



Globalization and E-Commerce: Growth and Impacts in Denmark

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SUMMARY

- The Danish e-commerce strategy is centered on rapid adoption, implementation, and exploitation of e-commerce in all sectors of the economy, rather than a production-led strategy.
- The economy has an international advantage in B-to-B e-commerce diffusion.
- The diffusion of the Internet based on B-to-C e-commerce has been less successful than in the other Scandinavian countries and the United States.
- E-commerce adoption has not led to rapid structural changes in the employment pattern.
- The government is strongly committed to addressing the digital divide, implementing public e-procurement as an e-commerce driver, and supporting e-commerce research and development.
- There is a policy commitment to utilize e-commerce with a welfare twist: to further develop the current welfare society model for a better quality of life; new scientific achievements; better public service; improved healthcare; more exciting jobs; more interesting cultural offerings; and a less stressed workforce with more time for individual development.
- There is a lack of commitment towards fighting structural and legal inhibitors (such as educational aspects, taxation, and venture capital).

INTRODUCTION

On December 31, 2000, Poul Nyrup Rasmussen, Danish Prime Minister, said that he envisions a Danish society that is the world's leading IT nation. He believes that this is not an impossible dream and that all Danish citizens should have access to the Internet and the opportunity to use an e-mail account. He said the public sector needs to be at the leading edge of exploiting IT; that there are several challenges for Danes to meet; and that efforts to educate everybody should have core priority beginning at the primary and secondary schools. We also need a partnership between the public and private sectors to meet the challenge of organizing and financing the change process.

As part of the European Union, Denmark plays an active role in the eEurope2002 R&D efforts implemented by the commission. The quote above indeed indicates that e-commerce is a high priority for the Danish government. Also, the various business policy associations and the major industrial players are committed to aid the adoption of e-commerce. The government is committed to push the economy forward to become one of the five countries in the world with the largest e-commerce turnover per inhabitant by the year 2003. Another central policy issue is to develop a capacity to offer competitive outline provisions for enterprises in the network society (Ministry of Information Technology and Research, 1999).

The government has stated explicitly that it will not focus on the production of hardware. Lacking a national IT production dynamo, the Danish e-commerce transformation focuses on ensuring rapid adaptation, implementation, and exploitation of e-commerce among small and

medium enterprises (SME)¹, large enterprises (LE), and public sector units. Accordingly, e-commerce policies are directed towards ensuring a rapid diffusion and exploitation of e-commerce, and a clear commitment to meeting the challenges of the digital divide. The public sector is seen as a primary driver in the adoption of e-commerce.

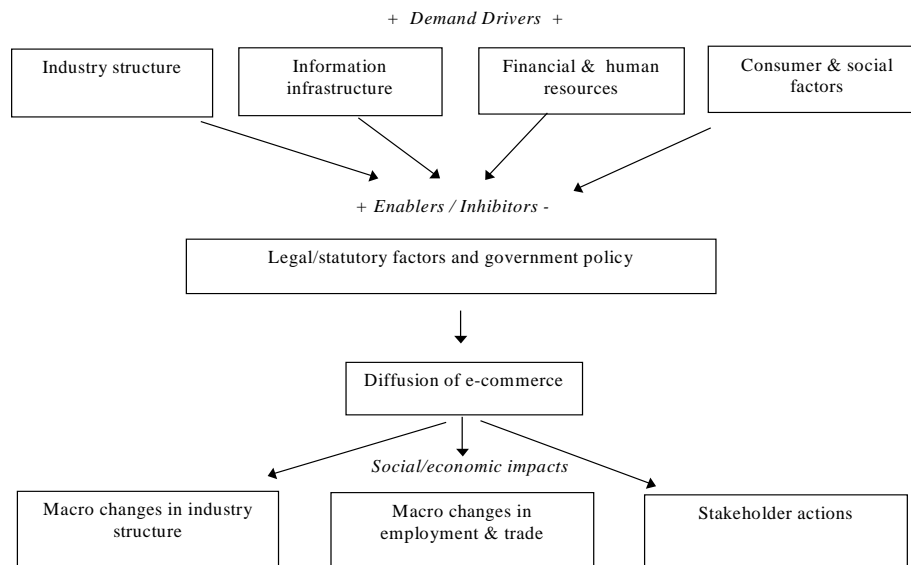
We introduce our paper with a brief overview of the framework for our analysis. In the subsequent sections, we outline the demand drivers and the enablers/ inhibitors for e-commerce in Denmark. After the analysis of the government policy actions, data on diffusion of e-commerce are analyzed. The paper concludes with an assessment of the social and economic impacts of e-commerce.

Our Framework of Analysis

We have structured our paper according to the general model in the Globalization and E-Commerce (GEC) project that views the global environment -- including such processes as globalization of production and markets, MNC strategies, and technical innovation -- as incentives for industry to adopt e-commerce. Yet we focus on specific factors in the Danish environment that might affect the diffusion and impact of e-commerce.

The demand drivers include four sets of variables: 1) industry structure (concentration, sectoral distribution, vertical integration, size of firms, and value networks); 2) information infrastructure (telecommunication, wireless and Internet infrastructure, technology access and use, and technology acceptance); 3) financial and human resources (payment mechanisms, venture capital, population, wealth, income distribution, age, education, and IT skills); and 4) consumer preferences and social/cultural factors (consumption patterns, business culture, investment levels, and language).

¹ In EU terminology, a SME is defined as a firm with less than 250 employees and either a turnover total of 40 million EURO, or a balance sheet of no more than 27 million EURO.

FIGURE 1: Conceptual Framework

Within the GEC framework, the diffusion and impact of e-commerce depend on the presence of enablers and inhibitors. These include *legal/statutory factors* (regulation of transactions, privacy protection, security, intellectual capital protection, and taxes on e-commerce transactions), and *government policies* (promotion of IT production and use, telecommunication regulation, and government's own use of e-commerce).

Depending on the demand drivers and the relative strength of the facilitators and inhibitors, the diffusion of e-commerce revenue by industry sector and country varies over time and between total e-commerce, B-to-B and B-to-C revenues.

In industry segments with a high level of diffusion, we would expect a major impact on industry structure, employment, trade, and productivity. Segments characterized by a large gap between market potential and current diffusion have substantial untapped market potential, and might be positioned for rapid growth if the environment changes. In such cases, e-commerce diffusion will have a social/ economic impact measured by 1) macro-level changes in market structures, industries, and value networks; 2) macro-level changes in trade, employment, and productivity; and 3) stakeholder actions by firms, governments, consumers, and workers to ensure their current and future competitiveness and welfare.

