (Asymmetric digital subscriber line) service called Prodigy Infinitum. This service offers three broadband Internet access options, depending on the speed preferred the customer: at 256 and 512 kbps, and 2.0 megabytes per second. The options are described in Table 35.

Table 35. Prodigy Infinitum Broadband Services and Charges

Service	Speed (Receive/send)	Modem	Monthly charge
Prodigy Infinitum 256	256 Kbps / 128 Kbps	US\$306.00	US\$50.00
Prodigy Infinitum 512	512 Kbps / 256 Kbps	US\$306.00	US\$92.00
Prodigy Infinitum 2000	2.0 Mbps / 512 Kbps	US\$306.00	US\$460.00

In general, Internet access costs via modem are reasonably low in Mexico. Phone companies only charge the number, not the length of local calls, while ISPs typically charge around US\$40 a month, which is well within the range prevailing in OECD countries.

An Internet2 super broadband network began construction four years ago in Mexico. It links Mexico's major universities and research institutions, and is managed by a collective body called the University Corporation for Internet2 Development (CUDI), established in April 1999, to plan and manage the development of that higher echelon of Internet in Mexico.

Construction of CUDI's network and the backbone to power it, began in the late 1990s, following steps taken in that direction by the United States and Europe years before. It is 8,000-kilometer long and provides links at 155 megabytes per second (Mb/s) to the border cities of Tijuana and Ciudad Juarez, and to Houston, Texas in the United States. It also provides links at 34 Mb/s to 16 Mexican universities and research centers. It is sponsored by Telmex and Avantel, Mexico's top phone service providers, and up to now is available exclusively for education and research purposes (CUDI, 2002).

Broadband network infrastructure is likely to be significantly extended and improved in the next few years as a result of the construction of the e-Mexico System, to be discussed later. For this project aims at providing broadband Internet connectivity to the country's 2,400 plus main localities.

In addition to education and research institutions, other Internet service providers (ISPs) include government agencies, large private sector organizations, and specialized domestic companies like Cablevision, Megacable, Pegaso, Infosel, and Telecable, as well as foreign providers like Prodigy and AOL. Prodigy recently signed an alliance with Telmex to offer a service package called Prodigy Plus 5, which includes one-year Internet access via modem and a Pentium IV-powered personal computing system (Compaq or IBM Netvista), all for about US\$1,300 payable in 12 monthly payments. The package can be purchased in Telmex's 360-plus stores nationwide.

Mexico ranks highest among Latin America's most advanced countries—Argentina, Brazil, Chile and Venezuela—in the number of Internet hosts per 1,000 inhabitants. In contrast, it shows the fewest number of Internet users per 1,000 inhabitants (Table 36). This data is consistent with the mixed nature of Mexico's performance by international standards in the Americas.

Table 36. Number of Internet Users Per 1000 Population

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
Argentina	7.30	67.51	\$92.02
Brazil	5.15	29.39	N/A
Canada	76.88	413.01	\$24.87
Chile	4.91	166.80	N/A
Mexico	5.65	27.43	\$30.78
United States	292.83	346.58	\$22.05
Venezuela	.67	39.30	N/A
Latin America	5.20	39.66	\$61.40
OECD	91.76	256.03	\$39.43

^aSource: International Telecommunication Union, *Yearbook of Statistics 1991-2000*. Geneva: International Telecommunication Union, 2001. ITU definitions: Internet hosts refers to the number of computers that are directly connected to the worldwide Internet network (note, however, that the statistic is based on country code in host address and may not correspond with actual physical location); Internet users is an estimate of the number of Internet users.

^bSource: International Telecommunication Union, *World Telecommunication Development Report 2002, Reinventing Telecoms*. Geneva: International Telecommunication Union, 2002.

The number of residential fixed phone lines was 9,034,054 in 2000 [COFETEL, 2002], The penetration of fixed phone lines into households rose to 42%, which is substantial for business Internet connections⁹.

E-Commerce Infrastructure and Diffusion

The penetration of businesses-to-consumer (B2C) e-commerce in the Mexican economy in 2000 was only 0.16%. It was expected to reach 2% in 2004. In the case of business-to-business e-commerce (B2B), the estimated proportion for the same year was 6.1%, and it was expected to hit 20% in 2004. That is, in line with a pattern common in other countries, B2B e-commerce in Mexico is much higher—nearly forty times—than that for B2C. This difference is due in part to the previous existence of EDI networks in many companies before the Internet was a reality in Mexico [Select-IDC, 2001].

By mid-1999, 20% of Internet users were conducting some kind of transactions on the Web. By December 2000, 19% of users were buying and 7% were selling products and services on-line. In early 2001, about 15,000 Web sites were in operation in Mexico that offered some kind of product or service [García, 2001a]

Nearly eight out of 10 of e-commerce transactions corresponded to B2B and 22.5% to B2C e-commerce. Likewise, of the 2.9 million Web surfers estimated to exist at the end of 2000, 71% were in government, education, and the private sector (potential for B2B), while 29% were home users (potential for B2C) [Cruz Pantoja, 2000]. The proportions are even more unequal according to Forrester Research, which estimated that B2B accounted for 93% of total e-commerce in 2000 (Table 37).

⁹ This rate is obtained by dividing that number of fixed lines by 21,513,235 by the total number of housing units in 2000.

Table 37.E-Commerce Infrastructure and Extent in Selected Countries in the Americas

Country / Region	Secure servers per million population 1998 ^a	Secure servers with strong encryption per million population 1998 ^a	B2B trade in US\$M 2000 ^b	B2C trade in US\$M 2000 ^b
Argentina	.58	.11	\$617.80	\$47.18
Brazil	1.06	.38	\$2,232.63	\$170.50
Canada	30.66	21.82	\$15,867.52	\$1,496.00
Chile	1.28	.20	\$142.50	\$10.88
Mexico	.27	.08	\$3,018.52	\$230.51
United States	54.29	38.39	\$449,900.00	\$38,755.00
Venezuela	.34	.04	\$2,13.27	\$16.29
Latin America	.74	.24	\$6,224.72	\$475.36
OECD	17.77	11.47	\$588,900.80	\$52,184.17

^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: Forrester Research Inc., Global eCommerce Model, 2000.

The main drivers of B2B electronic transactions are the big subsidiaries of multinational corporations operating in Mexico. For example, IBM moved virtually all of its Mexican operations into e-business, and handles payments, procurement and international invoicing electronically through the Internet by means of its Web page (Palacios, 2001a). Growth is also large for electronics contract manufacturing plants operating in Mexico, and the affiliates of major foreign firms in the computer industry like Hewlett-Packard and Acer.

Large domestic firms are, in turn, joining the circle of e-commerce practitioners. An emblematic example is that of Peñoles, a leading mining conglomerate, which has built a portal to manage all its procurement operations within an Internet-based Global Market Place [*El Asesor de México*, August 15, 2001; www.amece.com.mx/emexico]. Another is the case of Grupo Industrial Vitro, Mexico's top glassmaker, which invested US\$20 million in 2000 to build an Internet-based marketing arm and transform itself into a full-fledged e-commerce corporation [FINSAT, 2000a].

The technological base to support e-commerce activities is relatively small. The number of secure servers per one million population in Mexico is lowest among other relevant countries in the Americas. The same is true for secure servers with strong encryption, where Mexico is behind Brazil's and Chile, though ahead of Venezuela's and close to by Argentina.

The situation is the reverse for the volume of B2B e-commerce, where Mexico outperforms all the other Latin American countries in the group. However, the volume of its B2B transactions is three times smaller than Canada's even though Canada's population is three times smaller than Mexico's (see Table 37).

Transportation and Logistics Infrastructure

Over 200 logistics companies are in operation in Mexico, as listed on national phone directories (www.seccionamarilla.com.mx). The world's giants in logistics and delivery services—DHL, UPS, and FedEx—maintain an ample presence and extensive operations, servicing most of the country's major cities. Other lesser foreign players like Airborne and Purolator are also present. Major domestic courier companies include Estafeta, Multi-Pak, Mexico Express, Speed Pak, and a considerable number of local companies.

