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GOVERNANCE OF INNOVATION POLICY: THE CASE OF ESTONIA

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Abstract. An innovation policy aims at encouraging entrepreneurs to invest in the spheres that are characterised by high value added and intensive application of technologies and skills (industry; knowledge-intensive business services), since the latter ensure economic growth and improvement of the living standard. An innovation policy uses the establishment and implementation of priorities as its tools. This publication asserts that, firstly, the competitiveness of the Estonian economy has been declining since the middle of the 1990s and, secondly, Estonian innovation policy lacks measures to contribute to the improvement of competitiveness. The innovation policy of Estonia fails to serve its purpose. This is primarily due to the governance approach to the innovation policy, which emphasises competition and partnership and has led to renunciation of the establishment and implementation of priorities.

Keywords: innovation, economic development, innovation policy

1. Introduction

The objective of an economic policy is to ensure development that is generally expressed in a higher living standard of the population. Throughout history, the development of the sectors of economy that have higher value added has contributed to a higher living standard. Until now, industrial sectors have been such sectors of the economy, because it is namely industry where almost monopolistic competitive advantages can be achieved and thus remarkable profits earned.[1] Furthermore, it is a historical fact that a technological development in industry will bring about higher wages, while a development in the service sector and agriculture will occasion a decline in market prices. That phenomenon can essentially be explained by the circumstance that a technological development constitutes an input in the service

[1] Skill-intensive services relating to information technology are gaining that status on a growing basis, too.

sector and agriculture (in the form of new instruments), which provides a competitive edge for a certain period only, as the same input is freely available to the competitors in the market as well. Then again, in industry the very same new technological solution can be protected in various ways. For example, patents constitute a typical protection mechanism. Therefore, severe price competition is inherent in the service and agricultural sectors, which, in turn, occasions remarkable aids to the agriculture in developed countries. Contrarily, in industry the competition is more dynamic and competitive advantages are essentially much deeper, because industry usually requires intensive development activities, an extensive educational base, close relations with sub-contractors, etc.

Hence, an improvement in the living standard stems from technologies (i.e. skills) that, while spreading from one economic sector to another in the form of innovations, also enable other sectors to increase the added value created by them.[2] However, it is important that such development activities and innovations occur in the private sector to a great extent, because competition in the open market prevents monopolistic markets from rising to the fore, thus enabling consumers to keep down expenses. On the other hand, it is the market competition that leads to the increasing spread of technologies and innovations (because the competitors seek to achieve the same competitive edge), which in turn causes a decrease of value added and hence the need to look for new technological solutions to achieve a greater value added (that is why the pharmaceutical industry is now investing in biotechnology, and the IT industry is investing in material technologies). Hence, entrepreneurs are those who search and find new technological and innovative solutions, thus creating greater value added (Schumpeter 2002). Historically, the role of public policy has been to encourage entrepreneurs (through tax incentives, investments in education and infrastructure, creation of a safe legal environment and many other means) to move into sectors with higher value added. As was mentioned, the public sector is interested in that process mainly because the sectors characterised by higher value added and intensive application of technologies also enable employees to earn notably higher wages – while technological development is contingent upon people and their skills, companies are motivated to pay higher wages to employees as revenues grow. In turn, the government is thus able to increase state revenues both through direct and indirect taxes and thereafter place investments in social security spheres, education, infrastructure, etc.[3]

Therefore, an innovation policy aims at creating the conditions necessary for ensuring that the private sector's resources are transferred to technology-intensive sectors that are also characterised by high value added. Historical development and geographical conditions inevitably create both different advantages and different needs for each country. Politically speaking, an innovation policy should be targeted at establishing priorities and creating means for implementing these priorities.

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[2] See relevant statistics concerning the European Union in Götzfried 2004. For the purposes of the given context, innovation is deemed to include novel application of an invention, discovery, new knowledge or existing knowledge in an *economic* process (Schumpeter 1939: 58–61).

[3] See Reinert 1999 for more details also with regard to the following.

