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Contribution of the New Economy to Estonia's Economic Growth and Convergence with the European Economy

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Summary

Contribution of the New Economy to Estonia's economic growth is studied from the aspects of information and communication technology (ICT) penetration and development of high and medium-high tech industries. Comparison with EU member states and other candidate countries reveals that especially Internet penetration in Estonia is rather high. Contribution of high tech exports is also good in international comparison. Nevertheless, the direct impact of high tech industries and especially medium-high tech industries on economic growth might have been better. The main impact on growth is indirect and goes via high ICT level in the economy as a whole.

[1] We would like to thank Ms. Marika Kirsspuu for linguistic elaboration of the text. The study was funded by the Estonian Ministry of Education research projects No. 0341765s01 and 0341764s01. Additional financial support from the Estonian Science Foundation in the form of Grant No. 4794 is also gratefully acknowledged.

1. Introduction

Estonia restored its independent statehood in 1991. The legacy from the Soviet period consisted mainly of state-owned and centrally planned economy with an oversized, rather inefficient and ill-functioning public sector. It meant that almost all institutions had to be rebuilt to meet market economy requirements. Besides radical reforms in public sector it also meant large-scale privatisation of formerly state-owned enterprises and founding of numerous new private enterprises. A completely new financial sector was established.

Although few government agencies and private enterprises inherited some old and outdated capital stock, it was replaced quite rapidly. New institutions, enterprises and their interactions were largely based on new technologies also. There were no great traditions or habits to carry on. It made penetration of new technologies faster.

In the process of building up new institutions and enterprises for market economy, Estonia learned a lot from its nearest market economy neighbours – Finland and Sweden. These countries happened to be among technologically most advanced ones with rather high level of the New Economy. Besides learning from neighbours, the impact of Finland and Sweden was reinforced by ample inflow of Finnish and Swedish capital into Estonian economy. Numerous subsidiaries and affiliates of Nordic companies in Estonia contributed to faster penetration of New Economy and especially ICT.

An advantage of Estonia then was the existence of qualified ICT specialists – their preparation at Tallinn Technical University and at the University of Tartu was on a quite good level in the 1980s. Also remarkable research in the ICT field has been conducted at the Academy of Sciences – for example, the Institute of Cybernetics had rich experience in elaborating problem-oriented software systems.

In order to discuss the state of art of the New Economy in Estonia we try to compare it with the European Union member countries and also with other candidate countries of the enlarging EU. We also try to assess the contribution of New Economy to economic growth. However, as the statistics available on the New Economy are not very comprehensive we have to implement the term of New Economy in a more restricted sense than described, for instance, in SINE (2000). When discussing demand side problems and penetration of the New Economy we have to restrict ourselves to available information on ICT mainly. On the supply side and in the discussion of output, exports and employment, we have to deal mainly with the contribution of high and medium-high tech manufacturing and knowledge-intensive services (KIS). To identify the corresponding sectors we tried to implement the same classification of activities used by Eurostat (Laafia, 2002).

The information used is retrieved mainly from the Statistical Office of Estonia, Eurostat, OECD and other international sources of information on ICT.

2. New Economy and ICT penetration in Estonia

New Economy and especially ICT is rather broadly used in Estonia. Traditional indicators of the ICT penetration rank Estonia rather high among the EU candidate countries but still behind the EU-15 average (Table 1). A specific feature of Estonia is that the stock of personal

computers as well as number of mobile phone subscribers per 100 population is relatively low compared to the EU-15 average. However, the number of Internet hosts and Internet users per 100 population is rather high. Thus, computers are intensively used in communication services.

A reason for rather high Internet penetration lies in programmes and projects that promote Internet-based services and trained users.

2.1 E-government and public administration

There is an ambitious program in public administration targeted at broad use of ICT in state agencies and local government as well as in communication with citizens. The processes inside public management can be related to the e-government initiative to document management program of government agencies, numerous public e-services offered to e-citizens and e-businesses.

Table 1. Information society statistics for EU member states and candidate countries (per 100 inhabitants) in 2001

Country	Personal computers	Internet users	Internet hosts	Mobile phone subscribers (in 2000)
Austria	28.0	32.0	4.01	77.2
Belgium	34.5	28.0	3.41	52.1
Denmark	43.2	44.9	10.45	63.1
Finland	42.4	43.1	17.07	72.1
France	33.7	26.5	1.33	49.1
Germany	33.6	36.5	2.94	58.7
Greece	8.1	13.2	1.35	56.3
Ireland	39.1	23.3	3.34	65.9
Italy	19.5	27.7	1.17	73.2
Luxembourg	51.5	22.5	3.12	87.2
Netherlands	42.9	33.1	16.34	67.5
Portugal	11.7	35.2	2.39	66.7
Spain	16.8	18.7	1.33	62.7
Sweden	56.1	51.7	8.25	71.9
United Kingdom	36.6	40.1	3.71	72.9
EU-15	***30.0***	***31.5***	***3.3***	***63.5***
Czech Republic	12.1	13.6	2.09	29.2
Cyprus	25.1	19.7	0.30	26.2
Estonia	**17.5**	**31.7**	**3.57**	**32.0**
Hungary	10.0	14.5	1.68	29.7
Latvia	15.3	7.3	1.06	15.6
Lithuania	7.1	7.2	0.96	11.4
Malta	23.0	25.3	2.23	21.1
Poland	8.5	9.8	1.27	15.0
Slovak Republic	14.8	16.6	1.34	21.5
Slovenia	27.6	30.2	1.48	57.4
CC-10	***10.7***	***12.4***	***1.5***	***20.8***