FedEx offers an Internet-based package of e-services including applications like FedEx EC-Shop, FedEx PowerShip Server, FedEx World Software and FedEx Ship Manager. The latter is run from FedEx's central Web site, which permits users to track shipments any time, anywhere. FedEx World Software integrates pre-designed templates to speed up shipment preparation. The

FedEx EC-Shop and FedEx PowerShip Server options are run on users' systems [Grupo Reforma, 2001].

Logistics companies proper include Redmond Systems, Emery Logistics, and global logistic giant Kuehne & Nagel, which joined recently, and in April 2002 opened its first Logistics Center in Guadalajara, Mexico's second largest city. This center provides an integrated and comprehensive service package including air, maritime and surface transportation; customs management assistance; a service in-bond (maquiladora) plant; and Vendor Management Inventory services [Mural, 2002]. Grupo Pondisa, in turn, is a major domestic firm, which provided an array of services in logistics and warehousing for more than 25 years, with offices and facilities in 17 locations nationwide. Its newest facility was set up in June 2002, in the Guadalajara area.

In addition to courier services, over 7,800 freight transportation companies are in operation, which moved more than 413,000 tons in 2000 with a fleet topping 370,000 trucks and trailers [INEGI, 2002c]. Most of these, especially passenger bus companies, provide package delivery services, notably Omnibus de México, Tres Estrellas, Autotransportes del Pacífico, and ETN.

Finally, the operations of logistics and transportation companies are supported by 85 airports, of which 57 are international and 28 domestic. Therefore, Mexico has the required capabilities for both nationwide and international package delivery to support the functioning and development of both B2B and B2C e-commerce activities, presently and in the near future.

Enterprise Infrastructure

Although no detailed data seems to be available, the use of productivity tools, like Enterprise Resource Planning (ERP), Customer Relationship Management (CRM), and Supply Chain Management (SCM), is spreading rapidly in Mexico, in both companies and government agencies. CRM solutions were built on electronic data exchange (EDI) networks constructed in the past decade.

Top software packages like Germany's SAP and U.S.'s Oracle and People Soft are well known and used by both domestic companies and foreign subsidiaries, at least by those in the electronics and computer industries. As much as 48% of all the companies surveyed by Palacios [2001] were using an EDI network for their dealings with suppliers.

SAP Mexico's director general recently declared that ERP solutions are the most demanded. The heaviest investments are made by companies operating in this country, followed by CRM and SCM. He added that SAP serves more than 300 customers in Mexico and Central America, which is a small proportion of Mexico's company population. The largest ones in Mexico are Pemex, Hewlett-Packard, IBM, and Microsoft [Gassamans, 2002].

Major consulting firms also operate extensively in Mexico. For example, Gedas, offers services in outsourcing, software development, ERP in manufacturing, CRM, logistics, and e-commerce.

The trend toward the adoption of such productivity tools is being reinforced and promoted by the federal government with the development of EDI networks like the one called Government Contracts Electronic System (COMPRANET), through which the federal government manages all of its procurement dealings. Another major example is the network developed by the Mexican Institute for Social Security (IMSS) to manage its transactions with suppliers. Both are seen as an initial step toward building full Internet-based systems by the Mexican government. In 2002, they were far along in construction.

In early 2001, IMSS's informatics chief stated that 6,000 businesses already use EDI in Mexico, and that the number will increase to 12,000 in 2002 [Pérez-Moreno, 2001]. Major subsidiaries of foreign firms like Hewlett-Packard, SCI Systems (recently merged with Sanmina), Solectron, and Jabil Circuit, operate EDI networks that handle their procurement [Palacios, 2001].

Commercial Base

Mexico's commercial base presents a highly skewed structure characterized by a large number of small establishments and only a few large companies. The Mexican Business Information System (SIEM), a database assembled and run by the Ministry of Economics, lists a total of 402,297 commercial companies currently in operation. Of these, as many as 91% (366,632) correspond to micro establishments of five or less employees, according to the classification presented in Table 16 [SEC, 2002b].

The breakdown of the 9% that are larger units is as follows:

Classification	No. of Employees	No. of Firms	% of Total
Small	6-20	26,789	6.7%
Medium	21-100	6,891	1.7%
Large	>100	1,590	0.4%

Source: [SEC, 2002b].

The top retail chains in the supermarket category are controlled by the domestic business groups Comercial Mexicana, Gigante and Soriana, which are among the 30 largest companies in Mexico (Table 11), and Aurrerá. All these chains have stores in all major cities. Close competitors are subsidiaries of foreign companies like Carrefour, Price Club, and Walmart. Aurrerá has recently entered into an alliance with Walmart and established a company called Walmart-Aurrerá. None has yet developed an EDI network or a package of Internet-based solutions to promote on-line shopping in the spirit of B2C e-commerce. All rely on the entrenched shopping traditions of Mexican consumers (section IV).

Infrastructure Readiness for E-Commerce: Summary

Mexico's infrastructure provides a fair level of readiness for the operation and future growth of both B2B and B2C e-commerce. Federal toll roads extend over more than 7,000 kilometers, and the number of airports and maritime ports grew substantially over the 1990s. Both fixed phone and cellular phone lines exceed 12 million. It is expected that half of e-commerce activity by 2006 will be conducted through mobile communication devices, whose users are expected to increase to 40 million by then, up from the current 15 million.

The proportion of Mexican homes with at least one PC, though, was only 10% by the end of 2000 compared to a 50% for the United States. The proportion is likely to increase, nonetheless, as IT infrastructure is extended, particularly under the e-Mexico project. The construction of the first Network Access Point and the fact that Mexico invests 1.4% of GDP in IT attest to that.

Internet penetration in households was 5% in 2000. Two-fifths of the companies operating in Mexico are estimated to have implemented some kind of business strategy using the Internet.

Since over 300 Mexican cities are connected to the Internet, most of them allowing 256 kbs access implies a quite sizeable pool of opportunities for the growth of e-commerce, in general. It is encouraging that high-speed access and operation are already available in Mexico through broadband networks and backbones run by the top phone and cable television companies, including those for Internet2. That Internet2 is exclusively for users engaged in education and research is not as restrictive in general as it may sound. CUDI members estimate that about one-half of Internet users in Mexico are linked to universities [CUDI, 2002]. However, when it comes to e-commerce, the limitation is more apparent, given Internet2 is not accessible for commercial purposes.

Transportation infrastructure for delivering e-commerce goods is fairly adequate, with over 7,800 freight transportation companies servicing Mexico's entire territory, many of which offer package delivery options. These companies are complemented by more than 200 logistics and courier firms, including DHL, UPS, FedEx, Redwood Systems, and Kuehne & Nagel. The operations of all these companies are supported by 57 international airports and 28 domestic ones. All this means, therefore, that Mexico has a reasonably solid capacity for distribution and package delivery to support B2B and B2C e-commerce activities.

The use of productivity tools like ERP and CRM is spreading rapidly, relying on EDI networks built in the past decade. This trend is being reinforced and promoted by the federal government with the development of EDI networks.

The large presence of small establishments in the commercial sector limits the possibilities for the spread of B2C e-commerce activities, given that most of those micro shops lack both the resources and the business instinct that may induce them to invest in IT and conduct business on-line. The main wholesale companies and the larger commercial chains operating in Mexico do have, nonetheless, the required resources and conditions for developing EDI or even Internet-based solutions that make them able to venture into B2C electronic commercial transactions.

In summary, it can be stated that Mexico's infrastructure was instrumental in the inception and initial growth of e-commerce activities over the last decade or so, and offers the basic conditions and capabilities to support the operation of both B2B and B2C transactions now and in the near future.

IV. FINANCIAL RESOURCES

Fresh capital for new ventures, e-commerce or otherwise, is provided by both commercial and development banks like Nafin and BANCOMEXT (Foreign Trade National Bank). Nafin operates a program providing venture capital for investment projects to improve the financial management of new companies; another to provide fixed interest rate loans to SMMEs; and, one more to offer loans for technological innovation projects [SEC, 2002b].

