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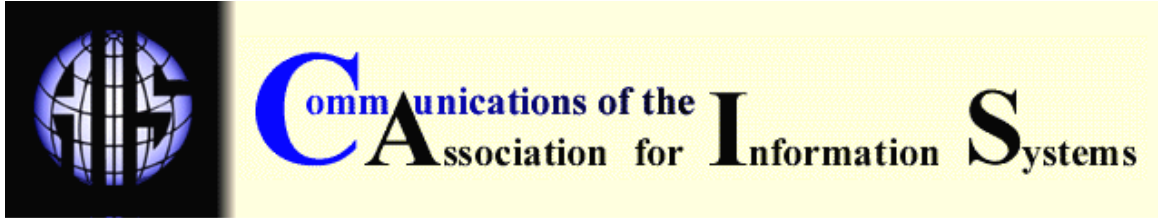
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GLOBALIZATION OF E-COMMERCE VIII: ENVIRONMENT AND POLICY IN TAIWAN

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ABSTRACT

The international environment is the most important factor that drives the diffusion of B2B e-commerce in Taiwan. The digital information network that enables supply-chain management is used by Taiwanese firms as a means to protect their position in global production. National environment elements, such as telecommunication infrastructures and human resources, are useful reinforcing factors, but not powerful enough to drive the whole process. Government policies play a role only to the extent that they encourage a certain approach to e-commerce solutions.

In the case of B2C e-commerce, Internet penetration among the general population is a precondition for diffusion. On-line security concerning trading and payment is critical for the acceptance of electronic commerce by Internet users and the national environment is crucial in this regard. Nevertheless, the most effective driver for the diffusion of electronic trade appears to be innovation of the right products. Without such products, the diffusion of e-commerce will be limited, even with the right environment and policies.

Keywords: electronic commerce, Internet, B2B, B2C.

I. INTRODUCTION

Electronic commerce remains a small proportion of trade in Taiwan, although it is growing steadily. To this point, B2B e-commerce is driven largely by the international environment rather than by policy. Competitive pressure in the international market forces firms to change both their trading habits and the internal organization of production. National environment matters only to the extent that it can be made to accommodate the need for such a change, and to provide an interface with the international environment. Government policies on taxes and incentives toward e-commerce have been even less powerful in promoting e-commerce, although they may spoil the whole process if the government takes a negative attitude toward e-commerce.

Providing a secure and convenient mechanism for account settlement on the Internet is crucial to the diffusion of B2C e-commerce. Without such a legal mechanism, e-commerce will not take off. But even if this mechanism is established, electronic trade is more likely to be a complement rather than a substitute for conventional commerce. The real change in trading habits will come only when new products that are only suitable for online transactions become available and the penetration of broadband is deep enough to provide that opportunity. Beneficial changes to

conventional markets may occur when these new products replace conventional products. In the author's opinion, the dot.com boom turned out to be a bubble because it only suggested a new way of trading without offering concrete product innovations.

Taiwan is unique in its high degree of exposure to the international market and its densely distributed real-time stores. The former factor is an effective driving force for the diffusion of B2B e-commerce, particularly in the trade between Taiwanese manufacturers and international buyers. But diffusion of online trade between domestic firms in Taiwan displays no major differences from the rest of the world. In B2C e-commerce the densely distributed retailers leave little room for online trading, which is limited to intangibles and small items with highly dispersed demand. The difference in B2C e-commerce diffusion in Taiwan and other countries is probably a matter of degree rather than substance. Like other countries, the key to the future development of B2C e-commerce depends on Internet-oriented product innovations.

II. NATIONAL ENVIRONMENT

POPULATION AND DEMOGRAPHICS

The population of Taiwan was estimated at 22.3 million at the end of 2000. As a result of a declining fertility rate and increasing life expectancy, the population aged rapidly in recent years. In December 2000, people aged 65 and over accounted for 8.6 percent of the population (Table 1).

Table 1. Age Distribution of Taiwan's Population, December 2000

Age	Percentage (%)
0 - 14	21.1
15 - 19	8.4
20 - 29	17.0
30 - 39	17.2
40 - 49	15.6
50 - 64	12.0
65 and over	8.6

Source: Directorate-General of Budget, Accounting and Statistics (2001).

The senior cohort, together with those aged 50-64, tends to be the most resistant to adapting to Internet life since they were brought up in the pre-computer era. This Internet-resistant group currently accounts for 20.6 percent of the population. Conversely, the younger population aged 15-29, accounting for 25.4 percent of the population, tends to be the most Internet-receptive. Those aged 30-49 with a varying degree of exposure to computers can be retooled to accommodate Internet life.

Taiwan is a small island with a high population density and most of the island's population lives in either cities or towns. In 2000, a total of 16.3 million people were living in cities and towns, representing 73.4 percent of the population, while only 5.8 million, or 26.6 percent, were living in villages [Ministry of Interior, 2000]. The most popular city and township habitat is a condominium dwelling, which makes cable TV networks prevalent in Taiwan's urban households.

ECONOMY

In recent years, Taiwan's economic growth slowed from its previous rapid pace of the 1980s, but it nevertheless remained robust. The average annual GDP growth rate for 1990-2000 was 6.42 percent. As a result of this robust growth, per capita income rose from US\$8,111 in 1990 to US\$14,216 in 2000. The economy experienced its first-ever recession in 2001, with an economic growth rate estimated at -2.2% (Table 2). Alongside the slow-down of economic growth, income distribution is worsening. In 2002, the average income of the top-quintile (20%) of households

was 5.55 times that of the bottom quintile, a ratio much higher than past norms, although still lower than most industrial countries. The unemployment rate was also at a historically high level, averaging 4.57% in 2001.

Table 2. GDP Growth and Per Capita Income

	GDP growth rate (%)	Per capita income (US\$)
1990	5.39	8,111
1991	7.55	8,982
1992	7.49	10,502
1993	7.01	10,964
1994	7.11	11,806
1995	6.42	12,686
1996	6.10	13,260
1997	6.68	13,592
1998	4.57	12,360
1999	5.42	13,235
2000	5.98	14,216

Source: Council of Labor Affairs (2000).

The structure of the economy reorganized significantly in the 1990s; in particular, the mainstay of economic activities shifted from the manufacturing sector to the services sector. Manufacturing accounted for 33.31 percent of GDP in 1990, but the share declined steadily in the 1990s, settling at 26.33 percent in 2000 (Table 3). In its place, the GDP share accounted for by service output increased to 65.99 percent from the 54.98 percent share in 1990. Amongst the various service sectors, retail trade and finance contributed most to this expansion.

Table 3. Distribution of GDP by Industry, Percent (%)

	Agriculture	Manufacturing	Construction and Utilities	Services		
				Retail	Finance	Others
1990	4.18	33.31	7.53	14.21	16.71	24.06
1991	3.79	33.34	7.36	14.61	16.25	24.65
1992	3.60	31.70	7.69	14.98	16.96	25.07
1993	3.64	30.56	8.02	15.30	17.56	24.92
1994	3.51	28.99	8.21	15.61	18.96	24.72
1995	3.48	27.92	7.98	16.35	19.26	25.01
1996	3.19	27.92	7.39	16.80	19.50	25.20
1997	2.55	27.80	7.05	17.23	20.56	24.81
1998	2.47	27.39	6.65	17.77	20.36	25.36
1999	2.56	26.59	6.10	18.49	20.35	25.91
2000	2.06	26.33	5.62	19.16	20.50	26.33

Source: Directorate-General of Budget, Accounting and Statistics (2001).

Although Taiwan is a major producer of computer hardware, it is not a major consumer of computer-related services. Nevertheless, structural changes in the 1990s pushed Taiwan's economy toward greater consumption of such services. As shown in Table 4, Taiwan produced U.S. \$22,157 million worth of IT hardware in 2000, ranking it fifth in the world in terms of IT output, just behind the U.S., Japan, Singapore and China. In contrast, the number of PCs owned in Taiwan is relatively small, and estimated at 224.65 per thousand people. The number is dwarfed by 344.52 in Australia and 483.11 per thousand in Singapore. Lack of purpose discouraged households from owning PCs, even though PC prices are relatively low in Taiwan. This data suggests that Taiwan did not take full advantage of information and communication technology to become an "information society." But Internet diffusion did promote PC ownership,

as the number of PCs per thousand people was 102.67 in 1996. Likewise, IT spending also accounts for only a small fraction in Taiwan's GDP. In 2000, only 1.47 percent of GDP was spent on IT hardware, software, and related services—much less than the proportions in major IT-producing countries such as the U.S., Singapore, and Japan.

Table 4. IT Infrastructure in Asia-Pacific

	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
Australia	3.63	344.52	\$943.19	\$810.32
China	1.49	15.90	\$23,075.00	\$10,169.00 ^f
Hong Kong	1.87	382.73	\$1,737.51	\$11,359.41
India	0.92	4.54	\$781.38	\$116.01
Indonesia	0.57	9.43	\$1,029.00	\$1,146.00
Japan	2.50	315.16	\$55,339.56	\$25,697.98
Korea	2.69	190.27	\$7,680.75	\$10,257.00
Malaysia	2.21	103.14	\$10,637.76	\$16,977.89
New Zealand	4.85	360.24	\$142.20	\$80.11 ^f
Philippines	1.28	19.35	\$2,484.00	\$3,300.00
Singapore	3.52	483.11	\$25,797.31	\$29,422.94
Taiwan	1.47	224.65	\$22,157.29	\$24,547.31
Thailand	1.07	37.95	\$8,730.92	\$7,936.51
United States	4.56		\$88,488.62	\$38,488.00
Asia Pacific ^d	2.24	34.33	\$160,535.90	\$141,820.50
OECD ^e	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, March 2001.