The first stage of the **e-government** was implemented in August 2000 when a shift from paper-based documents to digital ones was made. All documents for Estonian Government Cabinet meetings are prepared digitally. The system includes also possibility to record meetings and to show digital materials to participants and visitors by the video projector. The system includes working places for Ministers and several places for personnel. The terminal-type computer is used for one working place and the system can be used to follow the meeting, surf the Internet, look the documents, etc. It had to open possibilities to participate in and follow the meetings via Internet (Estonian Government, 2000).

The **document management program (DMP)** of government agencies is targeted at the transition to inter-agency digital document management. All documents are prepared on computers, most government agencies use computer-based information systems. All main registers of the state (citizens, businesses, land, immovable property etc.) are available in digital form. A fully functional land register (cadastre) was implemented in November 2000, which enables fast inquiries by the name, address or feature of a cadastral unit (also WAP-based). Service for examining land information enables to see spatial data, e.g. data of cadastral units (including graphical data), borders of administrative units and geodetic points (functioning since July 2001) against the background of different base maps that include:

- Orthophotos – in the scale of 1:10 000 and 1:2000;
- Basic Map of Estonia – in the scale of 1:10 000;
- Base Map of Estonia – in the scale of 1:50 000.

There is a special program for national databases (project **X-road**) to enable agencies, legal and natural persons to search data from national databases over the Internet, provided they are entitled to do so.

From June 2002, the legislation, notices, and other documents issued on paper and in electronic State Gazette have equal legal force. Basic official statistics produced by the Statistical Office and Bank of Estonia are publicly available in the Internet. All ministries and state offices have their own websites with broad information about their activities, structures, personnel, main legal acts under preparation and additional more detailed statistics. There is also an extension of the DMP to **e-County** project to elaborate public information portals for counties, which would enable all county governments and municipalities to use the common information management system.

All documents that citizens may need to communicate with public administration are available in the Internet in PDF-format and can be printed out for filling in (over 230) or can be filled in directly on the screen (over 110). Until now it is not possible to transmit all these documents directly to state agencies via the e-government portal due to the lack of secure authentication and transmission system of digital documents, in general. However, in many cases authentication over Internet banks is still possible. Presumably electronic submission of documents advances with realisation of the e-citizen project and broader implementation of ID cards that enable digital signature (IT in Public, 2002).

There is already a long list of public services provided to **e-citizens** and **e-enterprises** digitally over the Internet. The most developed one is tax administration or **e-TaxBoard**. The project was launched in spring 2000, when the natural persons were first provided with the possibility of electronic filing of their income tax returns for 1999 via the portals of two banks - *Hansapank* and *Ühispank*. More taxpayers than expected, namely 11,760, used the new solution already in the first year. In 2001 36,488 personal income tax declarations or 8.7% of

their total number were submitted electronically. Since 2002 it is possible to enter e-TaxBoard directly with ID cards also and about one-fifth of personal income declarations were made electronically.

The second stage of the project, concluded by autumn 2000, launched e-services for companies. According to the Tax Board Annual Report 2001 162.3 thousand VAT declarations made by companies in 2001 or 29% were made electronically (Tax Board, 2002). 183.5 thousand social tax and withheld income tax declarations (22%) were the electronic ones. Thus, tax administration is rapidly growing electronic.

2.2 Financial services

The history of Estonia's financial sector goes back to 1988 only. Thus, most of the commercial banks, insurance and leasing companies, investment and pension funds are quite young. When established, these institutions were open to new technological solutions and as they offered very competitive wages on Estonia's labour market they employed the best ICT experts available, perhaps. It made Estonian banks and Estonian financial sector more innovative than rather conservative European banks.
Clients of Estonian banks are used to electronic transactions. There were 1.09 million bank cards emitted by Estonian commercial banks by the end of September 2002 or just 1 bank card per 1 person aged 15-79 years. Estonian residents made 24.4 million card transactions in 1998 (with the total value of EEK 16.1 billion) and 66 million transactions with the total value of EEK 42 billion in 2001. Thus, an adult person made 1.25 card transactions per week, on the average. About two-thirds of the card transactions were cash withdrawals in ATM-s (Automated Teller Machines) and one-fourth of the transactions were Points of Sale (POS) terminal payments[2].