Four sets of explanatory demand variables were applied in our research on the growth and impacts of e-commerce in Denmark: 1) industry formation capturing data on industry concentration, vertical and horizontal integration in clusters, and size of firms; 2) information

infrastructure revealing data on the telecommunication, wireless, and Internet infrastructure, technology access channels and use, and general technology acceptance; 3) financial and human resources such as the level of digital payment mechanisms, availability of venture capital, population size and growth, wealth level, income distribution, age distribution, education level, and IT skills; and 4) consumer inclination and social/cultural factors such as consumption patterns, business culture, investment levels, and language.

Industry Structure

The annual output of the Danish economy amounts to US\$ 174 billion. By comparison, the U.S. economy has an output that is 53 times as large, and the overall European output is 48 times as large. Yet with a GDP per capita of US\$ 32,781, the productivity of the Danish workforce is one of the highest among the developed countries when considering the decreasing workforce and the high efficiency level of the economy. The corresponding figures for the U.S., Scandinavia, and Europe are US\$ 34,101, US\$ 29,150, and US\$ 22,393, respectively (World Bank Group, 2000).

OECD, in its year 2000 report, expects that the Danish economy will maintain close to its full capacity level. Owing to a surplus in the public sector budget (2.3 percent), increasing exports and a surplus in the trade balance (2.9 percent), relatively low inflation (2.5 percent), solid investments, and a historically low unemployment rate (5.5 percent), the Danish economy is expected to maintain its annual growth rate of 2-3 percent in GDP within the next two years. On a long-term basis, the Danish economy is expected to grow 1.75 percent a year until 2010. This output growth is less than the average EU growth (OECD, 2000a; Ministry of Finance, 2001a).

If we compare the GDP growth ratio for Denmark with the corresponding ratios for Scandinavia (3.31 percent) Europe (3.21 percent) or the U.S. (4.17 percent), we see that the Danish economy is growing at a lower rate. According to OECD and national economic studies, the lower growth rate is a result of structural unemployment problems and perhaps insufficient growth in the high-tech industry during 1995-1999.

The IT sector is gaining in national importance in terms of employment, turnover, and value generation. Yet hardware production is at a modest level in Denmark and insignificant on an international scale. However, in relation to the Danish GDP, IT hardware exports in Denmark are proportionally larger than in the U.S. and the other Scandinavian countries. The high export ratio is due to the fact that companies such as Alcatel Space Industries, Bosch (telecom), Hewlett-Packard, IBM e-business, Lucent Technologies, NCR Corporation, Dai Nippon Printing Co., Ltd., Oracle, Siemens, Nokia and L. M. Ericsson have significant re-export and subcontracting activities in Denmark.

TABLE 1
IT Hardware Production and Exports, US\$ M and Relative to GDP, 1999

Country	IT Hardware Production		IT Hardware Exports	
	US\$ M	US\$/GDP	US\$ M	US\$/ GDP
Denmark	119.0	0.1	840.2	0.5
Scandinavia	1,399.2	0.2	2,997.6	0.4
European Union*	57,978.5	0.7	83,810.6	1.0
United States	85,085.2	0.9	37,967.0	0.4
OECD**	221,159.2	0.9	169,573.8	0.7

*Excluding Luxembourg

**Excluding Iceland, Luxembourg and Slovakia

Source: Reed Electronics Research (2000).

The Danish economy is much more dominated by SMEs than by LEs. Sixty percent of the *private sector* labor force works in companies with less than 100 employees. SMEs employ about one third of the *total* work force. This applies in particular to the Information and Communication Technology (ICT) service sector, where close to 70 percent of the employees work in companies with less than 100 employees.

With approximately 800,000 employees in the public sector, and 1,900,000 employees in the private sector, it requires a unique balance between the two to stay competitive. The large scale of the government sector has been a primary reason for the advancement of technology, not only by means of legislative power, but especially in terms of streamlining its own processes. Compared to the U.S., the Danish employment pattern shows that a larger part of the GDP output derives from agriculture, manufacturing, and transportation. Overall, the Danish economy can be characterized by dominant clusters² such as:

- Information technology and communication;
- Medical and health; and
- Knowledge services

Yet their share of the annual GDP and exports are relatively small compared to clusters of, for example, a) shipping, b) agriculture, fishing, food, and beverage processing, and c) industry equipment and processing. More than 30 percent of Danish exports derive from the agriculture, fishing, food, and beverage cluster. Only a fraction is employed in the ICT cluster, providing a small share of the annual GDP (Ministry of Trade and Industry, 2001a). Lacking international comparable data on clusters, we concentrate here on industrial sector distribution.

² A cluster is, according to Porter (1998) "...a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities."

TABLE 2
GDP Distributed by Industrial Sector, Denmark and United States, %

Sector	Denmark	United States
Agriculture, hunting, forestry & fishing	5.3	1.9
Mining and quarrying	1.1	1.7
Manufacturing	25.1	19.6
Electricity, gas and water	2.5	3.1
Construction	6.9	4.5
Wholesale and retail trade and restaurants and hotels	16.8	18.1
Transport, storage and communication	11.4	6.4
Finance	23.9%	30.8%
Community, social and personal services	7.0%	12.4%
GDP total US\$ (Billions)	174.9	8,230.4

Source: United Nations National Accounts (1999).

A rather large part of the labor force (5 percent) is employed in the agricultural, hunting, forestry, and fishing sector. In addition, transportation, storage, and communication constitute a large employment segment. The Danish economy has been able to exploit technology, in particular, within agriculture and shipping. The push for efficiency in the fishing and agricultural sector has been a long process. It involves streamlining the processes of production and document exchange with the meat and fish processing units, including the health inspection offices (Lundvall et al., 1984; Porter, 1990). Thus, the agricultural sector shows a high level of electronic data interchange (EDI) use and an eagerness to exploit new e-business opportunities, such as online consulting. This informatization of the internal and external work processes is the central reason for the increasing value generation in a sector that has comparatively few employees. Within the shipping industry, the key stimulus has been the Maersk-Sealand companies' push to stay competitive and expand their activities, which in turn has had an impact on the other carriers. The globalization of Carlsberg Breweries and the Lego Group has also contributed to the development and implementation of e-logistics. Lego has been pushing global B-to-C e-commerce since the late 1990s through Lego Worldshop.