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

^dOnly countries included in the 44-country sample are used in the classification. Asia Pacific consists of the following countries: Australia, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore, Taiwan, Thailand.

^eOnly countries included in the 44-country sample are used in the classification. OECD here denotes the OECD member countries, excluding Luxembourg, Slovakia and Iceland.

^f1998 data.

Low levels of PC ownership and IT spending indicate that the Taiwanese society is not ready to take advantage of new IT technologies despite its ability to produce IT hardware for export. This production ability, however, is being undermined by rising wages. In the second half of the 1990s, hardware producers started shifting their production to China while they continued to serve as subcontractors for international brands. These producers found that investment in IT technologies to reorganize production globally was a good way to preserve their position in the international production network. In essence, it is the linkage to international buyers that drives the diffusion of IT technologies in Taiwan.

The government in Taiwan is also concerned that the imminent 'hollowing-out' of the domestic manufacturing sector as a result of foreign direct investment will loosen its ties to international buyers and hence jeopardize Taiwan's ability to win major export orders. The government conceived several measures as a means of reinforcing the foundation of Taiwan's export-order winning capabilities, one of which was to strengthen the B2B networks linking Taiwanese companies to the major multinational buyers.

In March 2000, Taiwan elected a new president from the opposition party and unseated the KMT government, which ruled Taiwan for over 50 years. The transition of power is not smooth, as the new ruling party is not a majority in the parliament. Being unable to implement the programs that

the party conceived in its efforts to reform the economy, and burdened by the simultaneous international recession, Taiwan's economy since the new government took office has been miserable. The manufacturing sector was in a tailspin with both high-tech and traditional industries forced to lay off workers. While the recession hampered the willingness and ability of enterprises to invest in Internet-related facilities, consumer demand for Internet services was not affected. In addition to the increase in household connections to the Internet, Internet shops (Internet cafés) also mushroomed throughout the streets of Taiwan in 2001.

INDUSTRY STRUCTURE

One distinctive characteristic of Taiwan's industrial structure is the dominance of small and medium enterprises (SMEs). Table 5, which lists the size distribution of business firms from the 1996 census, shows that firms with 100 employees or more account for less than 1 percent of the total number of business enterprises in Taiwan. The average size of manufacturing firms is slightly larger than service firms, but manufacturing firms with 100 employees or more still account for only 2 percent of the entire sector. At the end of 2001, SMEs with less than 300 employees employed a total of 4,636,377 persons, accounting for 68.9% of total employment. But in 2001, the turnover of SMEs only accounted for 28.4% of the total transactions in the economy and the exports of SMEs accounted for 20.7% of total exports [Small and Medium Enterprise Administration, 2002, p.5-9]. The dominance of SMEs in terms of number and employment presents a major obstacle to the adoption of e-commerce in Taiwan's industry. SMEs lack the financial resources to invest in computer hardware and software to enable their computer-based transactions, Even if computer-based trading systems were installed free of charge, they still lack human resources with the capability of maintaining them.

Table 5. Distribution of Business Firms by Size, 1996

Size by Employment	All Sectors		Manufacturing Sector		Service Sector	
	No.	%	No.	%	No.	%
Below 5	618,434	(71.4%)	71,105	(45.9%)	523,552	(79.0%)
5 - 9	138,272	(16.0%)	36,631	(23.7%)	88,037	(13.3%)
10 - 29	82,212	(9.5%)	32,890	(21.3%)	40,386	(6.1%)
30 - 49	13,608	(1.6%)	6,544	(4.2%)	5,561	(0.8%)
50 - 99	8,631	(1.0%)	4,593	(3.0%)	3,056	(0.5%)
100 - 499	4,590	(0.5%)	2,587	(1.7%)	1,509	(0.2%)
500 and more	821	(0.1%)	403	(0.3%)	361	(0.1%)
Total	866,573	(100.0%)	154,753	(100.0%)	662,462	(100.0%)

Note: The numbers of firms in the manufacturing and service sectors do not add up to the sum total because mining, utilities, and construction sectors are left out.

Source: Industrial and Commercial Census, Taiwan, 1996.

To overcome these obstacles, rather than searching for individual solutions, the Taiwanese government advocated a group approach to the adoption of e-commerce. The government encourages SMEs to adopt the new technology in consortium with large firms, which will often act as their buyers, and initiated programs to subsidize such a group approach to the e-commerce solution. The government also offers various training programs through government-sponsored technology institutes to help SMEs gain an understanding of e-commerce related technologies. Taiwan's manufacturing sector is expected to be more receptive to e-commerce than the service sector because of its close linkage to the American firms that are leading the drive toward total electronic-based trading.

The manufacturing sector evolved from a well-diversified structure to a very concentrated one; the output of manufacturing sectors in 2000 is listed in Table 6. It can be seen from Table 6 that because of the rapid expansion in the 1990s, the electrical and electronics sector now accounts for 36.7 percent of the total manufacturing output; in contrast, traditional industries show a rapid decline in their output shares. For example, the textile and apparel sectors account for 4.4 percent of manufacturing output, rubber and plastic products account for 4.3 percent, and metal

products account for a mere 0.5 percent. Within the electrical and electronics sector, information and communication technology-related

Table 6. Output Value of Manufacturing Sectors, 2000

Sector	Output value (NT\$ million) ¹	Share (%)
Food	448,326	5.3
Tobacco and beverages	24,713	0.3
Textiles	348,222	4.1
Apparel	86,026	1.0
Leather products	41,937	0.5
Bamboo and wood	16,543	0.2
Furniture	52,318	0.6
Paper	153,845	1.8
Printing	65,540	0.8
Chemical products	717,619	8.5
Chemical materials	196,259	2.3
Petroleum and coal	396,404	4.7
Rubber	62,153	0.7
Plastics	304,693	3.6
Non-metal minerals	194,348	2.3
Basic metal	795,631	9.4
Metal products	410,113	0.5
Machinery	406,149	4.8
Electrical and Electronics	3,119,021	36.7
Transport equipment	481,140	5.7
Precision instruments	58,584	0.7
Miscellaneous	109,621	1.3
Total	8,489,205	100.0

Source: Industrial Development Bureau (2001b).

production plays a central role. The output value of computers and computer peripherals was NT (standing for Taiwanese currency, New Taipi) \$959,971 million in 2000, accounting for 11.3 percent of total manufacturing output, and exceeding all of the other manufacturing sectors listed in Table 6. The output value of semiconductors was NT \$807,511 million, accounting for 9.5 percent, and for telecommunications equipment it was NT \$154,373 million, accounting for another 1.8 percent. These three information and communication technology sub-sectors together accounted for 22.6 percent of total manufacturing output in 2000.

The growing importance of the information and communication technology industry creates an environment conducive to the diffusion of e-commerce. Although Taiwan was not a major user of information and communication technology products, despite its major role in producing them, the situation has started to change approximately in 2000. The industry itself is active in information and communication technology investment to update itself on new ways of international trading. Most information and communication technology firms are contract manufacturers for multinational firms, and thus the ability to receive, process, and respond to new information is essential to their competitiveness. They also must integrate themselves into the production and market-servicing networks of international buyers, and digitization is indispensable in that endeavor.

HUMAN RESOURCES

In 1968, the government of Taiwan extended the mandatory period of education from six to nine years (from primary school to junior high school) and since then, it introduced a requirement for a

¹ Approximately NT\$33 = \$US 1

three-year period of English education in the junior high school curriculum, thus exposing the majority of the population to the English language. Although Chinese language-based computers were available since the late 1970s, knowledge of English is essential in the ability to use computers.

Along with the country's rapid economic growth, educational attainment levels were also enhanced. By December 2000, the literacy rate amongst the population aged 15 years and above was 95.6 percent (see Table 7). Amongst this group, 30.9 percent received secondary education (high school) and 20.6 percent received postsecondary education (junior college and above). Altogether, 51.5 percent of the country's potential labor force received a secondary education or higher.

Table 7. Educational Attainment of Taiwan's Population, Age 15 and Over, December 2000

	Population (1,000s)	Percentage (%)
Total	17,574	100.0
Literate	16,792	95.6
Graduate School	219	1.2
College	1,517	8.6
Junior College	1,935	11.0
Senior High	5,426	30.9
Junior High	3,820	21.7
Primary School	3,875	22.0
Illiterate	781	4.3

Source: Ministry of Interior (2000).

In addition to telecommunications infrastructure and financial services, the development of e-commerce ultimately hinges on human skills. Taiwan's educational system produces a large number of junior-college graduates who are mainly trained as technical personnel in trade, engineering, or office management. Starting in the late 1990s, the junior colleges were gradually upgraded to regular colleges, which are now expected to produce even more college graduates for the future. This upgrading in educational structure is also conducive to Internet diffusion.