Another major source of funds is the National Council of Science and Technology (CONACYT). This council runs a Support Program for Joint Research and Development Projects (PAIDEC), which provides venture funds for Mexican investors in this kind of project, linked with experts from public universities. CONACYT reimburses 50% of lost investments, up to US\$250,000 per year for a period not exceeding two years [CONACYT, 2002a].

V. CONSUMER PREFERENCES AND PAYMENT INSTRUMENTS

PAYMENT MECHANISMS

The Director General of Terrapin, a firm specializing in intelligent cards, recognizes Mexico as the top consumer of this product in Latin America. The trend is toward convergence on international standards, so as to prevent waste of time and resources and protect infrastructure. Intelligent cards are most useful especially in the areas of commerce, health, and education [*El Universal*, June 14, 2001, www.amece.com.mx/emexico].

CONSUMER PREFERENCES

Mexican consumers still tend to be highly skeptical of the Internet as a means to shop and carry out commercial transactions in general. Most people think that it is not safe to do so, given the numerous cases of electronic fraud and hacker attacks that occurred since on-line shopping became an option for consumers in Mexico [Uribe, 2002]. Reservations and fears, coupled with shopping habits and traditions rooted in national culture, nurtured such skepticism in Mexican consumers about using credit cards to buy on-line, let alone do business over the Web. Non-authorized charges and the cloning of cards using devices, such as a beeper-like device called Skimmer, are the most common of those crimes [Cruz, 2002].

As a consequence, the use of credit cards, as a major means of payment, is quite limited. Credit cards accounted for a negligible 0.1% of total bank loans in 1987, the figure just increasing to 5.9% nearly a decade later, with a peak of 10% in 1992 (Table 38).

Table 38. Share of Credit Card Accounts in Total Bank Loans

Year	Percent
1987	0.1
1988	0.8
1989	4.2
1990	5.0
1991	8.8
1992	10.2
1993	7.5
1994	6.2
1995	5.5
1996	5.9

Source: Gómez Pacheco [1998], Table 2.

We see similar pictures of the number of credit card holders. Table 39 shows 6.6 million accounts were in operation in 2000, which amounted to only 6.8% of the Mexican population, and only 10% of those 15 years or older (assuming only one holder per account). Two main banking institutions, BBVA Bancomer and Banamex, account for four-fifths of the total.

Table 39. Number of Credit Card Accounts by Issuing Institution, 2000

Bank	Number of accounts.	Percent
BBVA Bancomer	2,554,553	38.5
Banamex	2,761,730	41.6
Serfin	88,069	1.3
Bitel	309,728	4.7
Santander Mexicano	57,315	0.9
Mercantil del Norte	175,707	2.5
Citibank	393,329	5.9
Scotiabank Inverlat	131,795	2.0
Afirme	3,514	0.1
IXE	3,283	0.1
American Express	157,426	2.4
Total	6,636,449	100.0

Source: CNBV [2000].

Given the high insecurity prevailing in Mexico, fraud victims undertook direct actions to defend themselves from hackers and credit card criminals. For example, they created a private organization in 1998, the Coalition against Fraud with Credit Cards and other Payment Means, which demanded the official recognition of those crimes in both federal and state legislations, so that sentences of up to nine years in prison with no bail option can be established [Orihuela, 2002a]. As a result, appropriate provisions were introduced in 1999 in the Federal Penal Code for the case of crimes involving development banks. For these provisions to be applicable to individuals, state legislatures must introduce the corresponding reforms. Only four states—Federal District, Mexico State, Quintana Roo, and Puebla—passed the legislation by 2002. The coalition estimates that credit card fraud caused US\$54 million in losses in 2001; nearly two-thirds of the losses occurred in those states, plus Jalisco and Nuevo León [Orihuela, 2002b].

Toward Safe E-Banking

Commercial banks and other companies in turn undertook actions on their own to induce customers to use credit cards to trade on-line. Banamex, for example, offers a virtual credit card called Klick Card that can be requested only via the Internet, while BBVA-Bancomer offers an electronic check that works in a fashion similar to the Klick Card [Galán and Vizcaíno, 2002].

General actions include setting up of digital kiosks in branch offices of most banks, information brochures sent to customers, and charges on transactions made in person at branch offices, which are free if carried out on the Internet through the banks' portals and Web sites.

The efforts to inculcate Mexican users into a new banking culture based on the use of digital technologies are strengthened by the heavy presence of foreign corporations in the originally home-grown top domestic banking institutions. Bancomer is now an affiliate of Banco Bilbao Vizcaya Argentaria from Spain, while Banamex was recently bought by U.S.-based Citigroup. The other big players are Banco Santander, another Spanish firm; Scotiabank, a Canadian concern; Citibank itself; and others like Tokyo-Mitsubishi, Bank of America, and Bank of Boston. As with other multinational firms, these banks are bringing new corporate philosophies and leading-edge management practices that revolve around the concept of electronic banking via the Internet. After the merger and takeover between Citigroup and Banamex, the resulting joint company spun off an e-banking arm called Artikos. They set the gradual replacement of its existing branch offices with virtual service centers as a top priority. In mid-2002, electronic transactions already accounted for 60% of the bank's total [Flores, 2002].

An initiative in the same direction is the launching in May 2000 of a new product called *Yahoo Card*, jointly by Yahoo Mexico, Banco Santander Mexicano, and Visa, which offers more flexibility and special security in its use on the Internet guaranteed by a Verified-by-Visa certificate. The services provided by this card are linked to a specialized Web site called *Yahoo Mi Empresa* (Yahoo, My Company), which provides all that Mexican companies, especially SMMEs, need to set up new businesses on-line, or to digitize existing business establishments [García, 2002].

However, the penetration of the Internet in banking activities is quite limited in general, especially in Mexico where only 14.5% of the population—14.2 million people—had a banking account in 2000 [CNBV, 2002]. In the United States, where nearly one-half of the population can access the Internet and virtually everybody owns a bank account, less than 5% of the people use the Internet for their banking transactions. The figure is similar in the main European economies [Vernon, 2001].

Traditional payment options like bank drafts and long-distance deposits on bank accounts provided by well established institutions, are still the most preferred in Mexico by individual customers and businesses alike. Other, new instruments available to Mexican consumers include a number of money transfer services provided by foreign firms. The most well known is PayPal, which permits credit card holders to make payments on-line to establishments or individuals not equipped to accept credit cards. Others include Billpoint and c2it, affiliates of eBay and Citibank respectively, which offer similar services. One more is P-Cash, run by Patagon, which is a safe alternative to on-line transactions with a credit card. It consists of an account where the user can deposit cash that is immediately ready for transfer [Chávez, 2002]. This service was well received by users of Mexican auction portals like DeRemate, Mercadolibre, and Todito.com.

The safety of e-commerce transactions depends on factors like the authenticity of the parties involved; the certainty that only the client and the bank will have access to the information related to the transaction (confidentiality); the certainty that the information sent must be equal to the one received (integrity); and the certainty that none of the parties involved will deny his/her participation (recognition). At least the first two are provided for in the legislative package on e-commerce in force since May 2000 (Section VII).

VI. BUSINESS ENVIRONMENT AND READINESS

In spite of the prevailing fears and distrust about the use of credit cards and other digital payment instruments, a generally favorable business environment exists in Mexico for e-commerce to grow and prosper.

The economy is gradually recovering after the slump of 2001. Growth is expected to pick up in the second half of 2002 and post an annual rate of about 1.8%. An overtly pro-business federal government is in power, which is pushing for further reforms to open up to private capital sectors

still controlled by the state, especially oil and electric power. This government intends to build a vast telecommunications infrastructure under the e-Mexico project (Section VII) . It is even postulating the Internet as the basis of a new development model, seemingly in line with the so-called Digital Opportunity Initiative, launched in 2001 by the United Nations in association with The Markle Foundation [Bowman, 2001]. Economic liberalization is well underway and progressing, and free trade ideology is deepening as reflected in the signing of more free trade agreements—nearly a dozen, the latest one under negotiation with Brazil and MERCOSUR—all anchored on the North American Free Trade Agreement (NAFTA). Globalization is a welcome reality by both business and government. A widespread consensus exists about the need for Mexican businesses to open up to foreign markets and to embrace digital technologies to modernize and improve company structures and management practices.