The medical industry is taking an increasing part of the manufacturing industry, with the Novo Nordic Group (health care and enzymes) in the forefront as a leading IT user. According to Gartner Group benchmarks, the Novo Nordic Group is twice as effective in its use of IT as its global equivalents. Novo Nordic Healthcare is a world leader in insulin as well as diabetes care. It has pushed e-commerce by selling diabetic products to both new and existing users through the Internet. Novozymes is the world's largest producer of enzymes for industrial use. It has established its own very successful B-to-B e-market for a whole range of enzymes. Within the medical field, there are several foreign companies located in Denmark, including ACADIA, Ferring Pharmaceuticals, Genmab, Nutri Pharma, and Structural Bioinformatics.

The financial sector comprises close to one quarter of the workforce. Within the banking segment, national and international mergers have been the overall trend. But there have also been an increasing number of mergers between the banking and real estate markets. The dominant players are Danske Bank and Nordea. The financial sector is aggressive in using e-commerce as a strategic tool and as a means of reducing processing costs. From 1999 to 2000, the number of customers who used the Internet to complete banking transactions doubled (Ministry of Information Technology and Research, 2000a). The number of customers who handle all their banking transactions via the Internet varies from 10 to 30 percent among the various banks. With

its more than ten million Internet users, the Nordic Nordea bank has approximately the same number of Internet users as Bank of America, but has more Internet transactions than any other bank in the world, including Bank of America.

The ICT sector is an essential driver for e-commerce diffusion, whether it is production or exploitation driven. Compared to other Scandinavian countries (Sweden and Finland with Ericsson and Nokia), ICT manufacturing employment in Denmark is less specialized. This applies in particular to employment in insulated wire and cables, television and radio receivers, measuring instruments, and electronic valves and tubes. In the area of ICT services, Denmark is also less specialized. In this sector, employment in ICT wholesale, telecommunications, and consultant services is at an almost equal level.

TABLE 3
Employment in the ICT Sector 1993-998 (index 1995=100)

Year	ICT Mfg.	ICT Services			Total ICT Services	Total Private Sector*
		Wholesale	Telecommunication	IT Consultant		
1993	96	90	87	122	99	94
1994	95	94	100	95	96	96
1995	100	100	100	100	100	100
1996	102	99	116	108	106	101
1997	101	106	105	117	109	103
1998	99	114	127	135	124	106

*NACE 15-37, 45, 50-74, 92, 93

Source: Statistics Norway (2001)

In assessing the employment pattern, it is remarkable that the ICT manufacturing sector has decreased in absolute numbers since 1995. The wholesale, telecommunication, and IT consultant sector reflects a much more vivid picture. If we compare the growth in the ICT sector with the general growth in employment in the private sector, the Danish ICT sector has experienced a rapid uptake, in particular since 1997.

Information Infrastructure

In 2000, two out of three citizens had access to the Internet either at home or at their job. About 56 percent of all Danish citizens have a mobile phone subscription package, and close to 1.5 million out of the 2.9 million households have access to the Internet. As of August 2000, only 5,000 households were using ADSL. The majority was using ordinary, digital phone lines or ISDN.

Focusing on Internet access from the household, the data displayed in Table 4 reveals a very rapid increase in Internet access during the period from 1997 to 2000, regardless of age group. There is only a marginal difference between the age group 16-29 years, and the age group 30-49 years. But the households with family members older than 60 years have a significantly lower frequency of Internet access. The data displayed in Table 4 does, however, measure only access. Data from international comparisons of Internet use (see Table 5) suggest that the other Scandinavian countries are at a much higher level of use. Yet Denmark is still beyond the average EU and U.S. levels.

TABLE 4
Internet Access in Danish Households, 1997-2000, %

Age	1997	1998	1999	2000
16-29 years	8	20	32	49
30-39 years	9	19	43	56
40-49 years	9	17	47	57
50-59 years	8	13	31	43
60+ years	2	4	12	18
Total	7	15	33	45

Source: Statistics Denmark, 2001

Comparing the costs of off-peak Internet access, Danish costs are substantially higher than those in the U.S. Although flat rates have been introduced, the bulk of Internet users pay by the minute. It is worth noting, however, that with Internet access costs based on a 20 hours a month peak rate, Danish Internet access costs are lower than or not exceeding the corresponding costs in the U.S., according to the OECD Technology Outlook. The figures are displayed in Table 5. Also, it is worth noting that CATV subscribers are at the same level (25 percent) as subscribers in the in the U.S. Compared to subscribers in other Scandinavian countries, the level of Danish CATV subscribers is about twice as high.

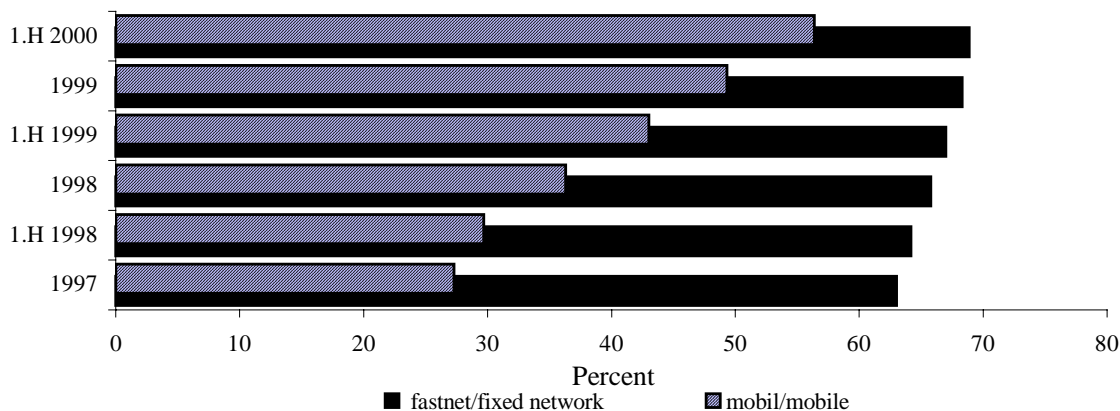
The number of Internet hosts per 1,000 inhabitants is still at a much lower level in Denmark than in the U.S. Comparing 1998 data on the number of secure servers, the Danish information infrastructure is at a very modest level. Data from the Telecom Agency suggests, however, that the number of secure servers has increased rapidly in 1999 and 2000.