Electronics-related disciplines remain the most favored programs currently being pursued by college students in Taiwan. In 2000, for example, Taiwan produced 138,575 college graduates in science and engineering (including advanced degrees), making up 55.9% of the total number of 247,890 students who graduated from colleges (including junior colleges) that year. That number is, however, still insufficient to support the rapid expansion of the information and communication technology industry and the increasing need for Internet-based services [Ministry of Education, 2002]. The increasing supply of engineers is outpaced by increasing demand, which is fueled by the booming information and communication technology-sector and increasing need for IT skills. In 2001, an average Taiwanese large enterprise (with employment over 300) employed 11.49 IT personnel, a 34.9% increase from the previous year [MIC, 2002, p.95]. Managerial and artistic skills to handle aspects such as management information systems and Web page design are also in short supply.

The rising demand for skilled labor within Taiwan attracted talented college graduates to join the industry instead of going abroad for advanced studies like their predecessors. This change threatens to deplete the pool of skilled engineers who are educated overseas that Taiwan's information and communication technology industry depended upon so much in the past for its development. Although overseas Taiwanese engineers continue to return to Taiwan, the pool of returning expatriates shrunk due to the declining numbers of new students. In contrast, the number of mainland Chinese overseas students continued to rise and the stock of Chinese overseas engineers is accumulating quickly. Taiwan's information and communication technology industry continues to pressure the government to allow Chinese engineers to work in Taiwan; otherwise the industry may have to relocate their R&D centers to mainland China.

INFRASTRUCTURE

In December 2001, 12.8 million people subscribed to fixed-line telephones in Taiwan, representing 57.4 percent of the population. In comparison, 21.6 million people subscribed to cellular phones, which were not available until the late 1980s. The number of cellular phone subscribers was only 4.3 million in December 1998. Many youngsters own more than one cellular phone just to enjoy the incentive package that telecommunication service operators offer to attract subscriptions. The five-fold increase of cellular-phone users in the three years between 1998 and 2001 was precipitated by the liberalization of the telecommunications market, which only began in 1996. Liberalization removed the monopoly power of the government-owned telephone operator and opened the market to private competition. In particular, participation by private operators in the cellular phone industry has led to a rapid decline in service charges, along with enhancements to the service quality and a broadening of product choice, which in turn, has induced a ballooning demand amongst the younger population, those who would not normally have a fixed-line telephone for personal use at home. As shown in Table 8, public-owned Chunghwa Telecom accounted for 28.6% of the 2001 market share in terms of subscription, as opposed to 71.4% accounted for by the private operators. In terms of revenue, Chunghwa Telecom accounted for 33.2% of the market share, indicating its richer product portfolios than those offered by the private operators.

Table 8. Market Share of Public-Owned and Private-Owned Cellular Phone Companies, November 2001

	Subscriber (1,000)	Share (%)	Revenue (million NT)	Share (%)
Public-owned	6,124.4	28.6	51,993.4	33.2
Private-owned	15,264.2	71.4	104,610.0	66.8
Total	21,388.6	100.0	156,603.4	100.0

Source: Directorate General of Telecommunications, Ministry of Transportation.
Note: Revenues are January-November, 2001.

As a result of increasing demand for cellular phones, mobile phone services in Taiwan now constitute the mainstay of the telecommunications industry. Private competition also drive down the ultra-high tariffs previously charged by the state-owned monopoly. In 1999, the average cellular phone service fee in Taiwan was estimated at US\$29.0 per month based on 90-minute peak-time service and 50-minute off-peak service [ITU, 1999], which was very close to the worldwide average of US\$33.4.

In December 1996, the number of Internet subscribers in Taiwan was 600,000; by December 2001, that number had risen to 7.82 million, a 13-fold increase in five years. Internet subscribers now represent 35 percent of the entire population, making Taiwan one of the most Internet-penetrated countries in Asia, next only to Singapore and Korea [III, 2002]. Table 9 shows the growth of the Internet population from 1996-2001. It can be seen that Internet diffusion was not disrupted despite the Asian financial crisis of 1997-1998 and the severe recession in 2001.

Table 9. Growth of Internet Population

Year	Year-end population (thousands)
1996	600
1997	1,660
1998	3,010
1999	4,800
2000	6,260
2001	7,820

Source: III (2002).

Like most other countries, Internet penetration in Taiwan started with the younger generation. Schools are generally the place where students first gain experience with an Internet connection. A 1999 survey by the Institute for Information Industry [III, 1999] indicated that around 70 percent of Taiwan's Internet users were below 30 years of age, and 69.3 percent of them were college students or college graduates. About half of all Internet users live in metropolitan Taipei and the number of male users exceeds the number of female users. Most new entrants to 'cyberspace' come from the population cohort aged between 16 and 35 with postsecondary education. Because of the active participation by college students and graduates, 78 percent of Internet users now are educated beyond the secondary degree level. The average age of Internet users is moving downwards while the average level of educational attainment is moving upwards.

A survey conducted in August to October 2001 [III, 2002] indicated that about 27.4% of Taiwan's households could access the Internet. However, some studies show that technical support provided at the workplace or school is important to keep the Internet users on line. Those who access the Internet only at home, such as non-working housewives, suffer from a high dropout rate [Chen et al., 2002]. Internet penetration rate is the highest among the households formed by both parents and some children. Single parent families and families without children are relatively inactive in Internet surfing. This result suggests that children are an important facilitator of Internet subscription. In terms of age, Internet-connected households are dominated by those headed by men aged 30 to 50.

The most common activities conducted on the Internet by Taiwanese users are, respectively, sending and reading e-mail, transmitting files, searching for information, downloading online voices and images, playing games, chatting and reading news. On average, Taiwanese Internet users spend 9.1 hours browsing Web sites each month, and stay online for 24.4 minutes during each visit [Commercial Times, 2001d].

In addition to Internet service providers (ISPs), Taiwanese Internet users also use cable TV and direct PCs (which are provided by satellite TV operators, with direct broadcasting system [DBS] technology) for Internet access. Cable TV potential for providing Internet services in Taiwan is great because 80.6 percent of the Taiwanese households are connected to cable TV networks and the government has allowed cable operators to engage in data communication services since 1997.

In March 2000, the government issued three new licenses to private fixed-line operators, all of whom commenced operations in 2001. Not only will these private operators participate in domestic competition for voice and data communications, but they also will be allowed to invest in intercontinental access cables. Until now, these access cables were monopolized by the state-owned Chunghwa Telecom, which is accused of charging excessive rental fees for international connections in order to put its competitors in the ISP business in a disadvantageous position. As a result, Chunghwa Telecom continued to dominate Taiwan's ISP market with a market share of around 38 percent (through its subsidiary Hinet.com) but was slow in establishing its broadband-enabling asymmetric digital subscriber line (ADSL) network because of bureaucratic procedures that hampered the procurement and construction of the necessary infrastructure. With the entry of private fixed-line operators, the construction of ADSL and optical fiber networks accelerated, leading to increased broadband penetration, which in turn drove down Internet access fees. The intensified competition since 2000 increased the number of ADSL subscribers from a mere 2,000 in 1999 to 125,000 in 2000, and to 920,000 in 2001, while the number of cable modem subscribers also rose from 25,000 to 95,000 and then to 210,000 during the same period. The total number of broadband Internet users was 1.13 million in December 2001.

The speed of ADSL penetration apparently exceeded that of cable. Rapid expansion of ADSL networks was attributable to Chunghwa Telecom's aggressive marketing effort in 2001 and the increasing demand for online image transmission capacities among the younger Internet users. Chunghwa lowered ADSL access rates and stepped up construction of optical fiber networks to boost subscriptions in an effort to combat its loss of market share and revenue in voice transmission services, especially in the mobile-phone segment. The newly entering private fixed-

line operators, although posing a potential threat to Chunghwa Telecom in the broadband market, turned out to be friendly allies for Chunghwa in the short run. Thwarted by local governments' reluctance to issue permits for works on public roads, the private operators find it difficult to construct their own networks in the short run while the demand for broadband service is rising rapidly. They chose to lease the networks from Chunghwa Telecom to provide such services, acting as a promoter for Chunghwa. Demand for broadband service was boosted by the increasing popularity of online gaming among the young population. Traditional dial-up service does not provide enough bandwidth to accommodate the capacity needed for image transmissions. Even if the private operators are to establish their own backbone networks, they will not be able to penetrate the "last mile" because the networks inside the existing buildings, including the connecting boxes and phone-line ducts, are owned by Chunghwa Telecom. Although the government issued an administrative ordinance in 2001 that instructed Chunghwa Telecom to make these local lines accessible to its competitors in offering broadband service, or else it will be charged with "abusing the monopoly position" under the purview of the Fair Trade Law, the private operators have not yet built the networks outside the buildings to take advantage of this open-access policy.

Another major infrastructure factor that affects the development of e-commerce in Taiwan is the widespread presence of neighborhood retail stores on the island. Most retail stores stay open for business for long hours to accommodate nighttime shoppers. E-commerce is hard to substitute for conventional trade unless it offers a genuine product innovation. For example, despite its small area, the second largest number of 7-Eleven convenience stores in the world are in Taiwan (second only to Japan), which are open 24 hours a day. As a result of these pre-conditions, a combination of virtual (electronic) and real stores seems to be the best e-commerce solution. The virtual stores on the Internet can reach distant consumers while the actual stores can provide real-time services such as product delivery, and allow consumers to examine the products physically before purchase. Payment can also be made at the store site to avoid the security problem of online payment. A survey by Ill [1999] on the electronic stores in operation in November 2001 found that 38% of these stores were run by real-time stores, and another 28% of the virtual stores indicated that they would establish a real-time store to facilitate their online transactions [Liu, 2001].