There were 475.4 thousand Internet bank users in January 2002[3]. Internet banking has broadly replaced paper-based credit orders, which were usually written in bank offices. From the total number of payments intermediated by commercial banks at the end of 1997 and in the beginning of 1998 over 40% were paper-based credit orders and about 1-2% Internet bank orders. By the end of 2002, the share of paper-based credit orders had declined to 3% and the share of Internet-bank credit orders had grown to 22% of the total number of transactions. Together with telebank credit orders (23-24% of transactions) and card payments (40-42% of payments) electronically initiated payments are responsible for approximately 90% of their total number. Broad Internet penetration enabled to reduce the number of bank offices and tellers, electronic payments squeezed out the use of cash and reduced the share of black market.

Estonian credit institutions have continued to upgrade the range of services. Since the end of June 2002, prompt domestic payment has been available, which allows making inter-bank transactions just in a few minutes using SWIFT-based payment mode. The service is accessible in bank offices, via Internet and telephone banking both for retail and corporate customers. In June, Estonian large banks launched also an m-payment pilot project with about 1,000 test users. M-payment is an alternative to card payments and enables mobile phone holders to pay for goods and services.
The Estonian Central Depository for Securities (ECSD) was established in 1994 with an electronic registry of securities that enabled electronic trading on secondary market. The goal

[2] Calculated on the basis of Bank of Estonia data (http://www.ee/epbe/statistika/itp.html.en)
[3] Newspaper *Postimees* 13.02.2002

was to create a well regulated and efficient environment for electronic clearing and registering of shares. Tallinn Stock Exchange (TSE) started operation in 1996 as an electronic trading environment for securities listed by him. In April 2001, Finnish HEX Group acquired strategic ownership in the TSE and trading with Estonian securities was removed into HEX trading system from February 25, 2002.

2.3 Trade, e-commerce and m-commerce

It is estimated that monthly turnover of the largest Internet stores did not exceed EUR 60 thousand at the end of 2000. The total annual turnover of Estonian B2C (business to citizen) e-commerce was between EUR 1.3 and 2 million in 2000. Computers and computer appliances, home electronics, books and CD-s were most often bought from Internet shops. However, one may add to traditional e-commerce also subscriptions for newspapers and journals with payments over the Internet, payments for housing, electricity, telephone, mobile phone or ADSL services as well as insurance payments if e-accounts for these services are sent directly to bank to be accepted by customer with a single keyboard click only. The list of companies that prefer to use e-accounts, standing agreements or traditional payments from customers' bank accounts is rising and administrative power is sometimes needed to force companies to accept cash payments.
There are successful B2B (business to business) projects implemented in Estonia as well. One example is the wholesale company of medicines - Magnum Medical who started to develop its Internet based ordering system already in 1997. By 2000, the share of electronic commerce of the company had grown to EUR 13 million per year; it accounted for half of the total turnover of the company.

Nevertheless, turnover of the traditional e-commerce is rather moderate in Estonia. One of the strongest advantages of Estonia in e-commerce is widespread Internet banking while the most important discouraging factors are smallness of the potential market and sometimes conventional shopping habits.

Although card payments are quite popular in Estonia's retail trade, these are still quite costly (2-3 % of the paid value) for retailers. Additional investments are necessary to set up POS terminals. Therefore, POS terminals are not very widespread in small shops and instead of them use of mobile phones in intermediation of payments (m-commerce or m-payments) are picking up.

Estonian Mobile Telephone (EMT) developed a mobile payment system for parking a car in Tallinn that started operating on July 1, 2000. For a year, the company offered only a system that simply added the service costs to the phone bill. The service was open to all private persons with contracts or pre-paid mobile phone cards and other mobile operators joined it. It became quite popular and on the average 15% of all parking payments in Tallinn were made using this system. In June 2001, EMT opened an alternative system, which is currently offered for mobile parking, but could be easily implemented also for other services. In the new version, the charge is made to a special mobile account kept by the operator. In order to start using an m-account, the user has to accept the agreement with bank. Then it is possible to load the m-account with a pre-determined amount by sending a SMS to a special number. Thereafter, one can pay for services using the money on the m-account. The third version is that all payments made with mobile phone automatically transfer money from the user's bank account to the merchant. In this way the mobile operator is not involved in moving money, but provides only the transaction medium. At the same time, the solution would be

unreasonable for small payments since it requires a bank transaction each time a payment over the mobile phone is made, which costs approximately EEK 1 (EUR 0.06) for the bank. Consequently, the payment would become too expensive for very small sums, e.g. less than EEK 10 (EUR 0.6), considering that the operator also wishes to receive some commission like the SMS fee, for example (Adamson and Kaarli, 2001). As mentioned above, Estonian banks launched an m-payments pilot project in 2002. M-payments are tested now mainly as an alternative to card payments in smaller shops. M-payments are also used in public transportation (to pay transportation fees on some urban bus lines in Tallinn). Mobile phones are also used for positioning (emergence) calls, in security systems including the systems for positioning stolen cars.