TABLE 5
Overall ICT Penetration Figures (1999)

	Denmark	Scandinavia	European Union Member Countries	US
PCs per 1,000 population ^a	414.9	422.36	248.44	517.07
Internet users per 1,000 population ^a	282.3	390.83	158.65	271.74
Internet hosts per 1,000 population ^a	63.66	73.67	22.57	195.00
Secure servers per 1 million population (1998) ^a	8.3	16.15	13.31	54.29
Cost of 40 hours off-peak Internet use US\$ ^b	53.48	n.a.	n.a.	35.40
Cost of 20 hours peak Internet use (index OECD=100) ^b	65	n.a.	n.a.	83
CATV subscribers per 1,000 population	251.22	129.64	111.49	251.34
Cell phone users per 1,000 population ^a	494.69	583.66	400.28	315.55

Source: a: ITU, 2001. b: OECD, 2000a.

The penetration of cell phones is very high and still increasing in the Scandinavian countries. The data displayed in Figure 2 indicates an increase in the mobile device, content, and infrastructure market that outpaces the increase in the fixed network market. The industry has exploited the highly mobile and accessible population using Short Message Services (SMS). The use of the third generation of the General Packet Radio Services (GPRS) standard is expected to increase especially fast in the Scandinavian countries in areas such as marketing, logistics, ticketing, news, and entertainment. The Danish auctioning of the 3G-net in the fall of 2001 generated a higher than expected revenue.

FIGURE 2: Fixed Network and Mobile Subscribers per 100 Inhabitants, 1997-2000, %

Source: National Telecom Agency (2000).

Thus, intelligent tags in the baggage industry, information and infotainment distribution and services over Bluetooth technology, and payment using mobile phones in, for example, trains and ferries are currently being implemented. The following services are already implemented and used extensively:

- Notification via SMS in case of flight and train delays and cancellations;
- News (financial, weather updates, general news narrowcasting) E-mail and web-surfing;
- Banking services via WAP; and
- Peer-to-peer services (chat, etc.)

It is worth noting that the major emphasis of the current SMS and WAP applications are directed to the peer-to-peer market, thus leaving no or very limited room for content developers to capitalize from market adoption. Instead, the operators are cashing in on the current adoption patterns.

Turning to the information infrastructure in the private sector, more than 90 percent of all Danish enterprises have access to the Internet, and more than 80 percent of companies with more than 10 employees have their own homepage. Internet access and a digital front-end can be positively correlated with the size of the company. Yet administrative systems still constitute the largest ICT investment area. The market expects that e-commerce, supply chain management (SCM), customer relationship management (CRM), and knowledge management will be the largest ICT investment areas in the coming years (Ministry of Information Technology and Research, 2000a).

TABLE 6
Internet Access and Homepages in Danish Enterprises, By Size, 2000, %

Number of Employees	Internet Access	Own Homepage
10-19	87	84
20-49	93	84
50-99	95	91
100+	97	92
All	94	88

Source: Statistics Denmark (2001).

In the infrastructure area, virtually all sectors are linked to the Internet, with the construction sector as a partial exception. It is worth noting the rapid uptake since 1998, as indicated in Table 7. From a diffusion perspective, the first movers were finance and business services, followed by manufacturing.

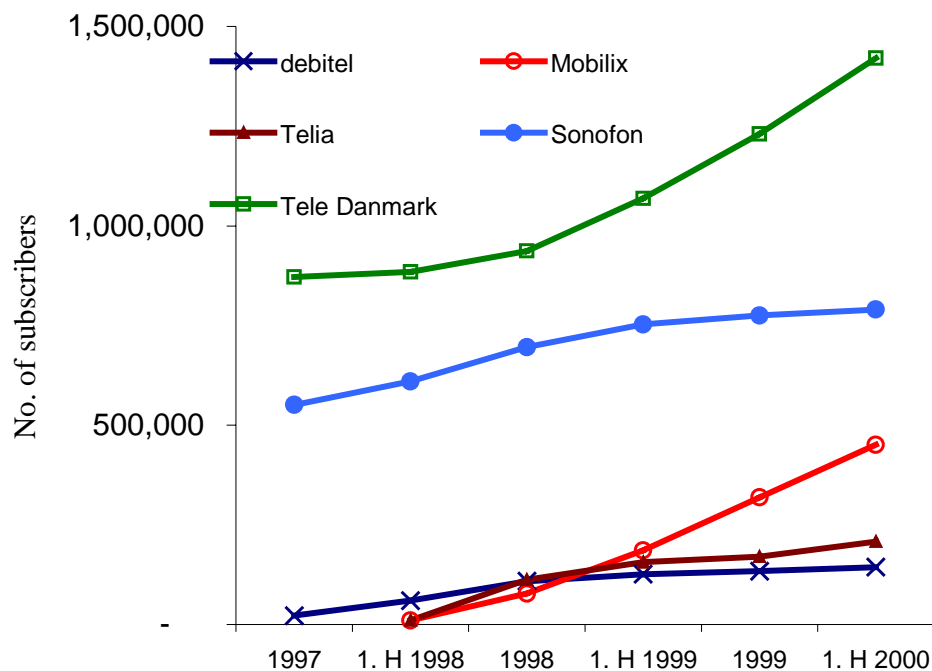
TABLE 7
Internet Access Distributed by Sector and Year, %

Sector	1997	1998	1999	2000
Agriculture, hunting, forestry & fishing	n.a.	n.a.	n.a.	n.a.
Mining and quarrying	n.a.	n.a.	n.a.	n.a.
Manufacturing	42	81	89	95
Electricity, gas and water	n.a.	n.a.	n.a.	n.a.
Construction	17	58	78	86
Wholesale and retail trade and restaurants and hotels	36	76	86	95
Transport, storage and communication	32	68	88	94
Finance and business services	55	84	95	96
Community, social and personal services	n.a.	n.a.	n.a.	n.a.
Overall private sector	40	77	87	94

Source: Statistics Denmark (2001)

Extensive liberalization at the European level within the telecommunication sector has had a great influence on national policy. The liberalization of the telecommunication market and a general growth in the market segment has increased the number of companies and lowered prices. On average, prices have decreased annually by 2.5 percent since 1984. The rates in Denmark are at the average level of the OECD countries (OECD, 2000b).

In 2000, more than 50 companies offered Internet access to 1.5 million households. Yet the three dominant players shared more than 70 percent of the market (Tele Danmark, 37 percent; Tele2, 23 percent; and World Online, 12 percent). It is also worth noting that 13 companies offered Internet services at a national level in 2000, compared to only four companies in 1998. In the global system for mobile (GSM) market, liberalization has also had an impact. Figure 3 below illustrates the overall market and the entry of new market players. The company that dominated the scene in terms of subscribers before the liberalization is still in a leading position.

FIGURE 3: Mobile Subscriptions, 1997-2000

Source: National Telecom Agency (2000).