7-Eleven is successfully operating an online shopping portal in consortium with several electronic stores, using its nearly 3000 real-time stores around the country as outlets. Internet shoppers can designate any store as the delivery point where the purchased item can be examined and picked up and the payment settled at the same time. In fact, 22% of the electronic stores use some convenience stores for delivery service [Liu, 2001]. 7-Eleven also runs a door-to-door delivery service, which can ship the purchased items to the doorstep of the buyer. Some products that are unsuitable for display at the store sites, such as fresh fruit, can be ordered online with pre-payment and shipped to the store sites for pick-up. This procedure allows 7-Eleven to market such perishable items from distant origins. 7-Eleven plans to establish a broadband network connecting its island-wide stores, with the assistance of Chunghwa Telecom. The project, which costs NT\$8 billion, will further upgrade the capacity of 7-Eleven to provide B2C services.

FINANCIAL RESOURCES

One of the most important functions facilitating e-commerce is the Internet payment mechanism. Taiwanese consumers are well accustomed to payment by credit cards, which were introduced to Taiwan in the 1970s, but they are not so accustomed to using this payment method on the Internet. 18.3 million credit cards were in circulation in 2000, with card-based transactions amounting to NT\$659 billion (approximately US\$20 billion) [Ministry of Finance, 2001]. Most credit cards were issued by international credit card agencies, such as Visa and American Express, thus enabling international transactions.

But a survey by Institute for Information Industry [Ill, 2002] on "electronic stores" conducting B2C commerce in December 2001 indicated that Interbank transfers and money orders placed through the post office still dominated the payment scheme for online transactions. In addition, payments collected upon delivery by courier carriers or at designated convenience stores are also popular

methods for payment. Although credit card payment is accepted by most electronic stores, consumers are reluctant to use it because of the concern for security. Even when credit cards are used, consumers often prefer to send a written payment agreement through facsimiles rather than paying it directly online [Liu, 2001]. Although credit-card holders are protected by law from fraudulent use of their cards, they nevertheless are wary of the potential troubles.

Taiwan's Banking Law was amended in 2000 to incorporate a provision allowing banks to issue 'electronic money' to facilitate electronic-based trade. Under the new law, banks issuing 'cash-storage cards', which carry cash in an electronic form to enable real-time transactions, must hold reserves against the value embodied in the cards. Treating banks as the designated issuers, the law implicitly disallows non-bank financial institutions to issue such cards. While the regulation is designed to prevent e-commerce related transactions from distorting the money supply mechanism, cash-storage cards have been used only sparingly until now.

Financial resources that enable the establishment and the operation of e-commerce businesses are also important to the development of e-commerce. The lack of physical assets and tangible products often makes it difficult to finance such businesses using traditional financial instruments. A few 'dot.com' companies tried, and failed, to list on the Taiwan stock exchange and eventually moved to the U.S. for listing on the NASDAQ. Under criticism, the Taiwan government instructed the Industrial Development Bureau to establish the criteria that would enable the Bureau to recommend some premier dot.com companies to be listed on the Taiwan Stock Exchange under the heading of 'technology shares'. The targets are Internet content providers (ICPs) and application service providers (ASPs); however, with the bursting of the dot.com bubble in 2000, the program did not yet produce any recommendations from the Bureau.

Taiwan nurtures a sizeable and vibrant venture capital industry, which provides critical support to Taiwan's high-tech ventures; however, the industry tends to lean toward hardware manufacturers in which concrete 'products' are pivotal in winning the endorsement of fund managers. The industry is decidedly lukewarm toward cyberspace start-ups. Instead, it is the established big business groups that are taking the initiative and chipping in funds to jump-start e-commerce operations, the purpose of which is often to facilitate trade within the groups or to trade with a group's external customers and suppliers. For them, e-commerce is more of a new form of 'production' rather than a new product to be offered to the market. Alliances with big business groups are another way some e-commerce entrepreneurs manage to obtain financial resources for the growth of their ventures. Alliances are often formed on the basis of complementarity between the products offered by the business groups and the services offered by the e-commerce ventures.

A survey by Institute for Information Industry in November 1999 located over 40 ISPs, over 20 ASPs, and a large number of ICPs in Taiwan. The survey indicated that the ISP and ASP markets were highly concentrated and dominated by large firms spun off from conglomerates, often taking a joint venture form between several business groups in various industries. By contrast, Internet content providers (ICPs) were only nascent and dominated by a large number of small firms in which venture capital played a significant role in funding the company. Apparently, in Taiwan the entry barrier for ICP is lower than for ISP or for ASP, and innovation is key to its competitiveness. ICP seems to be typical of Taiwan's emerging industry characterized by small-scale and free competition. Despite its shaky start, the ICP sector seems to be the most dynamic segment of Taiwan's Internet service industry [III, 1999].

BUSINESS ENVIRONMENT

Electronic commerce was negligible in Taiwan in 2000, although the government planned to bolster this form of business up to 9 percent of GDP by 2004 [CEPD, 2000]. In a survey conducted by the Ministry of Economic Affairs (MOEA) on Taiwan's Top 1000 enterprises in 1999, less than 40 percent of these enterprises planned to introduce any form of e-commerce, and less than 30 percent of them planned to introduce any online trading in terms of booking, price quotation, invoicing, or the like [MOEA, 1999a]. Among the companies surveyed, the top-ranking firms which did have plans to engage in e-commerce were mainly interested in

broadening their marketing channels (54 percent), followed by coordinating activities among suppliers and subcontractors (27 percent), improving internal management efficiency (12 percent), and others (8 percent). However, most of Taiwan's enterprises engaging in international trade do so as contract manufacturers without their own brand names. Therefore, it is unclear to what extent e-commerce can broaden their marketing opportunities.

By July 2001, the number of Internet hosts in Taiwan reached 2.29 million (Table 10), a number ranking Taiwan in second place in Asia behind only Japan (which had 5.89 million), and sixth in the world [Network Wizards, 2002]. A significant increase in the establishment of Internet hosts in 2001 despite the on-going recession was attributable to the rapid penetration of ADSL networks. Internet penetration among business firms was still at a low level however. A survey from 2000 indicates that the proportion of business enterprises that established their own Web sites stood at 10.7% [MOEA, 2000]. A III survey in 2001 indicates only 26.4% of business could access the Internet, 21.5% of enterprises engaged in online trading, and only 15.0% engaged in online procurement [III, 2002]. As shown in Table 11, among the 1,200 firms surveyed, only 57% of them connected company-owned personal computers to the Internet, while 26% of them connected fewer than 40% of company PCs to the Internet. On the other hand, only 42% of the surveyed firms offered e-mail to more than 80% of the company employees, and only 31.2% of the companies' PC-to-employee ratio exceeded 0.8. The results indicate that business enterprises do not embrace the Internet whole-heartedly.

Table 10. Internet Hosts in Taiwan

Year	Number of hosts (thousands)
1995	16
1996	31
1997	41
1998	354
1999	677
2000	1,157
2001	2,293

Source: Network Wizard (2002).

Note: All data are from July of each year. As of July 2001, out of 2.293 million hosts, 1.28 million were registered under .tw and 1.01 million were under .hinet.net.

Table 11. Internet Penetration of Business Enterprises in Taiwan

Penetration ratio	0	0-0.2	0.21 - 0.4	0.41 - 0.6	0.61 - 0.8	Over 0.8
PC	2%	15%	9%	8%	10%	57%
E-mail availability	3%	25%	12%	9%	9%	42%
PC/employee ratio	0.3%	20.1%	16.4%	16.8%	15.1%	31.2%

Source: Liu (2001).

Table 12 lists the activities and transmission mechanisms that business enterprises use for various transactions. It can be seen that most activities engaged by business enterprises are catalogue submission (or presentation) and price inquiry (or quotation). For large firms (with sales exceeding NT\$500 million), more than half of them participated in these transactions. Order placement and order tracking involve more than one-third of the large firms, but only one-fourth of the medium sized firms. Payment and invoicing are relatively rare in online transactions. Among three mechanisms for data transmission;

Table 12. Data Transmission Mechanism for Various Transactions

	Large Firms			Medium Firms		
	e-mail	exclusive line	Internet	e-mail	exclusive line	Internet
Catalogue Submission	53.6	4.8	21.4	32.3	0	13.8
Price Quotation	51.5	7.2	12.4	32.9	3.7	3.7
Order Placement	45.0	13.0	18.0	26.5	8.4	14.5
Order Tracking	36.8	11.5	10.3	22.1	0	4.4
Inventory Checking	29.5	11.4	11.4	20.5	3.8	7.7
Product Returning	24.7	5.9	8.2	13.6	1.5	0
Payment and Invoicing	22.4	9.4	10.6	9.4	1.6	0

Source: Liu (2001).

Note: Medium firms refer to those with sales 50-500 million NT\$; large firms refer to those with sales exceeding 500 million NT\$.

namely e-mail, exclusive line, and Internet, e-mail is most popularly used, followed by the Internet. An exclusive line is least popular because of high installation costs. In general, the Internet is only sparsely used in trading activities. For example, even for large firms, only 18.0% were using the Internet to place orders, and only 10.3% track their orders on the Internet. As to the benefits of e-commerce, most businesses quoted the saving of delivery time and inventory-holding costs, and the reduction of coordination and consumer-service costs [Hsu, 2002].