In summary, a favorable environment exists in Mexico for business over the Internet to prosper, all sustained by a rather healthy macroeconomic stability and significant progress made in the last few years toward a more democratic political life. Moreover, a population of nearly 100 million and a surface area close to two million square kilometers whose main cities are connected by a reasonably efficient road system with over 100,000 kilometers of paved roads, jointly project a sense of potential for economic growth and the development of scale economies that add to such an environment. The several programs in operation by both the federal and state governments, especially those by the Ministry of Economics and development banks like Nafin and BANCOMEXT, all aim at providing technical and financial support for new and existing businesses, further contribute to nurture a business atmosphere auspicious to the growth of both B2C and B2B electronic commerce.

In support of the above perceptions, the Global Entrepreneurship Monitor reported that Mexico showed the highest entrepreneurial activity prevalence rate among all the countries surveyed in 2001.¹⁰ It was followed closely by New Zealand, and then by Australia, Korea, and Brazil. Mexico showed a rate of 18%, while Belgium presented the lowest rate, 5%, of the group [GEM, 2002]¹¹.

Mexico posted the highest number of persons per 100 adult individuals (18 to 64 years of age) who are in the process of starting a new company or are the owner/managers of a business establishment less than 42 months old. [GEM, 2002]. This data is encouraging because it signifies that the overall level of development of a country does not necessarily imply a low entrepreneurial drive in its economically active population. It also means that the adverse factors that act as hindrances do not deter Mexican entrepreneurs from engaging in the creation of new business ventures and in the development of business activities in general, e-commerce included.

Unionization of workers is still controlled by old-style unions that were created and developed under the 71-year long corporatist political and institutional regime of the PRI (Institutional Revolutionary Party). These are mainly Mexico's Workers Confederation (CTM) and the Regional Confederation of Mexican Workers (CROM), and other major unions all under the Labor Congress (CT). This old union system, created under a welfare state and Fordist regime of social

¹⁰ The total population of the 29 countries participating in GEM 2001 is about 2.5 billion. Approximately 56% (1.4 billion) are adults of working age. GEM surveyed random samples of at least 2,000 adults from each participating country to ascertain several measures of entrepreneurial activity. From the more than 74,000 surveys conducted with those 18 to 64 years of age, about 10% of the adults were engaged in entrepreneurial activities. Results were similar for the 21 countries participating in GEM 2000. This means that in the 29 GEM 2001 countries, at any point in time, approximately 150 million people are involved in starting and growing new firms.

¹¹ The countries included in the GEM survey were: Argentina, Australia, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, Hungary, India, Ireland, Israel, Italy, Japan, Korea, Mexico, The Netherlands, New Zealand, Norway, Poland, Portugal, Russia, Singapore, South Africa, Spain, Sweden, the United Kingdom, and the United States.

regulation, began to transform over the last decade, as new organizations like the Mexican Workers Union emerged. Ever stronger demands for reform of the existing Federal Labor Law are being raised by both individual companies and industrial chambers and business organizations, particularly the subsidiaries of the powerful multinational corporations with operations in Mexico. As shown in Table 40, the coefficient of strikes that broke out every year tended to decrease,

Mexico's entrepreneurial culture started to improve in the last decade. Individual companies and the Mexican economy in general were more exposed to foreign competition. At the same time, the economy responded to the ideas and know-how prevailing on the international business scene, to a large extent thanks to the advent of the Internet and its introduction and spread in Mexico.

Table 40. Labor Strikes Break-out Annual Coefficient

Year	Coefficient
1989	1.9
1990	2.4
1991	1.7
1992	2.4
1993	2.0
1994	1.4
1995	1.2
1996	0.6
1997	0.5
1998	0.4
1999	0.4
2000	0.3
2001	0.5
2002 ^a	0.4

Source: De Buen [2001].

^a Up to January

Note: The coefficient refers to the ratio of the number of strikes that actually broke out in the month in which they were announced to the total number of strikes announced in that month.

Substantial drags need to be overcome, however, so that e-commerce, in particular, and economic activities in general can develop more fully. Some of the more significant are an entrenched tradition of family-owned company structures and management systems that usually imply an inefficient way of using company resources. Another is the still widespread lack of a truly entrepreneurial vision and instinct, wide enough and strong enough to override the still predominant conservatism that manifests itself in a "natural" tendency to invest only in well-known business areas like traditional commerce and real estate.

Only in that way can a new business culture emerge in line with the realities of the early 21st century. The Business Deputy Director of AcciTrade Banamex, an affiliate of Mexico's second largest banking institution declared that "We are still building the foundations, although it should be recognized that the progress achieved so far is important. What is needed is that technology be more accessible and that its diffusion gives rise to a new financial culture", [Cámara Trejo, 2002].

"The problem in Mexico will not be purchasing power, for that exists in operating systems to facilitate the purchase of a computer, but the lack of an informatics culture. Although, the advantage in this respect, is that there are nearly 35 million people less than 25 years of age who are receiving an education that will form them in that direction" IBM's Business Vice President for Latin America [Notimex, 2002].

The issue, nonetheless, is that only 14.5% of Mexicans have a bank account, a reflection of a highly skewed income distribution and an also highly skewed business size structure. An additional and significant drag that undermines the otherwise favorable business environment is the heavy paperwork and red tape that plagues Mexico's institutional systems for both the creation of new companies and the operation of existing ones, coupled with a highly complex,

bureaucratic and adverse fiscal system that imposes a heavy tax burden on companies and individual taxpayers alike.

To the extent that those hindrances can be overcome in the immediate future, Mexico's readiness for the development of e-business will be enhanced and consolidated so that this dynamic activity will find a propitious ground to arise and flourish.

VII. NATIONAL POLICY

POLICY INSTITUTIONS AND ORGANIZATIONS

Private Sector

The private sector is an active participant in the promotion and facilitation of e-commerce growth in Mexico. A diversity of working groups, chambers and organizations in the field were established over the last decade to coordinate activities aimed at fostering the development of e-commerce activities.

The most important of those is the Mexican Association for Electronic Commerce Standards (AMECE). Established in 1986, AMECE is devoted to promoting and managing the use of standards related to e-commerce through EDI implementation guides, product codification standards, and the development of an electronic catalogue. AMECE works through *ad hoc* committees composed of representatives of both the private sector and government agencies [AMECE, 2002].

The Mexican Committee on Electronic Commerce (COMECE), is a specialized body that works closely with, and practically inside, AMECE. It is organized in four working groups (e-payments, e-invoicing, security, and document certification), and is meant to be the official information center on e-commerce. Thus, COMECE groups the main actors of Mexico's e-commerce community and is a key liaison between government branches and private sector companies and organizations [COMECE, 2000].

Another important organization is the Electronics, Telecommunications and Informatics Industry National Chamber (CANIETI), which participates actively in COMECE and in most government-led committees and coordination bodies aimed at promoting the development of e-commerce in Mexico. CANIETI's goals include

- the establishment of a long-term national policy for digital convergence on a single technological platform, including the creation of a specialized agency charged with the implementation of policies in this field;
- the development of a digital economy in Mexico backed by a sound and comprehensive legal framework; the promotion of competition among Internet service providers; and
- the permanent increase of access and data transfer speed [CANIETI, 2002].

In early 2002, CANIETI proposed a project for a new Federal Telecommunications Law, which is under discussion in Congress.

The Mexican Association for the Information Technologies Industry (AMITI) is still another organization that actively participates in the promotion of e-commerce both within AMECE and on its own. It created specific departments to deal with e-commerce issues. The Mexican chapter of the World Information Technology and Services Alliance (WITSA), AMITI aims at promoting the creation and implementation of IT development policies, like the National Informatics Development Plan 1995-2000, and the adoption of standards that facilitate free access, interconnectivity and interoperability of IT infrastructure [AMITI, 2002].