Annual investments in telecommunications have increased substantially since 1992, although last year saw a minor drop. In 1992, DKK 512 million was invested in telecommunications. In 1996, the investments had increased to DKK 4,734 million, and in 1999, to DKK 6,526 million. The deployment of the FWA and 3G Net, including broadband wiring, is expected to rapidly increase these investments (National Telecom Agency, 2000). Investments in the development of broadband width and other telecommunication investments will primarily come from the private sector.

Telecommunication investments are well beyond the investments in the U.S., but smaller than investments in the other Scandinavian countries and the EU. If we look at the general spending on systems, software, and/or services, Denmark is spending less than the U.S., but more than the Scandinavian and European countries on average. ITU has also calculated the total expenditures on purchasing property and plants (including land and buildings) used for telecommunication services. The data show the Danish expenditures at an average OCED level, but higher than that in the U.S. Thus, one could expect this could lower the international (outside the European Union) competitiveness of companies located in Denmark.

TABLE 8
IT and Telecommunication Investments, Percent of GDP

	Hardware, software and/or IT services, as % of GDP ^a	Expenditures on acquiring property and plants (including land and buildings) used for telecommunication services, as % of GDP ^b
Denmark	3.41	0.54
Scandinavia	3.33	0.71
European Union*	2.67	0.61
United States	4.14	0.28
OECD**	3.09	0.54

*Excluding Luxembourg

**Excluding Iceland, Luxembourg and Slovakia

Source: a) IDC (1999), b) ITU (2001).

Financial and Human Resources

At the end of 2000, 1.6 million credit/debit card holders (30 percent of the total population) and 1.4 million-debit card holders (26 percent of the total population) had performed more than 400 million transactions during the year. Stored value cards amount to fewer than 10 million transactions annually. The common debit card (Dankort) can be used for Internet shopping. The cellular phone operators have launched payment via smart card technology and subscriber identity module (SIM) cards, which has increased the payment channels. SIM cards provide secure access to the mobile network and store basic network information within GSM, personal communications services, satellites, and digital cellular systems.

Payments from wireless application protocol (WAP) phones are still at an experimental level. Currently, there are alliances between the individual mobile phone operators, banks, and device producers (Orange, PBS, Nordea, Nokia, and Visa). Payments for vending machines, parking meters, and bus and train tickets are being developed and should be implemented in late 2001 and 2002.

The capital for developing and implementing e-commerce and m-commerce applications comes largely from equity funds, which also have been booming in Denmark, although the meltdown of the dot.com has had substantial implications for companies seeking capital for the m-commerce area. Banks and pension funds are important institutional players in equity funding, although investment companies such as 2M Invest, IVS, and Business Development Finance have demonstrated a more aggressive investment policy. However, the venture capital available for e-commerce initiatives is still at a much lower level than in the U.S.

In human resources, the Danish economy benefits from a very high adult literacy rate (99 percent), and a high level of secondary school enrollment.³ Yet the share of enrollment in tertiary education is very low compared to the U.S. (45 percent versus 81 percent).⁴ Adding to the low

³ Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Secondary education completes the provision of basic education that began at the primary level, and aims at laying the foundations for lifelong learning and human development, by offering more subject- or skill-oriented instruction using more specialized teachers (World Bank Group, 2000).

⁴ Gross enrollment ratio is the ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of education shown. Tertiary education, whether or not to obtain an advanced

tertiary enrollment is the long period of enrollment for students, despite free education. In the IT area, the Danish government has strongly promoted educational efforts since 1995. In 1995, the annual enrollment in IT-related higher education was 3,600 students. In 2000, the enrollment was 7,778 (Ministry of Information Technology and Research, 2000a). It is worth emphasizing that Denmark has very well organized vocational training for employees. This is in part arranged by the employers themselves, but to a much larger extent by the 15 local vocational training centers offering more than 2,000 different courses. This unique vocational institution was established in 1960, and is a cornerstone in diffusing e-commerce and IT in general to the Danish production and service companies.

TABLE 9

Secondary and Tertiary Enrollment and Science & Engineering Enrollment Relative to Tertiary Students, %

	% Secondary Enrollment*	% Tertiary Enrollment	Science & Engineering as % of Tertiary Students
Denmark	121	45	25
United States	97	81	n.a.

*The figure can exceed 100% since the ratio is calculated as the total enrollment, regardless of age, to the population of the age group that officially corresponds to the level of secondary education.

Source: World Bank Group, 2000.

A heated debate undertaken during 2001 regards publicly funded R&D expenses. Since 1992, public sector-financed R&D activities have been substantially increased. Yet in recent policy programs, public R&D efforts have been reduced (Research Council, 2001). Moreover, OECD is concerned about productivity in the educational sector, where, by OECD standards "...excessively long time spent in education still needs to be reduced" (OECD, 2000a). In the e-commerce area, it is particularly difficult to reduce the time students spend enrolled in school, to increase the output of tertiary students. With massive financial support for all students older than 18, and the absence of tuition fees, Danish students spend more years as graduate students than in any other OECD country, resulting in late entry in the job market for highly skilled labor. In the policy debate, the issue of special IT Green Cards has been discussed, but such a policy has not yet been implemented.

With generous welfare services; six weeks paid, annual vacation for all employees; a 37-hour work week, early retirement plans; and six months fully paid child-care leave (and a subsidized one year extension), the push to use ICT to boost efficiency and effectiveness is immense. Yet high progressive income and sales taxes are the primary sources for financing public sector spending, hence possibly reducing the incentives for marginal labor input. The government has to date not taken drastic initiatives to reduce the high income and sales taxes. Studies by the Danish Economic Council found that: "Taxation of labor income reduces earners' after-tax income and consequently the labor supply. The Danish income tax is characterized by high tax rates on wage income, with marginal tax rates of 44 percent on low income, 50 percent on medium income and 63 percent on high income" (Danish Economic Council, 2001).

Adding to the possible structural inhibitors, Scandinavian countries lack a large wealthy population segment to drive B-to-C sales. The most affluent 20 percent of the population in the

research qualification, normally requires, as a minimum condition of admission, the successful completion of education at the secondary level (World Bank Group, 2000).

U.S. accounts for 46 percent of the income, whereas the corresponding figure in Scandinavian countries is 35 percent. Yet the equal income distribution at relatively high levels could also be fueling e-commerce in Denmark relative to the U.S.