It is evident that the introduction of e-commerce may well interfere with existing company routines and practices in terms of procurement, production scheduling, or product delivery. and therefore most of the Taiwanese companies introducing e-commerce do so experimentally. In Taiwan's business world, negotiations are made mainly in face-to-face contacts (including telephones) and decisions are normally discretionary rather than rule-based. For example, to win an important order, a business owner may decide to postpone the production schedules of existing orders already in the production process. A business owner may decide to support a long-term supplier now in financial distress with lucrative terms of contract. Discretion and favors are difficult to digitize. Thus, e-commerce at the present time is limited to customer services and catalogue viewing.

Moreover, most enterprises are skeptical about the security of online trading, which suffers from limited legal protection, as well as the inherent inability of potential consumers to judge the quality of a vendor's product through online information. Skepticism is particularly keen in the financial industry where online transactions may reveal sensitive personal data. In fact, 42.5 percent of the respondents to the Ministry survey above [MOEA, 2000] indicated that security was the most serious bottleneck impairing the introduction of e-commerce in Taiwan. Many traditional industries, particularly those dominated by SMEs, such as the paper products and apparel industries, are most resistant to the idea of Internet transactions. They consider the adjustment costs to the new trade regime to be too high. Some existing commercial practices in the industry also impede the adoption of e-commerce; for example, in the pharmaceutical industry, commission is a common practice in wholesale trading between drug manufacturers on the one

hand, and physicians and hospitals on the other, who totally reject the introduction of online trading since it eliminates the scope for negotiation of commission.

A survey by III in 2001 [Liu, 2001] showed that the trading habits of consumers are the primary obstacle to the expansion of B2C commerce. In addition, security of online trading, the legal environment, and the prevalence of fake credit cards were listed by at least 98% of the electronic stores as major problems inhibiting the development of online business (Table 13).

Table 13. Problems Faced by Electronic Stores in Taiwan

Problem	Percentage of stores encountering the problem
Trading habits of consumers are hard to change	48
Imitation by other stores	48
Security of online trading	38
Hard to make the Web site known	34
Low rate of return on investment	32
Legal environment unsatisfactory	32
The prevalence of fake credit cards	28
Insufficient Internet bandwidth	18
Distribution and delivery problems	18
Management skills lacking	14
IT technicians lacking	8
Other	8

Source: Liu (2001).

Technological barriers also impede the introduction of e-commerce in Taiwan. Although most large enterprises are interested in establishing a Web site, and can afford to do so, they may lack the technical personnel to maintain it. Without the adjustment of a company's internal operational routine, a Web site is nothing more than a cosmetic arrangement, which can have no real effect on efficiency.

However, the entrepreneurship that feeds the vibrant small and medium enterprises is a natural facilitator of e-commerce. Entrepreneurship is particularly evident in the creation of many e-stores to pursue new market frontiers by first-time entrepreneurs. Because real-world space is not needed to store and display products, e-stores present a golden opportunity for potential entrepreneurs to enter the business world. Nevertheless, there are many hurdles to surpass for an e-store to succeed, including product innovation, technological competence, logistical support in terms of shipping, and account collection. And if an e-store indeed succeeds initially, the owner will soon find that the demand for financial resources in e-commerce is even keener than in conventional trade. The owner has to amass enough capital to build a viable e-business, which tends to be larger in size than a conventional business entity because of the absence of market segmentation.

III. NATIONAL POLICIES

POLICY INSTITUTIONS

In December 1997, the Taiwanese government established a task force under the Executive Yuan, known as the National Information Infrastructure (NII) Task Force, with its main task being to design and oversee policies promoting the development of e-commerce. Several major

government agencies are involved in this task force (Table 14). Amongst them, the Council for Economic Planning and Development (CEPD) is responsible for the drafting and amendment of laws and regulations that will facilitate or accommodate the development of e-commerce. The Industrial Development Bureau (IDB) and the Department of Commerce, both under the Ministry of Economic Affairs, are responsible for assisting in the respective digitization and automation efforts of manufacturing firms and service firms, while the Ministry of Finance is responsible for the promotion of electronic banking. In addition, two government-sponsored research institutes are responsible for providing technical support to private enterprises in their efforts toward digitization. The Institute for Information Industry (III) provides support in computer software applications and portal-related technologies, while the Industrial Technology Research Institute (ITRI) develops the necessary hardware technologies for e-commerce applications.

Table 14. Government Institutions for E-Commerce Development

Institutions	Responsibilities
Council for Economic Planning and Development (CEPD)	Laws and Regulations: Digital Signature Law, Law for the Protection of Private-data Processed by Computers, Law for the Revelation of Government-held Information, etc.
Industrial Development Bureau, MOEA	Digitalization and Automation of the Manufacturing Industry
Department of Commerce, MOEA	Digitalization and Automation of the Trade Sector
Ministry of Finance	Electronic Banking
Institute for Information Industry (III)	Technical support to private firms interested in digitalization
Industry Technology Research Institute (ITRI)	Technology development for e-commerce applications

In 2001, NII was reorganized into National Information and Communications Infrastructure (NICI) task force and its scope was broadened beyond infrastructure building. In addition to infrastructures, NICI was to oversee three national projects: e-government, e-industry, and e-society. The government also designated IDB as the supervisory agency for the newly emerging Internet service industry as opposed to the Commerce Department, which used to oversee traditional service industries. IDB is the most powerful government agency within the Ministry of Economic Affairs with a budget appropriation to subsidize the manufacturing sector.

ENABLING POLICIES

The government liberalized the telecommunications market in 1996 to induce more competition within the industry that was previously monopolized by a state agency. The government agency that was operating the sole telephone system in Taiwan was converted into a state-owned corporation, Chunghwa Telecom. Left without any business-operation responsibilities, the government agency then became the regulatory agency for the telecommunications market. Licenses for private cellular-phone service providers were issued in 1997, with eight licenses being granted, but market consolidation reduced the number of operators to four by 2002. Competition led to a lowering of service provision charges, contributing to a boom in cellular-phone subscriptions. In 2001, the combined share of the private cellular-phone operators exceeds that of Chunghwa Telecom by more than 30%.

Following the liberalization of the cellular-phone market, the government further allowed four private fixed-line operators to be established in March 2000, to compete with Chunghwa Telecom in fixed-line services, including voice and data communications. The government plans to privatize Chunghwa Telecom by the end of 2001, but the pace of privatization was slowed by the shrinking stock-market trading volume in 2001 and the target date has been protracted indefinitely.

The banking sector was liberalized in 1991 when fifteen new licenses for private banks were issued. Intensified competition improved the quality of banking services, but the industry suffers

from an excess of banks while awaiting consolidation. New laws designed to facilitate mergers and acquisitions within the financial sector were promulgated in July 2001, setting the stage for consolidation. Up until now, struggling with the problem of the saturated banking sector, together with the hangover of bad loans caused by asset deflation in recent years, the ability of Taiwan's banks to offer new services is hampered. Nevertheless, a few private banks are particularly active in introducing the concept of electronic banking to their customers. Taiwan's convenience stores, which boast the highest density of store presence in the world, also began introducing banking services to their shoppers. Tying banking in with their B2C e-commerce, the convenience stores promise to play a major role in electronic-based financial services in the future.

For example, the largest convenience store chain, 7-Eleven, introduced automatic teller machines (ATMs) to 50 of its stores in Taipei areas as a pilot project in 2001. The ATM was well received by consumers and 7-Eleven reported transactions were most intensive in stores located near the night markets, movie theaters, and schools. Although the transaction amount is typically small, the service boosted the number of visitors to the stores. As a result of this success, 7-Eleven decided to install a small-size ATM, custom-made for itself, in 1,500 of its stores around the island [Commercial Times, 2001b].

E-COMMERCE POLICIES

The Taiwanese government has initiated several programs aimed at promoting e-commerce. First, it launched the Industrial Automation and Electronic Business (iAeB) program in 1999 whereby tax incentives would be provided for private enterprises investing in computerization, and in related technology development and personnel training to accommodate the computerization. A certain proportion of this expenditure can be taken as a tax credit, under the auspices of the Statute for Industrial Upgrading, just as in the case of R&D expenditure. By December 2000, 36,293 tax credits were granted in e-commerce-related investment, with the total investment amounting to NT\$795.5 billion [IDB, 2001c].

In addition to tax incentives, the Industrial Development Bureau (IDB) also took initiatives to construct 'model' electronic-based exchange systems in the PC industry, emphasizing supply-chain management. The aim is to link PC system producers to their suppliers for the coordination of ordering, production, warehousing, transportation, delivery, and sales. The model program is divided into A and B projects. The A project takes an international system producer as the core firm around which the exchanges are to be clustered; while the B project takes an indigenous producer as the core firm. The model systems are heavily subsidized by the government, but the technologies accumulated in the process of developing such systems are to be made available to other firms which intend to emulate them. After reviewing the tenders submitted by the industry, the IDB chose IBM, Compaq, and HP to run the A project, and 15 indigenous PC makers, including Acer, Mitac, and Asustek, to run the B project.

IBM was the first to complete the A project in June 2001, and Compaq and HP finished near the year's end. With the completion of the project, 20 Taiwanese subcontractors were connected to IBM's e-Procurement system, which was mainly designed to improve the speed of data exchanges to coordinate orders and work. These subcontractors, most of who also participate in the B project, were subsequently connected to their components and parts suppliers. When both A and B projects are completed in 2003, a total of 1,800 components and parts suppliers are expected to be incorporated into the system [Wu, 2001].