2.4 Training the ICT users

The broad use of Internet and ICT in general would have been impossible without customers capable of using opportunities offered to them. One of the first programs to expand computer and ICT knowledge was the **Tiger Leap** (into 21st Century). The program was initiated in 1996 by the Ministry of Education and carried out in 1997-1999. The Tiger Leap program set the goals of introducing ICT knowledge in schools, connecting the schools to the global computer network and training in productive application of the technology. It was also a goal of the program that schoolchildren learn to cope in the information society.

Within the Tiger Leap program about 11 thousand teachers (out of 17 thousand in Estonia) upgraded their knowledge in ICT; schools were supplied with computers and 61 educational software programs (including 39 original programs in Estonian). By 2000, about 75 per cent of Estonian schools had got online Internet connection while others had dial-up connection. On the average, there were 25 pupils per computer in Estonian schools. A survey for 2000 revealed that 85% of the pupils used computer at school during a week, 81% outside school (spending more time on computers outside school rather than in school) while 44% of the pupils (and only 41% of teachers!) could use computer at home (Toots and Idnurm, 2001). The program was followed by the Tiger Leap Plus that was created to transform Estonian schools into schools of information society, to support teachers in their conversion into teachers of information society and to equip pupils with a compass for keeping on course.

Another program - **Village Road** of rural data communications (see: http://www.kylatee.ee/sisue.htm) was launched at the end of 1998 with preliminary studies. By now almost all of the 247 Estonian municipalities have a fixed line connection to the network. Village Road 2 project was started in 2000 and it expands fixed Internet access to schools and libraries where public Internet access points are opened. By now public Internet access points are open at more than 180 libraries across Estonia.

The third program to mention is **Look@World** funded by private sector companies (2 major banks and 2 telephone companies). The project started in April 2002 and was targeted at providing free of charge basic computer and Internet training for 100 thousand persons (about 10% of Estonia's adult population). During 2 years training will be held in almost 200 points all over Estonia in two 4-hour blocks. On the first day 4 hours are dedicated to basic knowledge about computer and Windows; the second day's 4 hours will focus only on Internet (Progress Report, 2002).

These projects were supplemented with several others that paved the way to broad usage of Internet in everyday life in Estonia.

3. Contribution of New Economy in exports, output and employment

Although New Economy and especially ICT have rather broadly penetrated into Estonian economic and social life, on the supply side the picture is less bright if to evaluate the situation on the basis of high and medium-high tech manufacturing and knowledge-intensive services (KIS).

Considering the World Bank data on manufactured exports Estonia enjoys a quite good position among EU member states and candidate countries. However, the share of high tech output might have been higher in manufacturing output. Estonia's economy might have been more knowledge-intensive and far less resource intensive (including energy intensity); its ecological footprint might have been smaller. Implications of the "weightless economy" (Quah, 1998; Coyle and Quah, 2002) are far smaller than desired.

3.1 Exports

The World Bank data on the contribution of high tech exports in total manufactured exports indicate that Estonia has enjoyed a rather high share of high tech exports in recent years compared to EU-15 and candidate countries (Table 2).

Table 2. High-technology exports (% of manufactured exports)

Country	**1996**	**1997**	**1998**	**1999**	**2000**
Austria	10.0	11.4	11.4	12.6	13.7
Belgium	7.6	7.7	8.1	9.4	10.1
Denmark	16.2	17.2	17.6	19.4	20.7
Finland	16.3	19.2	22.0	23.9	27.3
France	18.5	21.3	22.4	22.9	24.3
Germany	12.8	13.6	14.6	15.9	17.7
Greece	6.2	5.5	8.0	9.0	…
Ireland	46.6	46.2	44.1	46.7	47.5
Italy	7.7	7.4	7.9	8.1	9.2
Luxembourg	...	...	...	14.6	16.8
Netherlands	26.5	26.6	30.0	32.9	35.5
Portugal	4.3	4.2	4.0	4.9	...
Spain	7.4	6.8	6.7	7.6	7.6
Sweden	17.0	19.0	20.0	21.0	22.0
United Kingdom	26.4	25.7	28.8	29.8	32.0
EU-15	***16.1***	***16.9***	***18.2***	***19.4***	***21.4***
Czech Republic	6.9	7.3	7.9	8.3	8.2
Cyprus	6.2	3.9	4.2	4.1	2.5
Estonia	**8.8**	**9.0**	**11.6**	**13.4**	**29.8**
Hungary	5.7	18.0	20.6	22.6	26.4
Latvia	5.2	6.4	4.0	4.1	4.0
Lithuania	3.5	3.7	3.2	3.1	4.2
Malta	58.9	56.0	60.4	61.7	71.7
Poland	2.9	2.6	2.9	2.6	3.3
Slovak Republic	4.0	4.0	4.0	4.0	...
Slovenia	4.0	4.0	4.0	4.0	5.0
CC-10	***6.2***	***8.0***	***8.6***	***9.6***	***11.0***

However, a more detailed survey of Estonian exports reveals that the situation may not be as good as these data indicate. To analyse the dynamics of technology structure of Estonian special exports[4] we rearranged official statistics to distinguish high tech manufacturing, medium-high tech manufacturing and knowledge–intensive services (KIS) according to Eurostat definitions[i]. After regrouping data of Estonia's special exports (originally declared according to the Estonian classification of goods that corresponds to the Combined Nomenclature 2002 used in the EU) we got data presented in Table 3.