TABLE 10
Richest 20% and Poorest 20% Share of Income or Consumption, 1987-1998, %

Wealth	Share of income or consumption, richest 20%	Share of income or consumption, poorest 20%
Denmark	34.50	9.60
Scandinavia	35.15	9.73
European Union*	38.40	8.29
United States	46.40	5.20
OECD**	40.19	7.71

*Excluding Luxembourg

**Excluding Iceland, Luxembourg and Slovakia

Source: United Nations Development Programme (2000), pp. 169-72.

The Danish population of 5.3 million has a low growth rate (0.35 percent), and the country is facing the problem of an aging population. Approximately 18 percent of the population is under 15, and 14 percent are over 65. And the numbers are expected to increase by the year 2025. Aggressive efforts have been made to find ways to cope with the shrinking workforce. The problem with an aging workforce is more prevalent in Denmark than in the United States and OECD on average.

It is also important to note that the degree of urbanization is eight percent higher in Denmark than in the U.S. And it is higher than in the other Scandinavian countries. This aspect may have an impact on B-to-C e-commerce, although the direction and magnitude of the impact are very uncertain.

TABLE 11
Urban Population and Age Distribution, 1999, %

Demographics	Urban Population (% of total)	% Over age 65	% Under age 15
Denmark	85.26	14.45	18.23
Scandinavia	78.59	15.75	18.61
European Union*	79.36	15.97	16.83
United States	76.98	11.85	21.20
OECD**	77.28	12.62	20.43

*Excluding Luxembourg

**Excluding Iceland, Luxembourg and Slovakia

Source: World Bank Group (2000).

Business Environment and Readiness

The Danish job market is highly unionized (more than 85 percent), which is a unique feature of the industrial relations in the Scandinavian countries. The consequence, however, might be reduced structural flexibility and an inability to attract knowledge capital from abroad. Analyses from the Ministry of Finance (2001) demonstrate that the economy is at its capacity level, and needs to attract foreign labor to enter the digital arena.

In terms of innovation, Danish companies are adapting and reconfiguring their business organizations at a fast pace (Ministry of Foreign Affairs, 1999), although studies by Lundvall (1999) suggest that the Danish innovation culture is facing fundamental challenges. If we take a cross-section view on barriers to e-commerce, the lack of capabilities to innovate using ICT and the perception that goods in a particular industry are unsuitable for e-commerce suggest that business may not be ready to adopt a proactive approach to investing in e-commerce.

TABLE 12
Barriers to E-Commerce in Danish Enterprises, %

Barriers	All enterprises*	Industry Overall**	Construction**	Retail, Hotels**	Transport & Telecom**	Service**
Expenses due to internal readjustment	9	8	9	8	9	6
Considerations regarding existing sales channels	14	24	13	17	12	12
Uncertainty regarding guarantees, etc.	18	18	20	17	21	14
Uncertainty concerning payments	20	20	18	18	24	1
Customer potential too small	18	23	22	14	15	17
Goods unsuitable for Internet sales	30	41	40	22	26	45

Sources: *Statistics Norway (2001). **Ministry of Information Technology and Research (2000b).

National Policies Fueling and Inhibiting E-commerce Demand Drivers

In the previous sections we addressed four sets of demand drivers for e-commerce. We now turn to the policies that inhibit e-commerce in Denmark at the European level. These Danish e-commerce policies assume that the ICT Cluster is primarily use and demand oriented, rather than production and supply oriented (Ministry of Trade and Industry, 2001a).

The European e-action plan deals extensively with e-commerce initiatives promoting: 1) cheaper, faster and more secure networks for the Internet; 2) investment programs in people and skills; and 3) e-acceleration programs and transportation media to stimulate use of the Internet (European Commission, 2001). Adoption of EU legislation on copyrights, e-marketing, e-money, and jurisdiction is a key priority for the commission. There is a strong emphasis on co- and self-regulation within the e-commerce area, in close cooperation with the commission and various business groups such as Global Business Dialog (GBD). It is also worth emphasizing the European Data Protection Act, which mandates that companies use a specific standard for collecting and using private data. Similar directives have been issued on digital signatures and consumer protection. The extensive Internet regulation in Europe is in contrast to the market-driven approach in the U.S., and has been criticized as slowing e-commerce diffusion (Lewell, 1999).

The role of the public sector in Denmark is primarily to "...ensure that the overall market conditions are efficient and competitive making the new ICT available in all parts of the country at a realistic price level" [authors' translation] (Ministry of Finance, 2001b). Also, the demand

for new ICT services in the public sector is expected to produce a spiral impact. Although there is departmental disagreement, the overall picture is a national consensus without political infighting on the extent of governmental involvement. In 1999, a special task force made a set of recommendations relating to national e-commerce policy (Ministry of Information Technology and Research, 1999):

- Establish a Danish e-commerce house to promote incubators and start-ups and to unify research efforts;
- Award and acknowledge outstanding digital business people;
- Establish explicit and ambitious objectives for public e-commerce;
- Create a public auction hall on the Internet;
- Establish a research consortium on ICT;
- Provide attractive share options;
- Begin immediate depreciation of IT investments;
- Work towards adaptation of the labor market; and
- Increase the demand for broadband connections.

This task force was strengthened even further by a move to the powerful Ministry of Finance in 2001. It should be noted that the Law on Digital Signatures was approved in 2000 (L 229), aiming to "...promote secure and effective digital communication by establishing minimum requirements to certain digital signatures and to public key centers issuing certificates to digital signatures."

TABLE 13
Policy Institutions Addressing E-Commerce

E-commerce Focus	Policy Players
E-procurement in the public sector	-Ministry of Finance, Agency for Governmental Management -Task force: Ministry of Finance (chairman)*
Diffusion of e-commerce to SMEs	-Ministry of Trade and Industry, Business Affairs, -The Danish Commerce and Companies Agency
General awareness of e-commerce	-Ministry of IT and Research -Ministry of Business Affairs
Consumer confidence; encryption, decryption, signing and verification; security	-The Danish Consumer Council and The Danish E-Business Association (DEBA) -Ministry of IT and Research
Tax revenue & tax structure	-Ministry of Finance -Ministry of Taxation

*Overall focus is digitalization of the public sector. E-procurement is one of seven focus areas.

Although the list of policy players involved in e-commerce diffusion is long, the commitment in terms of financial resources directly targeted towards e-commerce has been criticized by both governmental departments and industry associations. For example, the special task force has about 25 staff employed to coordinate actions on digitalization, but almost no funding to push e-commerce in terms of R&D, support of pilot projects, etc. Also, tax policy issues have been caught between enabling the internal market (persons, goods, services, and capital), and running the large public sector. Finally, it is remarkable the degree to which private business associations

and government cooperate in terms of implementing very general regulations on issues such as encryption, decryption, signing, and verification.