It is the existence of an intricate and nimble network of components and parts suppliers that provides the foundation of competitiveness for the Taiwanese PC subcontractors, who serve IBM, Compaq, and similar firms. Therefore the effectiveness of the B project is the key to sealing the bond between Taiwanese subcontractors and their brand marketers. Even before the A and B projects were completed, procurements by the top five U.S. PC firms sourcing in Taiwan, namely Compaq, IBM, HP, Dell, and Apple, totaled \$25 billion in 2000, a 48.8 percent increase from the \$16.8 billion procurement level in 1999 [IDB, 2001a]. Despite the severe recession in 2001, international procurement offices (IPOs) in Taiwan increased their total procurement by 12% from the previous year [Commercial Times, 2002]. The A and B projects are aimed at preserving the

subcontracting relationship after some segments of production relocated to mainland China. To do so, the supply chain management (SCM) of Taiwanese subcontractors will need to encompass the production lines and parts suppliers in China. In implementing the A project, Compaq encouraged its subcontractors to include Kunshan (a major cluster of Taiwanese PC assembly lines in China) in its SCM networks. The experience of the project so far suggests that data exchange is not a major problem, but real-time logistics can be an insurmountable hurdle for the operation of SCM. For example, security-check procedures in China require an export commodity to sit in the airport for at least 24 hours before it clears customs. The absence of direct cargo flights between China and Taiwan also hinders any shipment between the two locations. Despite the whole-hearted support of the city government of Kunshan in establishing an information highway between Taiwan and Kunshan, lack of real-time logistic support limits the Chinese operations to the production of stand-alone subsystems that can be shipped directly to the final market, such as the United States. This limitation, on one hand, prevents a wholesale relocation of the entire production network to China, but on the other hand, encourages Chinese operations to develop self-sufficiency capabilities, which eventually will compete with Taiwan's headquarters.

The A project was successfully completed in 2001, while the B project is still struggling with difficulty to bring small and medium enterprises (SMEs) on board. The government launched follow-up projects C, D, and E in late 2001. Project C (standing for cash) is to bring financial institutions, project D (standing for delivery) is to bring shipping services, and project E (standing for engineering) is to bring design capabilities onto the logistics system to support the operations of offshore sourcing activities. The main thrust of the C, D, and E projects was again to offer financial subsidy to related firms engaged in building information networks enabling the provision of financial, shipping, and design services in consortium with the manufacturing activities undertaken by Taiwan's subcontractors. The government believes that the integration of financial and shipping services into the system will not only facilitate trade but also provide incentives to bring small domestic suppliers on-board. Being a part of the production system, where information on the flow of goods is transparent, will help small suppliers obtain financial support from financial institutions that are also a part of the system, because goods in process can serve as collateral in securing loans.

As of December 2001, at least 29 firms, including nine financial institutions, expressed interest in joining the C, D, and E projects. One leading candidate, Overseas Chinese Bank, was already granted the C project with a subsidy worth NT\$33 million. The bank reported that it signed a contract with Compal, a major Taiwanese computer manufacturer, to provide financial services to its electronic-based transactions with hundreds of upstream suppliers. When the system is completed, payments will be directly transferred between the bank accounts owned by Compal and its suppliers, and short-term loans can be offered to these suppliers against their accounts receivable. As a result, the creditworthiness of Compal can be extended to its suppliers because of the availability of production data.

IBM (Taiwan) claims the average inventory held by the company decreased from a four-week level to a two-week level, and the error in invoicing decreased from 5% to 1% after the completion of the A project [Commercial Times, 2001c].

Following the model demonstration program, the IDB program was extended to other manufacturing industries. The government will subsidize up to 50 percent of the costs of establishing such inter-firm electronic exchange systems, with the aim being to promote at least 200 such exchange systems, encompassing 50,000 manufacturing firms, of which 80 percent will be SMEs. As of November 2001, 18 such systems were already established with a total subsidy of NT\$140 million from the government to match with an estimated NT\$460 million in private investment, encompassing plastics, petrochemical, textile, and motorcycle industries [Commercial Times, 2001a].

In parallel with the above program, a "Four-Year E-commerce Application Plan" promotes e-commerce in domestic trade, in consortium with the Internet service industry. The program aims

to upgrade hardware facilities, provide legal infrastructure and establish e-commerce-enabling institutions for the local service industry; it also aims to cover a wide-range of industries with a target of 40,000 participating enterprises. In addition to domestic trade, interconnections to international e-commerce networks will also be attempted in consortium with international portals.

This program was undertaken by the Department of Commerce, which is responsible for promoting commercial development. The Department of Commerce is a relatively small department under the Ministry of Economic Affairs. Its effectiveness in implementing the program was apparently unsatisfactory, as the Internet service industry was taken away from its jurisdiction in 2001 to be put under the supervision of the Industrial Development Bureau (IDB). IDB's capability to mobilize technology resources to nurture newborn industries was the key consideration for the change of the supervisory agency. The government wanted to develop Internet services as a "strategic" industry capable of promoting economic growth rather than treat it as a simple "modernization" program.

LEGAL FRAMEWORK

Privacy is an important issue in e-commerce; without proper protection of privacy, e-commerce cannot prosper. Taiwan inaugurated the Statute for the Protection of Computer-Processed Personal Data in 1995, which was amended in 2001 to take into account the new facets of e-commerce. Local e-commerce operators also organized themselves to establish a 'code of conduct'.

Laws relating to the protection of intellectual property (IP) rights were also amended to strengthen the IP protection in electronic-based trade. Major amendments to the Copyright Law were made in 2001, whereby the right to transmit and safeguard data was specified and made an integral part of the copyright law. Copyright holders are also entitled to safeguard their copyrighted data with electronic devices, and any measures designed to dismantle or circumvent such devices to access copyrighted materials without permission are now specified as unlawful. The amended law also frees ISP providers from the liability of copyright infringement if the facilities they provide are improperly used to fetch or transmit copyrighted data. Finally, with the passage of the Digital Signature Law in October 2001, the legal framework governing the establishment and operation of certification agencies in electronic transactions is also in place.

V. CONCLUSION

DIFFUSION OF E-COMMERCE

According to estimates by Forrester Research Inc. [Forrester Research, 2000], the value of B2B trade in Taiwan reached US\$3,843 million in 2000, almost doubling the trade volume in 1999. As compared to other countries in Asia-Pacific, B2B trade in Taiwan is still underdeveloped (see Table 15). B2B in Japan is estimated at US\$29,618 million in 2000, and in Korea at US\$5,164 million. Rapid growth is expected to continue for some time, however. The Institute for Information Industry [III, 2002] estimated B2B trade to grow at an annual compound rate of 53 percent until 2003. III cited the need to hook up with international buyers and the rapid development of e-marketplaces in Taiwan as the reasons for optimism.

The volume of B2C was even smaller and estimated at US\$293 million in 2000. This low volume is reflected in the reluctance of Taiwanese consumers to purchase goods and services on line. As shown in Table 15, only 4 percent of Internet users in Taiwan purchased something online in the past month in 2000, as compared to 27 percent in the U.S., 20 percent in Japan, and 16 percent in Korea. The low participation rate in online shopping is attributable partly to the inadequacy of security measures and partly to the lack of attractive products. A survey conducted by III indicates that in Taiwan, 52 percent of online shopping went to travel-related services, such as airline or hotel booking, 27 percent went to IT-related products such as PC and PC parts, and the rest went to miscellaneous items such as books, music, and video products [MOEA, 2000]. It is fair to say that except for travel services and IT products, no other consumer goods or services take advantage of new trading technologies.

Table 15. E-Commerce in Asia-Pacific

	B2B trade in 2000 ^b (US\$million)	B2C trade in 2000 ^b (US\$million)	% Internet users who purchased online in past month 2000 ^c
Australia	5,160.55	394.09	10%
China	954.37	72.88	n.a.
Hong Kong	1,773.28	135.42	7%
India	675.72	51.60	5%
Indonesia	110.48	8.44	3%
Japan	29,618.20	2,261.84	20%
Korea	5,164.42	394.39	16%
Malaysia	311.85	23.82	5%
New Zealand	632.33	48.29	n.a.
Philippines	111.70	8.53	2%
Singapore	1,097.84	83.84	5%
Taiwan	3,842.73	293.46	4%
Thailand	432.15	33.00	1%
United States	449,900.00	38,755.00	27%
Asia Pacific ^d	49,885.63	3,809.59	
OECD ^e	588,900.80	52,184.17	

^aSource: Forrester Research Inc. (2000).

^bSource: Taylor Nelson Sofres (2000). Data are from a survey conducted in 27 countries. Internet users are defined as someone who has personally used the Internet in the past month: an online shopper is an Internet user who has bought or ordered goods or services on the Internet during the past month.

^cOnly countries included in the 44-country sample are used in the classification. Asia Pacific consists of the following countries: Australia, China, Hong Kong, India, Indonesia, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore, Taiwan, Thailand.

^dOnly countries included in the 44-country sample are used in the classification. OECD consists of the following countries: Australia, Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey, United Kingdom, United States.

ENABLERS AND INHIBITORS

Internet Penetration

Taiwan was quite successful in promoting Internet use in the household. With a 35.6% penetration rate by the end of 2001, Taiwan was one of the most Internet-penetrated countries in Asia. The most important factor contributing to the rapid diffusion of the Internet is the high literacy rate among Taiwan's population. As in other countries, Internet access started with the younger cohort of the population, and schools are the places where students first encounter computers. Many parents learn about the Internet because their children are playing with it. Sending e-mails and chatting with friends and unknown Internet pals on the computer by young people are the most important Internet activities in Taiwan. Internet users, in effect, formed a separate community outside their families and neighbors, which serves a useful purpose of "escape" from real life. The younger generation is also the apparent driving force of broadband penetration, as their demand for online gaming boosted the demand for bandwidth.