Table 3. Contribution of high tech exports in total exports of commodities

	1996	**1997**	**1998**	**1999**	**2000**	**2001**
Total export of commodities (bill. EEK)	**21.3**	**29.6**	**35.2**	**35.0**	**53.9**	**57.9**
From this in per cent						
High tech exports	9.2	14.0	18.2	18.4	31.7	26.7
Medium-high tech exports	14.8	13.6	12.6	12.0	11.5	12.4
Other commodities	76.0	72.4	69.2	69.6	56.8	61.0

The data in Table 3 confirm that there was a sharp growth in high tech exports in 2000 indeed, but the high level reached then was not sustainable. As a matter of fact, the sharp growth of high tech exports in 2000 resulted from the almost two-fold growth of subcontracting that was mainly driven by contracts allocated by Nordic ICT companies. Worldwide difficulties in ICT sector reduced the volume of subcontracts and contribution of high tech exports in 2001. Although the share of high tech exports remained quite high in 2001 it indicated that Estonia's high tech export was vulnerable. The share of medium-high tech exports has been almost stable or declined slightly.

In trade with Finland re-exports after processing (that means usually subcontracting) contributed 68% of total Estonian special exports in 2001. The contribution of re-exports to Sweden was 45% of special exports and to Japan even 81% (Foreign Trade, 2002). However, Japan was not among the main export markets of Estonia. *Nokia* and *Ericsson* were the leading companies that allocated high tech level subcontracts into Estonia while their main partner was *Elcoteq Tallinn*, a subsidiary of the Finnish owned Elcoteq that is employing about 2000 persons in Tallinn.

High dependence on subcontracting raises a question related to classifications and criteria used to distinguish high tech industries and products – in case of subcontracting actual contribution of R&D and knowledge intensive labour may be lower than in companies that carry on technological progress and allocate subcontracts. However, it would be very difficult to make international comparisons if to measure contribution of high tech exports considering the actual cost structures by countries and companies although they may produce similar output (computers or mobile phones, for instance). There are also some concerns about the transfer prices that are used in subcontracting (especially if subcontracts are allocated to subsidiaries of mother companies) as these may differ from real market prices and may depend also on differences in taxation between countries (and include different profit margin).

[4] Excludes exports of commodities from custom warehouses that had not entered Estonian territory for free circulation.

3.2 Manufacturing

Although data on high development exports look quite good the output structure of the Estonian manufacturing (Table 4) is less promising. Notwithstanding the increasing contribution of high tech manufacturing the volume of high tech output is still quite small. The contribution of high tech output has grown in parallel with the decline of the contribution of medium-high tech output while the share of output on lower technical levels has remained almost unchanged. Stable growth can be traced in the output of radio, television and communication equipment and apparatus (NACE code DL 32), of medical, precision and optical instruments (NACE code DL 33), while the manufacture of office machinery and computers (NACE code DL 30) has declined after the peak in 1998.

Table 4. Technological structure of the Estonian manufacturing*

	1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**
Output in manufacturing, billion EEK at current prices	**10.0**	**12.0**	**16.0**	**21.4**	**25.7**	**34.0**	**37.6**	**35.2**	**45.4**
From this in per cent									
High tech manufacturing	1.6	1.7	1.5	1.8	2.5	3.2	4.3	4.6	5.4
Medium-high tech manufacturing	18.8	17.4	19.5	18.7	17.4	15.1	13.7	13.7	14.4
Other manufacturing	79.7	80.9	79.0	79.5	80.1	81.7	82.0	81.7	80.2
Total employment, thous. Persons			**692.6**	**656.1**	**645.6**	**617.2**	**606.5**	**579.3**	**572.5**
From this in per cent									
High tech manufacturing**			0.76	0.85	0.83	0.90	0.93	1.05	1.44
Medium-high tech manufacturing**			4.01	3.80	3.53	3.30	2.88	2.56	2.56

* Official data of the Statistical Office of Estonia are rearranged according to Eurostat's classification of activities based on the technical levels brought in the endnote of the paper.
**Number of employees in manufacturing is calculated on the basis of industrial output and output per employee.

The low contribution of high tech manufacturing is partly due to subcontracting. Due to the statistical methodology subcontracting is included into output and sales with the value added only while other output is recorded at current prices (that include also value of intermediate consumption).

The data on employment in manufacturing were calculated on the basis of output and output per employee by NACE codes. The results for 2000 matched quite well with data available from the population census of March 31, 2000. This calculation enabled to depict in Table 4 the dynamics of high tech employment in manufacturing.

Notwithstanding the declining employment in manufacturing, the number of people employed in high tech manufacturing has increased. The employment rate of activities that were classified as high tech manufacturing was 7% of total manufacturing employment.