Finally, the Promotional Group on E-Commerce Legislation (GILCE) was established in 1999 within AMECE as a working group responsible for promoting and monitoring initiatives intended

to formulate and implement a proper legal framework. GILCE is composed of representatives from AMITI, CANIETI, the Bank of Mexico, the Ministry of Finance and the then Ministry of Trade and Industrial Promotion (SECOFI), Mexico's Bankers Association, the Notary Public National Association, and the Telecommunications Federal Commission (COFETEL).

In addition to the above organizations, major private companies contribute to the promotion of e-commerce in Mexico by setting up e-commerce divisions and/or departments. These companies include virtually all major banks and telecommunications giants like Telmex, as well as subsidiaries of top IT multinational companies like Microsoft, Compaq, and Oracle. The multinationals created Web sites offering e-commerce solutions to Mexican firms.

Public Sector

In parallel to the private sector initiatives, the Mexican government extended its involvement in the facilitation of e-commerce to create a favorable national environment for the growth of the digital economy. This work is being done mainly through the ministries of Transport and Communications (SCT) and Economics, and Nacional Financiera (Nafin).

SCT is the leading agency in the construction of the e-Mexico system, which is one of the flagship projects of the Fox administration. The system is intended to provide a vast broadband telecommunications network that would substantially instigate the growth of commercial transactions over the Internet.

In addition to playing a key role in the e-Mexico project in collaboration with SCT, the Ministry of Economics also contributed to create a propitious environment for e-commerce through programs intended to provide SMMEs the basic skills for the adoption of digital technologies and equipment. It launched the Digital Economy Development Special Program (PEDED), which seeks to coordinate the different initiatives aimed at helping companies and public offices to go on-line for transactions and dealings, including the introduction of a new official norm that regulates the use of data messages by electronic means [AMECE, 2002, e-Mexico section].

Nafin, self-proclaimed as Mexico's Small and Medium Enterprise Bank, in turn set up a Directorship for Electronic Products responsible for devising programs aimed at facilitating the use of IT by SMMEs so that they can be linked to larger companies as suppliers. One of the chief products of this directorship is called Production Chains, which aims at integrating the large companies and government agencies with all the businesses with which they have business relationships in a single electronic market, i.e., an e-marketplace. The large companies invite their suppliers into their supply chain, and Nafin sets up a Web site and links it with a common data base. Once the parties are interlinked electronically, Nafin approaches the SMME supplier to provide it with technical advice and training, loans, and other financial services via factoring, and shortly after with working capital [Hernández, 2002].

Finally, a close collaboration developed between the federal government and promotion bodies like AMECE, GILCE, COMECE and CANIETI. In May 2000, representatives from the Ministry of Finance, the then Ministry of Trade and Industrial Promotion (Ministry of Economics since December 2000), the Bank of Mexico, and COFETEL, established an Inter-ministerial Committee with AMECE and COMECE, in which the Notary Public National Association was also represented. This committee is the main inter-institutional body for coordinating all the activities related to e-commerce nationwide. The Ministry of Economics, which has the leading role in the committee, is responsible for promoting and coordinating both foreign and domestic trade and all commercial matters.

Mixed Initiatives

A growing collaboration is taking place between the public and private sectors in joint projects that involve partners from both. One of the most representative is the collaborative network called bNexus, launched in March 2001, by Microsoft in collaboration with seven Mexican companies. bNexus integrates the services of third-party companies, organizations and government offices in a package enabling users to conduct on-line commercial dealings, money transfers, payments, and *IMSS From your Company* transactions. The package includes access

to AMECE's product catalogues, e-mail services, and the use of Microsoft's Office suite. Although it links companies of all sizes and large public institutions, one of the network's main objectives is to induce SMMEs to improve their productivity and engage in e-commerce transactions [García, 2001b].

Specialized mixed bodies and private IT firms alike are instrumental in the emergence and development of e-commerce in Mexico by devoting themselves to both its promotion and the formulation of a policy and legal framework that facilitates its operation and growth. , They converge in their aims and initiatives, and collaborate closely by means of cross memberships in each other's committees and working groups. Representatives of government agencies also participate, an arrangement that assures the coordination of the work of both the private and the public sectors in the promotion and facilitation of e-commerce with the public sector and override whatever overlapping that may exist.

ENABLING POLICIES

Telecommunications Liberalization

Mexico's telecommunications sector was liberalized during the 1990s as part of the privatization and economic liberalization policies implemented by the Salinas and Zedillo administrations. The first steps were taken by the Salinas administration (1988-1994) with the privatization of Teléfonos de México (Telmex), the nation's telephone company and one of the most strategically important state enterprises. The Zedillo administration (1994-2000), in turn, liberalized, and thus opened to competition, both the long distance phone and the local call market. The first new entrants were mainly joint ventures between top Mexican conglomerates and multinational telecommunications giants like AT&T and WorldCom. Since then, new private companies like Avantel, Alestra, Unefon, Vodafone Pegaso and Axtel gradually entered both the long distance and local phone markets, which widened the options and possibilities for Internet service providers.

Foreign entry was facilitated by the relaxation of foreign investment legislation enacted earlier by the Mexican government, especially the old 1973 foreign investment law. By 1989, the Salinas administration introduced the main reforms in a bylaw published that year [Palacios, 1992]. Today virtually no restrictions exist on foreign concerns investing in Mexico, either in joint ventures or in wholly owned companies.

A number of world telecommunications and IT leaders made substantial investments in Mexico the last few years. Nortel Networks, the Canadian giant, invested over US\$1 billion in Mexico since 1999, funding the installation of wireless optic networks for Unefon and Axtel [García, 2001a]. Sun Microsystems funded several computer infrastructure projects for US\$20 million in various higher education institutions [AMECE, 2002; *El Financiero*, January 25, 2002]

The Ministry of Transport and Communications, in turn, announced that total investment in the telecommunications sector topped US\$5 billion in 2001, 18% more than in 2000. In 2002, this amount will increase due to the massive investments expected for the e-Mexico megaproject [AMECE, 2002; *El Financiero*, October 22, 2001].

Financial Deregulation

The liberalization of the financial sector was part of the package of privatization policies of the last two federal administrations. By the end of the 1980s, the financial system was dominated by two domestic groups that owned the two largest banking conglomerates: BANAMEX AND BANCOMER. An echelon of medium-sized banks like Banco del Atlántico, Banco Internacional and Banca Unión, and many regional banks operated alongside and complemented the two higher layers. Among the latter were Banca Promex, Banco del Norte, and Banoro.

The sector was liberalized during the 1990s and at the end of the decade foreign conglomerates bought major shares of domestic banks and entered the Mexican financial market. Top examples are Banco Bilbao Vizcaya and Banco Santander from Spain and Citibank from the United States.

Their entry entailed the introduction of new banking technologies by the newcomers and occurred in parallel of a significant deregulation of the sector regarding international wire transfers and deposits, and the possibility of holding accounts in U.S. dollars.

ELECTRONIC COMMERCE POLICIES

Research and Development and Other Incentives to Private Sector

Research and development (R&D) on e-commerce is virtually absent at universities and research centers. Market research is conducted mainly at private consulting firms, mostly subsidiaries of foreign companies with offices in Mexico, like Select-IDC, and others like eMarketer, The Boston Consulting Group, and Forrester Research, Inc., which periodically conduct surveys among e-commerce practitioners.

The e-commerce situation is symptomatic of the very limited R&D in Mexico, particularly regarding IT and e-commerce. As shown in Table 41, expenditure in experimental R&D in Mexico is much lower than in countries like Brazil and Spain, let alone the United States, Germany, and Canada.

In response, the Monterrey Institute of Technology, a leading private university, established a Center for Research on Electronic Business. In November 2001, the Ministry of Economics announced the imminent creation of an Institute for the Development of Electronic Commerce in Mexico, in a partnership between the business and the public sectors, which would promote the development of this activity by increasing the connectivity of companies [Mejía Guerrero, 2001a]. However, by mid-2002 this project had not materialized.