In the e-commerce field, business schools have promoted education in e-commerce in both regular and executive programs (www.gem.cbs.dk). In addition, the Danish government has established an entire university devoted to IT research and education. The IT University (www.it-c.dk) was opened in 1999 and is expected to enroll 1,300 students within two years. In 2001, the enrollment was about 500 students. E-commerce is one of the IT University's key priorities (www.ebuss.dk).

By 2002, all public procurement, which amounts to DKK 100-140 billion (about 10 percent of the GDP), should be completed digitally. It will be a special challenge to meet the EU tender requirements. So far, the government, operating in three layers, has taken the following direct actions:

- Reduced the operating budgets in the departments by a fixed amount equal to the amount that could be saved from using e-commerce;
- Required all central government employees to book airfares, transportation, hotels, etc., on a particular website; and
- Initiated a general public procurement portal to be operational by August 2001.

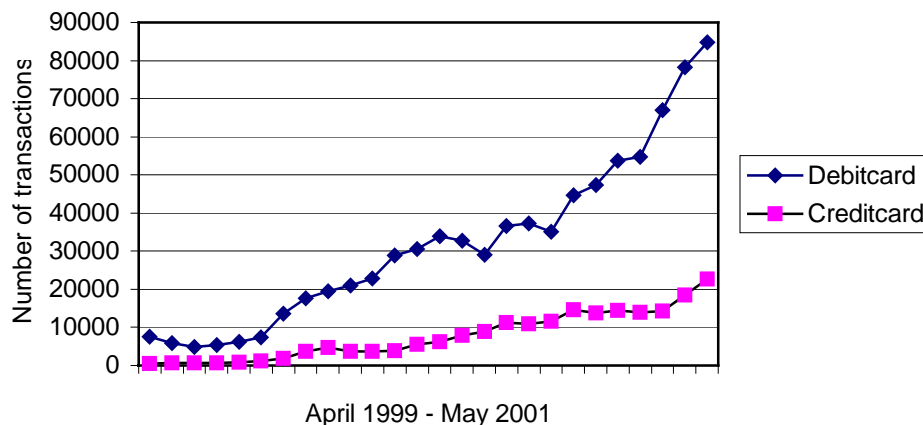
At local government levels, various experiments have been launched; but the initiatives are more diversified than unified. E-procurement is promoted in software vending and in government policy organizations. The most promising example is the *Digital Lighthouses*, where two areas in Denmark (Northern Jutland and the Oerestad) are promoted full scale. The goal is to encourage local and county authorities, along with local enterprises, to use digital procurement. The objective is supported by various pilot projects such as digital marketplaces, digital construction processes, and WAP interfaces for e-procurement. Yet several procurement officers object to digital procurement. Their arguments are threefold. First, they believe that they have already optimized their resources and view e-procurement as a critique of their job performance. Second, they feel that their privacy will be challenged relative to other employees. Third, they are concerned that employment in local businesses could be at stake if e-procurement is pursued.

Diffusion of E-commerce

In 2000, approximately one out of ten companies performed sales transactions through the Internet, to the tune of DKK 12 billion (US\$ 1.5 billion). The sales figures are primarily from the domestic market (81 percent). Thirteen percent of the sales were B-to-C. The remaining sales came from companies and the public sector (Statistics Denmark, 2001). Forty-three percent of the companies received orders through the Internet, and 37 percent ordered goods or services through the Internet. Thus, the Internet is used more as a *distribution channel* than to order goods. In terms of the value chain, support activities dominate the use of e-commerce. The Internet is used by 90 percent of companies for general information retrieval; by 65 percent for payment transactions; by 60 percent to streamline communication with the public sector; by 50 percent to obtain information about competitors; and by 33 percent to recruit personnel (Statistics Denmark, 2000).

The banking sector is leading the way, with Nordea being in the top internationally with regard to number of Internet customers. Nordic figures indicate that only 5 percent of the enterprises have a turnover of 2 percent or more that derives from Internet orders. Seven percent of transportation and manufacturing enterprises, 6 percent of business service enterprises, and 5 percent of trade enterprises have a turnover of 2 percent or more from Internet orders (Statistics Norway, 2001). Recent data on the number of payment transactions suggests an upturn in 2001, although it is yet to be determined whether the increased number of transactions also reflects an increase in turnover.

FIGURE 4: Payment Transactions by Debit/ Credit Cards, April 1999-May 2001



Source: PBS (2001).

If we compare the B-to-B and B-to-C turnover with the overall turnover in Scandinavia, Europe, the United States and the OECD, the Danish economy is at an average EU level in terms of B-to-C trade, and at a higher than average level in B-to-B trade. However, compared to the U.S., the B-to-C turnover in particular is smaller. A survey by Taylor Nelson Sofres (2000) showed that only 16 percent of Internet users purchased online in the past month, whereas the corresponding figure in the U.S. was about 27 percent. Measured in percentage of GDP, the Danish B-to-C trade is only 0.1 percent, whereas B-to-B in the U.S. is 4.8 percent. It should be noted that the data only show Internet-based EDI with regards to B-to-B, and do not include vendor-based or direct dial-up EDI messaging. In terms of turnover, it has been estimated that B-to-B turnover accounts for about 20 percent of total B-to-B e-commerce (DanNet, 2001). Thus, B-to-B e-commerce could account for about 9 percent of GDP. Comparable international figures that include EDI, however, are not available.

TABLE 14
B-to-B and B-to-C Trade, US\$ M and % of GDP, 2000

	B-to-B trade		B-to-C trade	
	In US\$ M	% Of GDP	In US\$ M	% Of GDP
Denmark	3,124.6	1.8	177.2	0.1
Scandinavia	12,490.3	1.8	1,042.2	0.2
EU*	71,880.2	0.9	8,083.1	0.1
United States	449,900.0	4.8	38,755.0	0.4
OECD**	588,900.8	2.4	52,184.2	0.2

*Excluding Luxembourg

**Excluding Iceland, Luxembourg and Slovakia

Source: Forrester Research, Inc., Global E-Commerce Model, 2000. GDP (1999) data from International Telecommunication Union, 2001.

The figures on B-to-B vary substantially, depending on whether EDI (direct access, vendor, and/or Internet) is included in the figures. Danish figures from comprehensive surveys on B-to-B traffic show an annual growth rate of 30 to 45 percent in EDI traffic from 1998 to 2000. According to national studies on B-to-B sales employing EDI, the data indicates that sales are expected to reach US\$ 14.2 billion (DanNet, 2001), and US\$ 1.4 billion for B-to-C sales (Statistics Denmark, 2001).