Compared to EU-15 member states (unfortunately we do not have comparable data for other candidate countries) Estonia's percentage of employment in high-tech manufacturing in total employment (1.44% in 2000) is even slightly higher than EU-15 average and it places Estonia between France and Sweden.

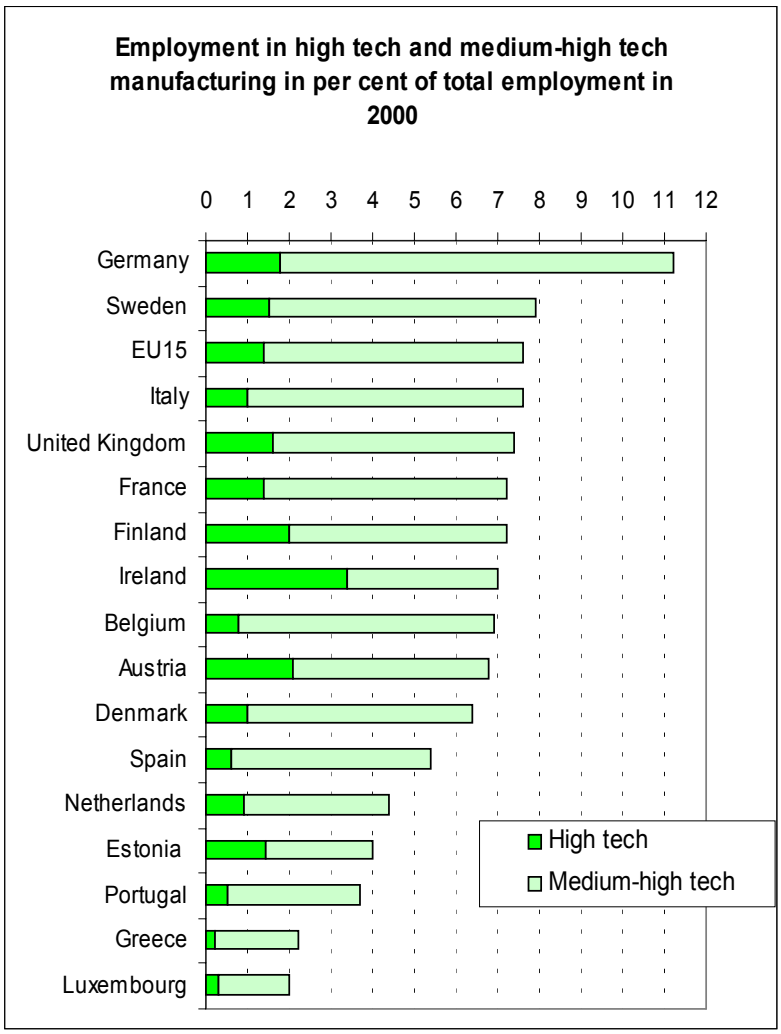

Figure 1

However, some concerns are related to the content of the work, or whether it really classifies as high tech labour. Another problem is that employment in medium-high tech manufacturing is declining and was only 2.6% of total employment in 2000 while EU-15 average was 6.2% of total employment (Figure 1). Employment in Estonia's high tech manufacturing grew by less than 3 thousand persons in 1994-2000 while more than 13 thousand jobs were lost in medium-high tech manufacturing. Medium-high tech manufacturing was responsible for more than half of the total employment decline in manufacturing.

3.3 Employment in Knowledge-Intensive Services

Activities classified by the Eurostat as Knowledge-Intensive Services (KIS) employ more people on high tech level than manufacturing. The same holds true for Estonia. For instance, ten times more people are employed in computer services compared with production of office machinery and computers.

Although the share of KIS in total employment in Estonia (27.7%) is below that of the EU member states (32.3%, see: Laafia, 2002), the difference is not very big (Figure 2). Comparison with the EU member states places Estonia between Austria and Italy.