The second facilitator of Internet penetration is the availability of low-priced computers. As one of the leading producers of computer hardware in the world, computers are obtainable in Taiwan at affordable prices. Young people, including those from low-income families, can purchase a do-it-yourself (DIY) computer at less than US\$500 in computer specialty stores. The increased

sophistication of data and image transmissions prompts consumers to upgrade their computers, which is often achieved by replacing some parts of the machines, such as motherboards and memory chips, instead of purchasing new ones.

The third facilitator of Internet penetration is the widespread telecommunications infrastructure. With more than 500 telephone lines per thousand people in Taiwan, almost all households are connected to telephone lines, which can easily be hooked up to the Internet. This infrastructure made the introduction of dial-up service to the Internet an easy task, and dial-up is indeed the dominant form of Internet access. Even in remote villages and islands, dial-up service through phone lines is not a problem. Liberalization of the sector allows private operators to compete with state-owned Chunghwa Telecom in data-transmission services, helping bring down the price. Price was shown by Chen et al [2002] to be conducive to the diffusion of the Internet

Of course, other factors inhibit Internet diffusion. The most difficult hurdle to Internet access is the entry of Chinese characters into a computer. Unlike English letters where alphabets can be punched on the keyboards in a straightforward way, Chinese characters need to be decomposed and entered in a specific way that is different from the conventional method of writing a word. Therefore, it takes some serious training for anyone to become comfortable with computer entry. The older cohorts of the population that refuse to be retrained for written computer language also shy away from the Internet. The old are often the last members of the family to accept the Internet.

The second factor inhibiting the diffusion of the Internet is the absence of localized Internet content. Most Internet products in Taiwan are designed for young users, such as chat rooms and online games, because the young generation is the largest group of Internet consumers. The old generation today can best consume certain news services or the popular stock price quotations. Most Internet materials are written in English and the majority of Taiwan's population is not competent in reading English. The government launched an ambitious plan to promote the Chinese-based Internet content industry, but the plan may bear fruit only a few years down the road. The difficulty of Chinese-language entry also explains why online games caught on with young children but not with the older generation in Taiwan.

The third inhibitor of Internet penetration is the inability to expand Internet-based activities beyond entertainment and other pastime areas. B2B and B2C commerce remain a very small proportion of trade. Many adults reject the Internet because they find it useless to their business or work. A recent government-sponsored project to establish a B2C network for fruit trade prompted many farmers to start learning computers, suggesting that Internet application is a useful driving force to diffuse the Internet beyond the young generation.

B2B Commerce

B2B commerce is still at a low level but it increased steadily in recent years. It was first applied in the transmission of product information, and then to price inquiry and quotation. In most cases, e-mail is sufficient to perform these functions. It then progressed to order placement and order tracking. At this stage, some investment in hardware and software becomes necessary, and users can choose between the Internet and exclusive lines as the transmission channel. The Internet seems to be more popular because of its cost advantage. Investment in hardware and software is subsidized by the government, but the greatest investment is in the area of internal adjustment in work routines to accommodate electronic transactions. A group approach to such adjustments is adopted by Taiwanese firms, prompted by the financial incentives offered by the government. Two existing institutions were used by the government to promote the group approach to B2B trade, one being the network of subcontractors surrounding the major foreign buyers, the other being the core-satellite system formed around a domestic manufacturer. The existing network relationships are the major facilitators of such a group approach. The establishment of electronic trading networks strengthened the network relationship, reduced the cost of coordination, cut down the inventory level, and sped up the time to market. The investment in the information system therefore enhances the competitiveness of the network as a whole.

The other facilitator of B2B commerce is competitive pressure from the market. As production costs become less important in global competition and time to market become more important, Taiwanese firms are under pressure to increase their flexibility and speed in servicing the market. B2B networks become an investment out of necessity. In fact, many such investments were forced upon firms by foreign buyers.

The major inhibitor of B2B commerce is the small size of the firms. Large manufacturers find it difficult to bring small firms on board because of the inability of small firms to manage the information systems and to work with the systems. Small firms also find it difficult to manage their inventory of raw materials, semi-finished, and final goods to accommodate the just-in-time production method adopted by the core firms. It is typical that small suppliers bear more responsibility in inventory control in electronic-based trade and they often find the burden beyond their capacity.

Another set of inhibitors is the quality of the Internet and the cost of Internet access. Business firms in Taiwan complain about the instability and low speed of Internet transmission and the cost of Internet access as important reasons why they do not embrace online transactions [Chen et al., 2002]. This data indicates that infrastructure is also an important determinant of B2B diffusion.

The third inhibitor to the diffusion of B2B commerce is the lack of uniform formats or standards for data exchange. Most software solutions designed for B2B trade are developed by Western firms and cannot readily be applied to the Taiwanese environment because of the difference in business practices and accounting codes. An industry may adopt several versions of Western software, forcing small suppliers to make multiple investments to engage in B2B trade. Although the government urges each industry to adopt a standard B2B trade framework and subsidizes such efforts, progress is slow.

B2C Commerce

B2C commerce remains a negligible proportion of consumer expenditure in Taiwan. Online shopping only accounts for 0.4% of consumer expenditures in Taiwan, compared to 1.64% in the U.S. [Liu, 2001]. Two major factors apparently inhibit the diffusion of B2C commerce in Taiwan: online security and the easy availability of retail stores. Security remains the top concern of consumers, who are reluctant to shop on line. Consumers are concerned about the possible leakage of sensitive personal and financial data when paying online, and worry about being cheated when buying something without viewing it in actuality. The return policy of the electronic stores, and for that matter, of real stores, has always been vague at the best. Taiwanese consumers are also spoiled by the presence of densely distributed retailers in the neighborhood, which makes substitution for conventional trade difficult.

The diffusion of B2C commerce is further inhibited by several institutional factors, including consumers' trading habits, online security, and the legal environment. Although the electronic signature law was promulgated in October 2001, as of October 2003, only a few financial institutions had obtained a public key infrastructure (PKI) certification from the government and were allowed to offer electronic payment services. The lack of a secure payment scheme is the main roadblock to the diffusion of B2C commerce if psychological barriers to online trading can be overcome. The convenience stores seem to offer a viable solution to this problem by offering in-store pick-up and payment for goods ordered online. Therefore, the diffusion of B2C commerce will further enhance the role of convenience stores in retail trade, rather than replace them.

KEY FACTORS INFLUENCING E-COMMERCE DIFFUSION

B2C e-commerce depends critically on Internet diffusion, while B2B e-commerce can develop independent of the Internet penetration into households. In 2003 both B2C and B2B remain a small proportion of overall trade, although the proportion of B2B e-commerce is slightly larger.

It is apparent that the international environment is the most important factor influencing B2B e-commerce in Taiwan. As an open economy with a great deal of exposure to international competition, online trading, data exchange, and work coordination are adopted by Taiwan's

business firms because they need to work with their business partners that operate on digital information networks. This need is particularly evident in the case of the PC industry, where global logistics are the industry norm and Taiwanese firms are forced to adapt to the new trading scheme just to remain in the game. The new trading scheme then trickles down to the working relations between the Taiwanese subcontractors and their suppliers, prompting them to reconstruct the supply chain networks and to change the way they work. The Taiwanese government's A and B Projects were designed to facilitate the process of these transformations with a subsidy.

The importance of competitive pressure is evident in that the industries in which e-commerce diffusion is most prevalent in the rest of the world are also the industries in Taiwan that are most receptive to online trade. For example, among the manufacturing industries in which e-commerce is most prevalent are the information, aerospace and defense, automotive, metal and chemical industries [Chen, 2002]. In Taiwan, the information, automotive, and chemical industries are also the industries that are most active in online trade. The metal industry is relatively slow because it is dominated by small and medium enterprises (SMEs). Firm size is an important determinant of a firm's propensity to invest in information and communication technology facilities as economies of scale and economies of scope of information and communication technology favor large firms. The firms that are more globalized in terms of holding worldwide production facilities are also more receptive to online trading. In short, globalization is a key driving force of the diffusion of B2B e-commerce.

National environment reinforces the international environment in speeding up the diffusion of e-commerce. Taiwan's traditional export industries suffered from rising wages in recent years that undermine their international competitiveness. The Taiwanese government and businesses soon discovered that information and communication technology was a useful means to regain international competitiveness. The government launched the "Regional Operations Center" (ROC) program in 1995 to modernize Taiwan's service sector, particularly in telecommunications, shipping, and finance. The improvement in logistics was considered the only way to salvage Taiwan's manufacturing industry that was losing its cost advantage. The government's effort coincided with the manufacturer's massive relocation to China and Southeast Asia. Business firms soon found that combining their regional production facilities with Taiwan's logistics capabilities through a digital network was useful in protecting their position in the international subcontracting business. A digital network that enables accurate and instant management of production and product-related services enhances the value of a subcontractor, making it difficult to be replaced in the industry. The digital network connects to the information hub of the major firms in the world market, allowing Taiwanese manufacturers to engage in product innovations that they were never able to do before.