Table 41..Expenditure in Experimental Research and Development as a Proportion of GDP, 1999

Country	ERD/GDP
USA	2.65
Germany	2.44
Canada	1.58
Brazil ^a	0.91
Spain	0.90
Mexico ^b	0.40

Source: CONACYT [2002b], Table 1.3, p. 35, with data from OECD [2001] *Main Science and Technology Indicators*, No. 1.

^a 1996

^b 2000

The Ministry of Finance and Public Credit (SHCP) provides fiscal credits and incentives in the form of income tax deductions of up to 1.5% for research and development projects. Likewise, CONACYT operates a Research and Development Trust Fund for Technological Modernization (FIDETEC), for promoting domestic private investment in the development and implementation of innovation projects of high risk and "technological merit", to make up the deficiencies of financial markets for this type of project. Projects should be in a "pre-commercial" stage, and should encompass stages from the generation of the original idea to the construction of prototypes. FIDETEC funds can be provided in three forms: direct loans, financial guarantee for projects that already have support from a commercial bank, and shared risk loans [CONACYT, 2002].

The e-Mexico National System

This megaproject was launched in early 2001 by the Fox administration, to provide connectivity to all of the country's 2,470 municipalities through a single nationwide, optic-fiber, broadband communications network that will also link the 9,500 telegraph outlets operated by the Ministry of

Transport and Communications (SCT), the project's coordinator [Barros, 2001]. The estimated cost is at least \$US70 billion.

A technical committee was created in February 2001 to coordinate the process with representatives from several ministries, private organizations involved in e-commerce matters, and from the main telecommunication companies operating in Mexico. The committee is headed by SCT's minister; with the Minister of Economics second in command. The telecommunication companies agreed to link their respective infrastructure and installations to assemble the projected macro network.

The goal is to transform SCT's telegraph outlets into so-called Community Digital Centers, and establish Internet-enabled municipal sites in two years time. Similarly, local schools and health centers will be transformed for the same purpose, so that by the end of this administration 10,000 localities and about 85% of the Mexican population will receive the benefits of the project [SCT, 2002].

The system consists of four main subsystems: e-economy, e-education, e-government, and e-health. Each has its own objectives and working groups, all under SCT's coordination.

One of the key objectives of the e-economy subsystem is to manage a package of integrated services to help SMMEs to modernize and make use of the possibilities opened by the Internet and the digital economy in general. The goal is to eliminate intermediation chains and barriers to market entry and thus help SMMEs learn about suppliers, consumers, competitors and more efficient production and management systems [Margáin, 2001].

Nearly one and a half years after launch, the construction of the e-Mexico System has not yet taken off as was expected. Progress is limited, as Dr. Julio C. Margáin, its director general admits [Aguilera, 2002]. It seems that the project turned out to be too ambitious and thus not as feasible as it appeared at the beginning. Although most of the resources to fund the project are supposed to come from the private sector, neither the government nor the private sector were able to find the way to put the resources together. Some analysts think that the problem is the lack of a coherent plan to take the project to practice. It remains as a set of good but unfeasible ideas [Valdiosera, 2002].

Nonetheless, some important initiatives were undertaken under the e-Mexico System. One was launching an electronic procurement system called Compranet (www.compranet.gob.mx), by means of which the Ministry of Auditing and Administrative Development (SECODAM) is managing all the procurement operations of the federal government. COMPRANET is also being adopted by public institutions like universities and national health institutes. A second is the program called *IMSS desde su empresa* (IMSS from your company) being implemented by the Mexican Institute for Social Security to conduct all its dealings with its suppliers [Pérez-Moreno, 2001].

A third is a collaborative network, called bCentral, designed and launched by Microsoft in alliance with seven Mexican companies. This network integrates the services of third-party companies, organizations and government offices including commercial transactions, electronic money transfers and payments, *IMSS From your Company* transactions, AMECE's product catalogues, e-mail services and the use of Microsoft's Office suite [García, 2001b].

National Policy

In January 2002, representatives of the leading telecommunications and informatics companies joined forces for the first time to demand a nationwide policy and a national plan on the use and development of information technologies from the Fox administration. Such policy is thought of as a comprehensive coordination framework, which can provide certainty and operational support for IT-related activities, including e-commerce. The proposal includes the creation of a leading central office responsible for the implementation and operation of the plan.

This initiative occurred right after Congress approved a fiscal package that considers computing equipment as a luxury item and charges an extra 5% tax on those whose sales value exceeds MX\$25,000 (some US\$2,700). Although the impact of this tax is estimated not to be significant,

its institution provided the excuse for the IT community to demand that the federal government formulate and implement the plan and policy detailed above [*El Financiero*, January 24, 2002; www.amece.com.mx/emexico].

In another important initiative, INEGI, Mexico's statistics think tank, is working on the design of a National Informatics Development Program, which is expected to complement the IT plan and policy referred to above [COMECE, 2001b].

Legal Framework

Although it is scattered in various laws and commerce codes, Mexico's legal framework provides basic legal support for e-commerce operations.

Such a framework is contained in the package of reforms prepared by GILCE (the Promotional Group on E-Commerce Legislation) on a number of commercial laws and codes related to e-commerce, and a number of provisions that already contained such codes. GILCE submitted the package to Congress in December 1999, and it was promulgated on May 29, 2000. It gives legal recognition to electronic documents and signatures and therefore constitutes the legal basis for the electronic contracts and transactions. Some of the main elements of this package are described in Sidebar 1.

A consensus does exist in Mexico's e-commerce community on a self-regulation approach based on standards and parameters adopted individually by companies and accepted by consensus, instead of a compulsory, outright regulatory framework [Álvarez, 2000].

Electronic Invoicing

The foregoing legal framework does not include norms on electronic invoicing, which is one of the most demanded issues by companies, industry chambers, and other private sector organizations in Mexico. In 2001, the Ministry of Economics, in close collaboration with e-commerce promoting bodies like COMECE, AMECE, CANIETI and GILCE, started to work on the preparation of a Data Conservation Norm, which constitutes the first step toward the full recognition of e-invoices. The norm is intended as a long awaited response to the demands and interests of all groups and sectors committed to the development of e-commerce in Mexico. It is expected to enter into force in mid-2002 and will include regulations about electronic invoices and the legal validity of banking and credit card account statements as fiscal proofs [*Reforma*, June 18, 2001, www.amece.com.mx/emexico].

The project was previously discussed in a forum on the Progress in the Legislation on Electronic Commerce organized by the Trade and Industrial Promotion Commission of the Chamber of Representatives of the Mexican Congress in August 2001 [COMECE, 2001a]. In April 2002, this Chamber discussed a project to reform the Federal Fiscal Code to make legal the use of electronic means to submit tax returns, make notifications, present reports, conduct auctions, and produce fiscal invoices and receipts on electronic documents [Díaz, 2002]. If and when approved, the reformed articles of the Fiscal Code will be part of the package that makes up the legal framework that regulates e-commerce activities in Mexico.

Cryptography and Electronic Signature

Electronic signatures are given partial recognition in the legislative package promulgated on May 29, 2000, as equivalent to autograph signatures. As described in Exhibit 1 of the legislation, the reformed Article 1811 of the Mexican Civil Code states that signatures affixed on contracts written on electronic messages "will be recognized when they can be attributed to the person acquiring the obligation and the related information can be accessible for future consultation".

SIDEBAR 1**MEXICAN LEGISLATION ON ELECTRONIC COMMERCE****Civil Code**

- *Article 1803.* Consent will be explicit when the will of the parties is expressed verbally or by data messages. By Data Message will be understood the information generated, sent, received, saved or communicated by electronic or optical means, or through any other technology.
- *Article 1811.* Proposals and their acceptance made by means of a data message, will have full validity and obligatory force.
- *Article 1811.* The signatures on contracts written on data messages will be recognized when they can be attributed to the person acquiring the obligation and the related information can be accessible for future consultation.