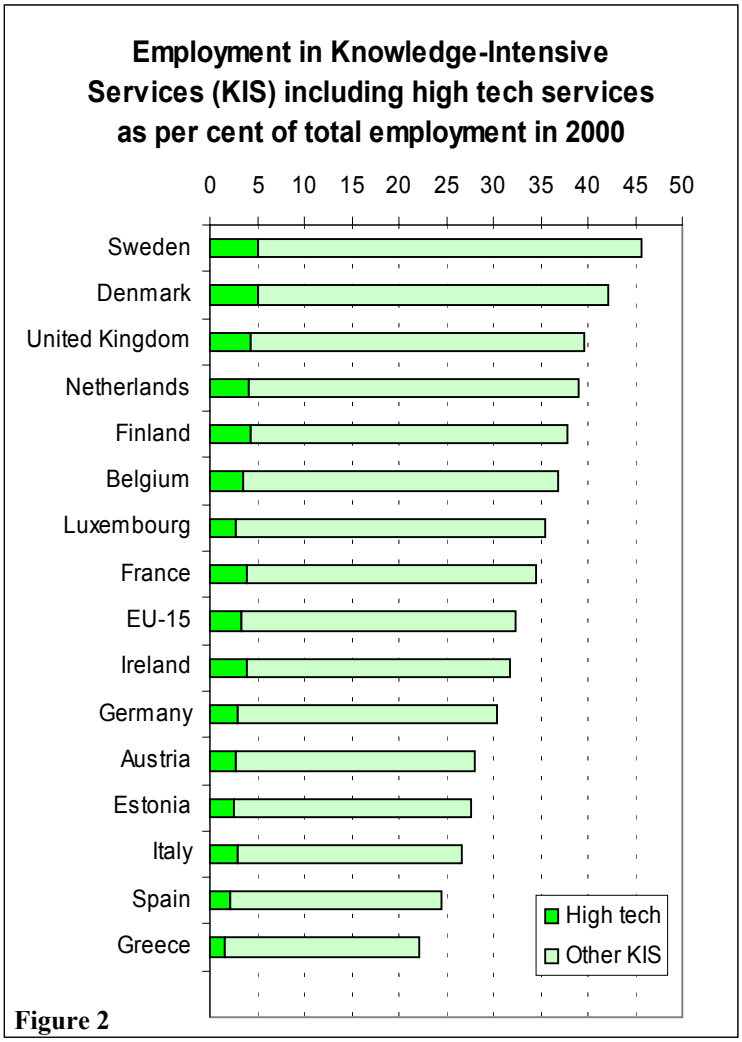

Figure 2

If to consider only services that are assessed to be on high tech level (post and telecommunications; computer services; research and development), then their contribution in Estonia's employment was 2.6% in 2000 while in EU-15 it reached 3.4%. Compared to EU member states Estonia's level falls between the levels of Spain and Luxembourg.

One of the reasons why Estonia's employment in high tech KIS is relatively low is related to low employment in research and development. Only 0.59% of Estonia's labour force was employed in R&D in personnel headcount (HC)[5] in 1999 while the average of EU-15 was 1.28%. The lowest level in the EU-15 (0.81%) was recorded in Portugal. The respective number in Finland reached 2.43% and in Sweden 2.36% (Laafia, 2002).

Low employment in R&D results from scarcity of funding, especially by business sector. Estonia's R&D expenditures were 0.75% of GDP in 1999 and 0.67% of GDP in 2000 while in EU-15 the share was 1.92% and 1.90% respectively. The main burden of funding R&D in Estonia is carried by the government – 75% of finances used in R&D originate from the public sector while in the EU the share is 36-37%. Funds from the government are used in higher education sector mainly. Business sector own funding is responsible for 15-18% of intramural R&D expenditures only (together with government funding 20-23% of expenditures). In EU, business sector is the main actor in R&D activities, as more than 50% of the funds for R&D originate from business sector and more than 60% of intramural R&D expenditures are made by this sector. In this context it is obvious that Estonian business enterprises rely too much on subcontracting and use of imported knowledge, their own efforts in technological advance are still quite limited.

[5] Personnel in head count (HC) are the number of individuals employed mainly or partly in R&D.

4. Contribution of the New Economy on growth in Estonia

It is generally expected that employment in high and medium-high tech industries grows faster than in manufacturing as a whole or general employment. It is also supposed that these sectors have higher productivity (both total factor productivity and simple labour productivity) than average for a country and thus employment growth in high and medium-high tech manufacturing and knowledge-intensive services should lead to economic growth.

The situation in Estonia is still slightly different. Although employment in high tech manufacturing increased indeed, there was a rather sharp decline in medium-high tech and general manufacturing employment. Thus, employment growth in high tech industries reduced the output contraction that otherwise might have occurred (if labour productivity growth had not compensated decline in employment). However, there is no strong evidence that more value added is produced by employees in Estonian high tech manufacturing. The manufacture of office machinery and computers (with a few hundred employees) produces about 10 times more value added per employee than manufacturing on the average, indeed. But in the manufacture of radio-, television and communication equipment (with 2-3 thousand employees) value added per employee tends to be even below the manufacturing average. The problem stems most likely from the aforementioned subcontracting and relatively low priced operations conducted in Estonia for producing high tech equipment. Due to the low contribution of ICT sectors in Estonia's output its economy didn't suffer from the burst of "dotcom" bubble.

Among knowledge-intensive services sea transportation, post and telecommunications as well as computer services have a positive impact on general growth. However, value added of R&D activities, education, health and social work is very low and even if employment will grow it may reduce average labour productivity.