Yet, neither the national nor local government has been able to implement e-commerce effectively in operations. In public sector procurement, the Internet is primarily used to access information, and only in areas such as software, books, and traveling is ordering done through the Internet. B-to-B takes the bulk of the e-commerce market in Denmark. To these figures, we can add the EDI-mediated sales. Our data from 1995 to 1999 shows that EDI applications on average have increased by approximately 45 percent annually in terms of number of messages, and by approximately 33 percent in terms of size of messages (Andersen et al., 2000). The health care sector accounts for the major part of the increase in EDI traffic. In addition, a number of other areas increased their EDI applications, primarily within distribution, and banking and finance. EDI users within industry, distribution, and wholesale have also increased.

It is the large companies that are the driving force within these business sectors. EDIFACT applications are relatively low in terms of vendor traffic within retailing, finance, and the public sector (except the health care sector). Finally, the agricultural sector accounts for substantial EDI applications via vendors, as does the shipping sector, especially large, global-oriented shipping companies.

If we look at the number of messages, 176 percent more messages were sent in December 1997 than in January 1995, which is equivalent to 1.5 million additional messages. In December 1999, more than 4 million messages were transmitted through vendors. In the four-year span 1995 to 1999, more than 140 million messages were transmitted through vendors. This growth has continued at least in the first half of 2000.

TABLE 15
Vendor Based EDI Traffic, 1995-1999

Year	Bytes (Number)	Annual Growth (%)	Messages (Number)	Annual Growth (%)
1995	32,595,785	n.a.	12,631,158	n.a.
1996	43,980,498	35	18,404,126	46
1997	58,325,636	33	26,602,973	45
1998	81,058,956	39	35,514,579	34
1999	110,254,656	43	48,305,810	36

Source: Andersen et al. (2000), pp.56, 58.

Our analysis of the vendor data indicates that the health care sector has the highest vendor traffic distributed on business sectors. Both in 1998 and 1999, the EDI traffic in the health care area accounted for about 40 percent of all messages exchanged through vendors. By comparison, only 25 percent of the traffic was in the health care area in 1997. The main users of EDI in the health sector are pharmacies, hospitals, GPs, and laboratories. About one out of two prescription messages, two-thirds of the laboratory results, and three quarters of the discharge letters are transmitted through EDI (Danish Health Care Data Network, 2001). The other successful EDI players are in shipping, distribution and transportation, banking and finance, and agriculture. The public sector has also been relatively successful in its use of EDI at the various levels of government, and in connection with salary, pension, and social security payments.

Social/Economic Impacts

The overall picture of the impact of e-commerce on the Danish economy appears primarily to be manifested on the internal value chain, and only in part on the external value chain. International B-to-B e-commerce and EDI diffusion have impacted external and internal business transactions in both the private and the public sector, but the magnitude and nature of the impacts are unknown.

We submit the view that the overall impact on cost reductions, service content and level, resource allocations, competitive advantages, employment structure, and privacy issues appears to be more mixed than unidirectional. Yet various policy players promoting e-commerce believe the output benefits to be unambiguous. This discrepancy between (promoted) expectations and solid data verifying clear impacts might in part explain the relatively small amount of B-to-C and B-to-B e-commerce transactions through the Internet.

In the financial sector, there has been a rapid increase in the number of customers who only exist virtually, that is, they perform all their banking transactions using home banking systems and have no personal contact with their bank offices. This has caused Danske Bank to reduce its staff in branches by 10 percent each year from 1999 to 2001. This will also, in turn, reduce the number of bank outlets.

Online recruitment and temporary agencies have been very successful, and as such are a challenge to several of the existing companies and governmental units. In 2001, the newspapers have lost 10 percent of their revenue from job advertising to online job databases. Successful content providers also challenge the public sector services. Although many enterprises operating on the net might complement public service, the prospect of substituting public services also

seems likely. There is a concern that the various online private enterprises searching for and matching governmental information might create a demand for additional public services.

In the mobile commerce (m-commerce) area, impacts on payment structures are likely to occur. One scenario could be the reinforcement of existing players. Alternatively, mobile companies in the banking sector could emerge. M-commerce and GPS services are likely to challenge privacy issues, both with regards to marketing and various GIS services. Changes in European laws on data protection, and national laws on public records, appear to be a prerequisite for the emergence of m-commerce and GPS services.

CONCLUSION

The Danish government will have to speed up e-commerce initiatives if it is going to meet the ambitious goal of becoming one of the top five countries with the largest e-commerce turnover per inhabitant by 2003. Although EDI diffusion is substantial, B-to-B figures are favorable by international comparison, and m-commerce is breaking new ground in the B-to-C area, B-to-C has yet to take off in terms of sales transactions. Moreover, Danish e-commerce sales transactions are primarily domestically orientated. Yet, in areas such as home banking and ticketing, B-to-C is rapidly diffusing.

It appears that the Danish economy is facing various structural challenges. The commitment to increase IT related education must be complemented with initiatives to reduce the length of programs at higher education institutions. The income tax is also at a very high level, reducing private initiatives and discouraging foreigners from working in Denmark. In addition, it is necessary to take initiatives to ensure the availability of venture capital.

As a member of the European Union that must respect the relatively tight regulations on data protection and taxation standards, the legal barriers for Danish start-ups are substantial compared to the U.S. A highly unionized labor force and a large government sector also suggest that the impact of e-commerce is more visible in the B-to-B market. It might be in this market that the Danish economy is most likely to capitalize from e-commerce.

In terms of demand drivers, the well established information infrastructure in telecommunications, and the wireless and Internet infrastructure, are contrasted by relatively high access costs, a lack of secure servers, and the high speed connections adopted by the end consumers. On the enabling side, the high income level and generally highly skilled labor force are contrasted by a lack of high-end income profiles and a highly skilled IT labor force.

The government's own use of e-commerce in procurement is seen as an important driver for the diffusion of e-commerce. But it is very difficult to implement the strategy in a highly decentralized public sector that lacks command-of-line policy instruments. Furthermore, implementing public e-procurement is challenged by European regulations on public tendering, and the constant need to harmonize regulations on such issues as taxation, digital signatures, and privacy rights.

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Disclaimer: The following list of References contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word-processor or are reading this paper on the Web, can gain direct access to these linked references. Readers are warned, however, that:

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