Civil Procedures Federal Code

- *Article 210-A.* Data messages, understood the information generated, sent, received, saved or communicated by electronic or optical means, or through any other technology, will have legal effects, full validity and obligatory force. When the law requires that a document be presented and kept in its original form, the requirement will be satisfied if it can be proved that the message has been kept unaltered and can be accessible for future consultation.

Commerce Code

- *Article 47.* Companies are obliged to safely keep letters, telegrams, data messages and other documents they happen to receive in relation with their business dealings, including the copies they produce.
- *Article 642.* Mercantile contracts established by means of data messages, will become perfected right after they are replied accepting the matter and conditions stipulated therein. In the case of contracts in which the corresponding data message requires acknowledgement of receipt, the said contract will enter into force according to the provisions of Article 649 of this code.
- *Article 647.* Full legal effects, validity and obligatory force are recognized to every manifestation or agreement of will established by means of a data message.

Federal Consumer Protection Law

- *Article 1.* It is the objective of this law to effectively protect consumers in transactions made through electronic or optical means, and any other technology suited for the proper use of the data in question.
- *Article 24.* Promote the formulation, diffusion and use of ethic codes for suppliers that consider principles contained in this law with respect to transactions made by consumers through electronic or optical means, and any other technology suited for the proper use of the data in question.

However, a legal framework that gives full security and recognition to digital signatures, including a system of certifying agencies that can provide public certification to the various types of signatures an individual can have for different purposes (paying taxes, buying on-line, establish contracts by electronic means, or doing e-banking) is still lacking in Mexico. Such a system will require a central certifying agency that plays the role of a sort of overall public notary entitled to give ultimate certification to digital signatures. It would have two segments:

- one grouping all signatures in government-related transactions, and
- another for those used for private commercial deals [Empresa-E, 2002a].

A first step was taken in that direction with the May 29, 2000 legislative package, by giving an extensive role to both public notaries and public brokers for issuing digital certificates. It also allows them to use electronic means to keep their books and protocols and register mercantile transactions at the Commerce Public Registry. These provisions are mainly contained in Article 210-A of the Civil Procedures Federal Code, and articles 90 and 93 of the Electronic Commerce chapter of the Commerce Code [Cornejo López, 2001].

As a result, the Mexican Notaries National Association and the Mexican Public Brokers National Association established a Digital Certification Network for each guild. Each network is operated and managed by *Acertia*, a private firm based in Mexico City that markets digital certification services derived from the implementation of the legal framework for e-commerce in force in Mexico. Thus, *Acertia* is the first certifying authority in Latin America, and as such manages the technological infrastructure used by public notaries and brokers. Backed by SeguriDATA, its cryptographic software supplier, *Acertia* serves three areas: Commercial (B2B), Financial (Electronic banking) and Government (B2G) (www.acertia.com).

Under this system, electronic signatures are recognized by using an asymmetric, or Public Key Infrastructure, encryption method, which assigns a dual code to each participant in the transaction, one public and the other to be known only by each participant. A notary public certifies each transaction, which gives it full security and legal value.

Toward an Integrated Legal Framework

Although the legal framework already provides the basic conditions for conducting electronic transactions in Mexico, and induces more companies and individuals to engage in e-commerce, it lacks provisions regarding important issues like privacy, consumer and copyright protection, content regulation, taxation of goods sold over the Internet, and specific protection in the case of electronic frauds like misuse of credit cards and personal information.

Developments like the creation of a Data Conservation Norm and the provisions regarding digital certification by public notaries and public brokers appear as part of a collective effort by both public agencies and private organizations engaged in promoting e-commerce—mainly the Ministry of Economics, AMECE, COMECE and GILCE—to create a sound legal framework that takes account of the many aspects still missing in the existing one and integrates all the required norms in a single package. The issue was discussed in Congress for at least a year, particularly in the Chamber of Representatives (Cámara de Diputados). In early May 2002, the Democratic Revolution Party (PRD) presented the project for what is proposed to become a Federal Law on Electronic Signature and Commerce, Data and Service Messages for the Information Society. The law aims to fulfill the need for such a framework, and is said to provide the legal conditions for the development of e-commerce and other services offered via the Internet required by both suppliers and users of those services [*El Economista*, 2002].

Collectively, those developments give reason to believe that the first integrated and comprehensive legal framework required for e-commerce to take-off fully in Mexico may emerge in late 2002 or early 2003, by providing security and full recognition to electronic signatures.

The enthusiasm that underlies the above prospects should be considered, though, with the knowledge that e-signatures did not receive the acceptance that promoters of e-commerce expected. In the United States, after nearly two years since the Electronic Signatures in Global and National Commerce Act took effect, business people are still reluctant and skeptical about using e-signatures. An analyst concluded that “the promise of e-signatures has fizzled in the face of security concerns, competing e-signature standards, and the fact that, when it comes to big deals, people still like to handle paper”. The reason, he continues, is that there may be greater risk with e-signatures than with the use of credit cards to buy on-line. Contrary to the case of credit cards, if someone were to steal a PIN or hack into a “signature page” on a Web site and sign up for a mortgage or purchase a car in another person's name with his/her electronic signature, the defrauded party would have little legal recourse [Wolverton, 2002].

In any event, the passing of legislation that gives full validity to e-signatures will be essential for e-commerce to fully take off in Mexico.

VIII. CONCLUSIONS

INHIBITORS

Business-to-Consumer (B2C)

One of the most visible obstacles to the spread of B2C electronic transactions in Mexico is the prevailing digital gap, in the sense that only a small proportion of high-income, cultured potential consumers can access the Internet. Most Internet users are less than 30 years old with low purchasing power; the most frequent users are in fact between 15 and 24, while only 20% are 44 or older.

A related barrier is that over one-third of Mexican households are poor and do not have access to credit and other financial services. Over two-fifths of the employed population lives in the informal economy, and most of this floating mass of self-employed, underemployed, and unemployed workers can be assumed to be members of poor households. Thus, two-thirds of the population is not likely to become on-line consumers.

This conclusion is reinforced by the prevalence of a traditional shopping culture that makes Mexicans, in general, prefer to buy at the store in person and distrust purchases through catalog, let alone on-line. Moreover, Mexican consumers are distrustful of making payments over the Internet because, in their view, the use of credit cards is unsafe. This perception is not unfounded. Electronic fraud is common with credit cards when used personally in establishments, which leaves open the way for similar crimes in on-line transactions. Electronic fraud is one of the main deterrents to consumers shopping over the Internet and so further limits the growth of B2C e-commerce, for the credit card is the payment instrument par excellence over the Web.

A final factor limiting the spread of B2C transactions is the dispersion of a considerable part of the population in small communities of less than 2,500 population. These communities are not likely to have the minimum conditions for introducing IT and telecommunications infrastructure in the near future. So far only 300 cities are connected, although physical connectivity is being supplemented by mobile telephony networks, which are growing much faster than fixed phone lines.

In summary, all the above factors hinder the diffusion of B2C e-commerce transactions. Forrester estimated that only 7% of Internet users are engaged in B2C e-commerce in 2000. Growth will depend on the extent to which income distribution is improved, in the sense of abating poverty, and Internet access is extended to reach a larger proportion of households. Access depends on how successful the efforts are by both telecommunications companies and the federal government, especially the e-Mexico project.

Business-to-Business

One of the most limiting factors of B2B e-commerce is that 96% of Mexico's company population consists of SMMEs, most of which generally lack the resources and entrepreneurial culture to know about, and acquire IT equipment and do business on-line. An additional drag is the considerable investment and the relatively long time required to install IT infrastructure and equipment and upload the company's business to the Internet.

The problem is complicated by the Mexican economy which is not entirely made up of formal production activities. As official statistics report, informal activities account for 13% of GDP. A mass of precarious informal establishments operate in the underground, outside the circuits of the formal economy, and are thus unlikely to go public and set up a Web site to do business on-line. For informal businesses to become suppliers to "formal economy" customers, they also need some kind certification, increasingly an ISO, which is not within their reach.