Thus, the evidence of direct positive impact of high tech, medium-high tech and knowledge–intensive industries on economic growth is not very convincing. It may be assumed that indirect impact of the New Economy that helped to make all industries more competitive, is still dominating. A very rough estimation based on input-output table for 1997 revealed that intermediate consumption of high and medium-high technology industries and knowledge-intensive services was about 20% of the total value of Estonia's outputs or 32% of intermediate consumption. Extremely high was the contribution of high and medium-high tech inputs in intermediate consumption of the same industries. However, high and medium-high tech inputs were also quite significant in many service activities, especially in financial services, telecommunications, sea transportation, hotels and restaurants, trade etc. High ICT efficiency helped to attract investment and create new jobs. For instance, Hilton Reservation Worldwide established one of their 17 booking centres in Tallinn just because the quality of telecommunications was estimated to be higher than in the neighbouring countries (including Sweden). The centre services more than 1000 calls per day (including about 500 from UK) and is going to increase the number of employees to 200. Also *SAS*, *Viking Line* and *Silja Line* have located their call and booking centres in Tallinn because of the good level of telecommunications and moderate cost level. Centres in Tallinn take care of calls from Nordic countries, from Great Britain, Germany, Netherlands etc. (Uljas, 2001).

Thus, our brief study brought us to the conclusion that is similar to the one expressed by Bayoumi and Haacker (2002) on the basis of cross-country analysis of worldwide data. Gains from IT do not depend so much on output of corresponding industries or contribution of these

industries in GDP as on the efficient use of IT. However, we have to admit that there is some unused growth potential in Estonia's high and medium-high tech industries as well.

5. Conclusion

We were unable to carry out analysis of the New Economy in a broad sense of the term considering technology, industry, economy and social domains. Instead we studied penetration of the ICT into Estonian economy and contribution of high and medium-high tech industries to Estonia's output, exports and employment.

Traditional indicators of ICT development reveal that the stock of personal computers and mobile phones in Estonia is remarkably higher than the average for EU candidate countries but still much lower than the average for the EU. Nevertheless, the number of Internet users and Internet hosts per 100 inhabitants put Estonia on the level of the EU average and ahead of other candidate countries and some convergence with the EU can be perceived.

There were both supply and demand side interests to introduce projects like e-government, e-TaxBoard for e-citizens and e-enterprises. The Document Management Program makes all documents publicly available over the Internet. Besides better access to public information it makes activities of the government and municipalities more transparent and supports democracy. Great variety of financial services is offered over the Internet. Along with the increasing share of payments with bank cards the share of e-commerce (both B2C and B2B) is growing. As a recent development m-payments are growing.

Several campaigns and projects have been carried out to reach that broad use of ICT. One of the most important one was the *Tiger Leap* (that provided schools with computers, software and Internet connection, trained teachers and introduced computers into everyday life of pupils). Another important program was *Village Road,* which extended data communications to countryside and connected municipalities and a great number of local libraries to the Internet. Libraries serve also as Public Internet Access Points where people can look up for information, make their transactions or communicate with each other over the Internet.

The third program *Look@World* is funded by private businesses (banks and ICT companies) to provide free of charge computer and Internet training to 100,000 persons (mainly adult population or about 10 % of inhabitants in age 15 and over).

Provided with rather good ICT penetration Estonia has also reached a quite high level of high-technology exports. However, notwithstanding the rather remarkable level of employment in high tech manufacturing high dependence on subcontracting and transfer pricing makes the contribution of high and medium-high tech industries to economic growth volatile and rather low. Economic growth is more influenced by indirect impact of ICT that made the economy as a whole more competitive and helped to attract investments and create new jobs. There is still some unused growth potential in high and medium-high tech industries if business enterprises increase their investments into R&D and shift from short-term targets to strategic planning of their technological development. The shift from resource-intensive to knowledge-intensive economy will also benefit convergence with the European economy.

Endnotes

Classification of high tech and knowledge-intensive sectors

The classification of high and medium-high technology manufacturing sectors is based on the OECD's classification (itself based on the ratio of R&D expenditure to GDP). Since the CLFS only allows reporting of NACE at the 2 digit level, the following NACE Rev 1 sectors are included:

High tech Manufacturing
30 Manufacturing of office machinery and computers
32 Manufacturing of radio, television and communication equipment and apparatus
33 Manufacturing of medical precision and optical instruments, watches and clocks

Medium-high tech manufacturing
24 Manufacture of chemicals and chemical products
29 Manufacture of machinery and equipment n.e.c.
31 Manufacture of electrical machinery and apparatus n.e.c.
34 Manufacture of motor vehicles, trailers and semi-trailers
35 Manufacturing of other transport equipment

Knowledge-intensive sectors (KIS)
Following a similar logic as for manufacturing, Eurostat defines the following sectors as KIS:
61 Water transport
62 Air transport
64 Post and telecommunications
65 Financial intermediation, except insurance and pension funding
66 Insurance and pension funding, except compulsory social security
67 Activities auxiliary to financial intermediation
70 Real estate activities
71 Renting of machinery and equipment without operator and of personal andhousehold goods
72 Computer and related activities
73 Research and development
74 Other business activities
80 Education
85 Health and social work
92 Recreational, cultural and sporting activities

Of these sectors, 64, 72 and 73 are considered high tech services.

Source: Laafia, I. (2002). „National and Regional Employment in High Tech and Knowledge Intensive Sectors in the EU 1995-2000". *Statistics in focus*, Eurostat, Theme 9 – 3/2002.

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