In the past, Taiwanese manufacturers were given the designs by their vendors and assumed the responsibility of manufacturing them, a role known as OEM (original equipment manufacturers) subcontractor. They were not good at designing a product because of the lack of contact with consumers. Even if they came up with a prototype product, the final definition of the product needed to be worked out between them and their vendors who knew the sentiment of the market. Taiwanese firms were also slow in product modifications because market information was only selectively fed back to them by the vendors. With digital information networks, they now share the consumer-related information simultaneously with their vendors and may make use of this information for product innovations and modifications. There are more chances for them to take over, or participate in, the design function of the vendors. The latter, in turn, are increasingly concentrated in organizing global production and providing worldwide services. It appears that in the information age, whoever has the first access to information and has the ability to make use of such information will obtain a competitive edge in the industry.

Government policies are only useful to the extent that they accelerate the process of transformation to a new era. Government policies are not powerful enough to create a new environment that never existed before or to reverse the business trend and comparative advantage of the country. The Taiwanese government's main policy toward B2B e-commerce is

tax incentives and subsidies. Investments in information and communication technology technologies, including hardware, software, and personnel training, are eligible for investment credits. The government also encourages a group-approach to the e-commerce solution, and uses a subsidy program to promote this approach. These policies are effective only to the extent that the environments, both external and internal, are ripe for the business firms to accept the new scheme of B2B transactions. The government's effort to promote e-commerce diffusion proved more successful in establishing an interface between Taiwanese firms and international firms, but less successful in establishing an interface among Taiwanese firms. The government's effort to bring financial, shipping, and service industries to the digital networks that coordinate production may prove fruitful, because this effort adds important value to the network, which in turn motivates small firms to sign on.

B2C e-commerce is a completely different story. The electronic store industry depends critically on Internet penetration and it takes more than online trade itself to promote Internet access. It is often non-trading activities that promote Internet access. In the case of Taiwan, it is the chatting and communications that first bring the young generation onto the Internet and the online gaming that prompts the penetration of broadband. Internet diffusion is a pre-condition for B2C e-commerce. Once the Internet population is large enough to secure an opportunity for the realization of scale economies, B2C e-commerce will start to emerge.

If B2C e-commerce is to replace real-time shopping, it must offer some advantages that the real-time stores do not offer, or at least, it has to neutralize some advantages of the real-time stores. For example, the real-time stores present actual commodities for viewing. This advantage is overwhelmingly important if the quality of the products can only be appreciated by eye contact. Therefore, it is natural for B2C e-commerce to start with the trading of intangibles, such as travel arrangements and ticket booking. It is almost universal in all countries that travel services dominate the initial phase of B2C trade. The advantage of electronic trade vis-à-vis arms-length transactions is its ability to reach distant and dispersed consumers. Therefore, books, music, and cosmetic products are also important items in online trade. The other advantage of e-commerce is that it can offer a small volume of highly differentiated products to a small number of consumers because of the saving of fixed costs such as renting a store space. It can therefore reach a small group of consumers dispersed around the country. In this regard, e-commerce stands in sharp contrast to real-time stores whose customers are typically geographically concentrated.

The most difficult hurdle to overcome in B2C e-commerce diffusion is the payment mechanism. Although credit cards are widely used in Taiwan, the security of online credit card usage remains shaky and hence discourages the concurrent payment in electronic trade. Separate payment mechanisms must be created to supplement electronic trade. Post offices, bank accounts and convenience stores served this purpose well. Therefore, a legal and financial environment that offers a secure and convenient mechanism for online payment seems to be the most important factor that influences the diffusion of B2C e-commerce. At this moment, both legal protection and electronic banking are lacking in Taiwan. Although an electronic signature law was promulgated in 2001, there were only a few certified providers for electronic payment services in 2003. B2C e-commerce will not take off until this environment is firmly established.

Nevertheless, the business sector found some ways to overcome payment difficulties through a combination of virtual and actual operations. Convenience stores spread across the country that offer combined services of product delivery, account settlement, and product return appear to be the most prominent solution to the problem. The combination also allows the role of the convenience stores to be reinforced rather than diminished by e-commerce.

Government policies played little role in the promotion of B2C commerce up to this point. But with the diffusion of broadband, a new market emerged for image products, which never existed in the past. The government seized the opportunity to promote new industries for this newly emerged market. The Internet content industry based on the traditional Chinese culture is exactly designed for that purpose. The potential products of the industry include movies, music, books, online

museums, and galleries. It is plausible that industry policies intended for the creation of Internet content products may be the most effective policies to promote e-commerce because new products in cyberspace are the best attraction to consumers. On-line games proved that an attractive product can create its own market even if the environment is not quite mature for its operation. The introduction of such a “killer app” product can accelerate the maturation of the e-commerce environment.

If product innovations will indeed play a key role in the future development of B2C e-commerce, then the institutions that support such efforts are crucial. For example, the availability of venture capital funds that nurture such innovations may be particularly important.

Implications for E-Commerce Diffusion

The diffusion of e-commerce implies important implications for the functioning of the market and for the organization of production. In the case of B2B e-commerce, supply chain management becomes an important element for competitiveness. Production is vertically disintegrated and may be spread out across great geographical distances. Nevertheless, production activities need to be closely coordinated with digital information networks. Such a production system imposes an entry barrier to new participants and therefore global production is likely to be dominated by a small number of firms that are at the core of the production networks. However, recent research [e.g., Leamer and Storper, 2001] showed that although production spread to areas remote from the market, the production is likely to concentrate in certain regional clusters. In other words, economies of network seem to be a local phenomenon [Hicks and Nivin, 2000]. The implication of these finding is that a country that falls behind in the adoption of information and communications technologies may be left out of the global production system. Thus, the government's role is important to establish the infrastructures needed for the operations of electronic trade.

Although the case of Taiwan demonstrates that the international environment is the primary driving force for the diffusion of B2B commerce, national environment is also an important facilitating factor. National conditions that are important to the diffusion of B2B e-commerce include telecommunications infrastructure, the price and quality of communication services, and the availability of shipping and financial services to accommodate global logistics. In other words, pure manufacturing capabilities are no longer sufficient to warrant a competitive edge in global production; it takes logistics services to secure a country's competitiveness.

B2B e-commerce allows a big company to control a large amount of production around the globe, in consortium with its suppliers and subcontractors. Digital information networks also allow big companies to enjoy economies of scope, where an array of differentiated products can be produced and can even be tailored to specific needs of individual consumers. Where is the room left for small firms? It appears that small firms will need to compete with their technological capabilities, given the disadvantage of scale and scope of products that they may offer. Small firms, of course, can only excel in a limited area of technology. Large firms, in turn, will specialize in system integration that builds on the technologies owned by small firms. A technology chain will be formed to drive the innovations of the industry. In short, the diffusion of B2B e-commerce potentially redefines the division of labor between countries and resets the role of individual firms.

For example, in the case of a personal computer, the location of production was concentrated in a few countries although the “product life cycle” is at work and continuously driving production from high-wage to low-wage countries. China, in particular, rose as a major supplier of PCs in recent years not only because of its low-wage labor, but also because of its availability of skilled labor that can assume the technologically demanding jobs, and further because of the support from Hong Kong and Taiwan which provide logistics and design capabilities. Other low-wage countries found it difficult to compete with China in PC manufacturing due to their lack of capabilities beyond low-cost labor. Within China, PC subcontractors are assuming responsibilities ranging from product design to after-sales service on a global scale. These subcontractors have to organize a sub-network of their own to perform these duties. It appears that it is a set of capabilities, rather than a single factor such as labor or capital, that defines the comparative advantage of a nation in the information age.

The experience of B2C e-commerce seems to suggest something very different from that of B2B e-commerce. Although still in its nascent stage, B2C e-commerce does not show any potential of replacing traditional markets and institutions. Even in the case of the U.S., e-commerce is still groping for viable market strategies as most dot.com companies incur heavy losses. In the case of Taiwan, a combination of virtual and actual stores seems to be the solution given the current business environment. On-line trade allows a seller to reach distant and dispersed consumers, making small-volume transactions. On-line trade thus addresses the needs of small and distant consumers that are often neglected in conventional markets. It therefore represents a complement, rather than a substitute, to conventional commerce.

The volume of e-commerce still accounts for less than 1% of the retail trade today. Its importance will increase in the future when right products and right transaction modes can be identified, but the proportion of B2C trade is unlikely to match B2B trade, which is expected to account for a half of the entire trade between businesses. New products that can not be offered by conventional stores seem to be the key to the future development of B2C e-commerce, the size of which is also likely to be determined by the demand for such products. Apparent candidates in this category are online image services, including video on demand and online games. New product innovations are also the most important area of competition between countries interested in developing e-commerce where industrial policy, rather than Internet policy, is likely to play a major role.

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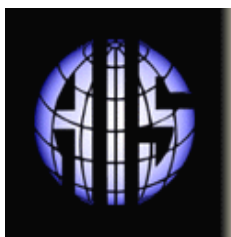
LIST OF ACRONYMS

ADSL	asymmetric digital subscriber line
ASP	application service provider
B2B	business-to-business
B2C	business-to-consumer
CEPD	Council for Economic Planning and Development
GDP	gross domestic product
ICP	Internet content provider
IDB	Industrial Development Bureau
III	Institute for Information Industry
IP	intellectual property
NT	New Taipei (Taiwanese currency)
PC	personal computer
SCM	supply chain management
SME	small and medium enterprises

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