Finally, as in the case of B2C, the still limited extent of telecommunications infrastructure is one more circumstance that inhibits the growth of B2B e-commerce. Although progress is substantial, Internet connectivity does not reach a large proportion of localities, many of which are very small towns and villages located far from the main networks.

All the above circumstances and factors, act jointly as barriers for e-commerce to grow more rapidly in Mexico. Their actual effect will depend on the extent to which they are counteracted by the enabling forces that are also in operation in Mexico.

ENABLERS

Overall Forces

A variety of enabling forces counteract the inhibiting factors. They include:

- The fair performance of the Mexican economy in the last few years, which was able to maintain a low and declining inflation, and a relatively stable exchange rate with the U.S. dollar. As a result, a favorable environment for investment in new ventures, including Internet and e-commerce companies, and for doing business in general, ensued. The number of commercial Internet users grew rapidly.
- The liberalization of the telecommunications industry during the last two federal administrations worked in the same direction, allowing the entry of new firms, and the introduction of competition in phone, television, and Internet provider markets.
- Although still limited in extent and coverage, Mexico's telecommunications infrastructure provides Internet connectivity to the main cities where the bulk of e-commerce activity takes place. Both government agencies and private phone companies are investing to extend telecommunications networks. These networks are being increasingly supplemented by the wireless infrastructure built for mobile telephony, Mexico's telecommunications infrastructure, coupled with a liberalized telecommunications industry jointly constitute a major driver and a solid enabling force for the spread of e-commerce. Although the e-Mexico system is still a project in search of both financial and operational feasibility, it is underway with the backing of the Fox administration's full political commitment. The e-Mexico system gives grounds to expect that the telecommunications infrastructure, in general, and Internet connectivity, in particular, will be extended and reinforced in the years ahead. For the time being, the e-Mexico promise is acting as an additional enabling force for e-commerce.
- An important, perhaps crucial, enabler of both B2C and B2B e-commerce transactions is the existence of legal norms that grant legal value to electronic documents and signatures. The law allows for notary publics to act on electronic grounds and through electronic means. The first steps toward legislation protecting consumers in the use of credit cards was also taken in some states and are expected to be extended to the rest of Mexico in coming months. In addition, the Data Conservation Norm, to be introduced shortly, will give full validity to electronic invoices. Jointly, these instruments make up a legal framework that provides basic security and certainty to companies and individual consumers alike for conducting business on-line, thus improving the conditions for the spread of electronic transactions in Mexico.

Business-to-Consumer

The low penetration of B2C e-commerce (0.16% in 2000) is indicative of the size of the growth potential that is dormant in the Mexican economy. The very existence of this potential and the growing awareness by both new- and old-economy companies of the benefits it can provide constitutes a major driving force for the diffusion of B2C transactions.

In spite of the substantial proportion of people in poverty, at least half of the Mexican population makes up a potential consumer market, which in itself can be identified as another key driver of B2C e-commerce. This potential is reinforced by the observed growth of households becoming connected to the Internet, by the consistent increase of individual Web users, by the increase in the number Mexican homes with at least one PC. These trends are further driven by the growing exposure of young generations to computers and the Internet both at home and in the classroom. Most elementary and secondary schools include basic instruction courses and computer labs in their academic programs.

The growing number of portals and Web sites set up by the federal, state and municipal governments offering the possibility of using public services and conducting all kinds of dealings with government agencies and offices through the Internet, is also contributing to B2C e-commerce diffusion. The growth of e-banking is working in the same direction. A wide and increasing array of services is available to customers by most banks operating in Mexico through comprehensive Web sites. The comfort and convenience offered by these options give grounds to expect that the number of customers preferring banking on-line will continue to increase significantly, reinforced by the prospects of improved security for on-line transactions.

More generally, the spread of e-government and e-banking together is inducing more and more Mexicans to use the Internet for shopping, and so to become e-consumers in a broader sense.

Business-to-Business

Although some of the factors driving the diffusion of B2C may also influence B2B, forces are at work specific to B2B. As elsewhere, B2B is the most common and widespread kind of electronic commerce in Mexico.

The fact that B2B has penetrated 38 times¹² more than B2C in the Mexican economy, and that B2B accounts for at least eight out of 10 e-commerce transactions, indicate that B2B offers greater growth potential than B2C, at least in the short run.

The low penetration in SMMEs and large companies alike, and the growing perception by both that they can gain and profit by optimizing organization structures and management methods speak of such potential. This perception is largely the result of the work of specialized organizations like AMECE, COMECE, AMITI, and CANIETI as well as high-tech and IT companies like Microsoft, Gedas, SAP, IDC, Oracle, IBM, and others, through working groups and permanent promotion campaigns.

These actions are a critical enabling element, because large organizations are the ones that come up with new ideas and initiatives to promote e-commerce, and push them through the government for approval and implementation. Very close to this industry initiative is the key role played by government offices, especially the Ministry of Economics, for several programs it operates geared at helping SMMEs to modernize and adopt IT and venture into e-commerce. A most important initiative in that regard is the development of the *e-Mexico* National System, which cuts across all areas of the Mexican economy and society, and is potentially one of the most important enablers of IT-related activity, B2B e-commerce included.

In addition to government agencies, like the Ministry of Economics and Nafin, makers, developers and marketers of IT equipment and computer software made SMMEs the target of their marketing campaigns with an eye to tap this substantial and dynamic part of the Mexican economy. The traditional limitations of SMMEs to acquire digital technologies and venture into the Internet are being eliminated with the introduction of services of a growing number of ASPs offering low cost access to software and Internet-based business solutions to SMMEs. This is also being reinforced by the increasing demands SMMEs face for modernizing their structures and upgrading their equipment and business capabilities as a condition to become suppliers of larger, more developed firms, especially subsidiaries of multinational corporations (MNCs).

MNCs are the carriers par excellence of high technologies in general, and of IT in particular. They are the leading practitioners of e-commerce. As dynamic nodes of continental and global production and business networks, MNCs and their domestic affiliates extensively and increasingly use the Internet to manage their operations via B2B practices like e-procurement, e-logistics, and overall supply chain management. In this sense, MNCs, together with large domestic firms like Peñoles and Grupo Vitro, can be said to be the main drivers of B2B in Mexico. As pointed out above, they are pulling SMMEs into their business networks as domestic suppliers, pushing them to upgrade their plant and equipment and their management practices.

¹² The expression "38 times" refers to the fact that B2B penetration was estimated at 6.1%, while that of B2C was estimated at only 0.16 percent; that is, 38 times smaller than the former.

The most dynamic industries—electronics, computing, automobile, telecom, and banking—are composed of and/or dominated by subsidiaries of MNCs. These industries constitute a driving factor that opens more possibilities for B2B e-commerce to grow in Mexico. Moreover,

- the large presence of MNCs,
- the close geographical vicinity to the United States, and
- the partnership of Mexico with the U.S. under NAFTA,

provide the conditions for developing strong exchange and collaboration links with Silicon Valley and, by extension, with other high technology hotbeds. These connections open the possibilities for technological upgrading and innovation development akin to e-commerce in Mexico's top high tech centers, like Guadalajara, Mexico City, and northern border cities such as Tijuana and Ciudad Juarez.

Overall Balance

The complex interplay of the two sets of opposing forces referred to in the foregoing discussion will define the pace and extent of e-commerce growth in Mexico in the coming years. Although it is difficult to predict the outcome, enabling factors are more likely to prevail over inhibitors, so that e-commerce is likely prosper dynamically over the first half of the present decade. The active and decided commitment of both the public and private sectors to this endeavor, and the more objective existence of rather favorable economic conditions lead one to this favorable conclusion.

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EDITOR'S NOTE: The following reference list contains the address of World Wide Web pages. Readers who have the ability to access the Web directly from their computer or are reading the paper on the Web, can gain direct access to these references. Readers are warned, however, that

1. these links existed as of the date of publication but are not guaranteed to be working thereafter.

2. the contents of Web pages may change over time. Where version information is provided in the References, different versions may not contain the information or the conclusions referenced.
3. the authors of the Web pages, not CAIS, are responsible for the accuracy of their content.
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