Consequently, innovation serves as the basis for improvement of the living standard. Innovation policy is the key tool for accomplishing that objective. In the European Union that relationship (the relationship between the living standard and innovation) is reflected in the so-called Lisbon Strategy.[4] To sum it up in a simplified manner, the contents of the strategy are as follows: By the year 2010, Europe must become the most competitive region in the world, which is simultaneously characterised by strong social cohesion (Rodrigues 2004). *Success of Estonia 2014*, a so-called governmental strategy document of the Government of the Republic of Estonia, should serve as the tool for accomplishing the goals set in the Lisbon Strategy.[5] This publication seeks to explain the status quo of the Estonian economy, as well as its sustainability in light of the objectives established in the Lisbon Strategy and in *Success of Estonia 2014*, and to discuss the role of the innovation policy of Estonia in that regard.

2. Competitiveness of Estonian economy

The current status of the economy can be evaluated quite differently based on different factors. However, in each case both the international status of the economy (the external factors) and the condition of the domestic market (the internal factors) must be considered to get the whole picture. Those two aspects are probably most successfully combined in the definition of competitiveness applied by the OECD, which is widely used and which served as a basis for the Lisbon Strategy, as well. According to that definition, the competitiveness of an economy is expressed in the production (exports) of internationally competitive products and services while the real income of people increases or at least stays on the current level.[6]

Figure 1 discloses the dynamics of the current account and balance of payments of Estonia and reflects a rising tendency of the current account deficit. Imports into Estonia exceed exports from Estonia notably. The situation with the trade balance is particularly drastic. However, the transportation of goods and passengers, as well as tourism (services) redress that shortcoming to a certain extent.[7]

The hitherto negative current account balance has been counterbalanced by an intensive flow of direct investments into Estonia, plus intensive borrowing on the part of the private sector (Bank of Estonia 2004: 26). Therefore, the external debt of Estonia grew to almost 75% of the GDP in 2003 (*Ibid*). On the one hand, Estonian producers face difficulties in international competition, because their products are not sufficiently competitive in the world market. On the other hand, the economic growth based on domestic consumption relies on foreign debt financing to a great

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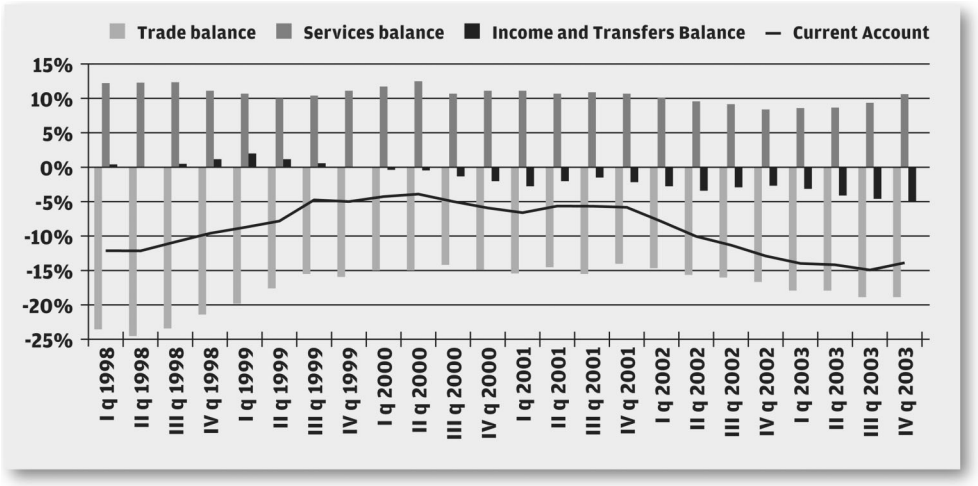
4 See relevant website of the European Commission at http://europa.eu.int/comm/lisbon_strategy/ index_en.html

5 For more information refer to http://www.tan.ee/tan/et/doc/Documents/1076663302.58/ Eesti%20edu%202014.doc

6 For more details, see OECD 1992 and then Reinert 1994.

7 That trend is typical of all new member states of the European Union; see Kuhnert 2004: 11.

Figure 1. Current account balance and sub-balances of the Estonian balance of payments, and the moving average of the last four quarters (% of the GDP).



Source: The Bank of Estonia, 2004: 26.

extent, which, in turn, increases the need for exports.[8] Hence, the restrictions on the Estonian economy that ensue from external factors are extremely serious: a decrease or appreciation in both direct investments and loans may bring about a severe crisis (as consumption will subside immediately), unless the export competitiveness of the economy improves materially.

One way to improve the export competitiveness of an economy is to adjust the price of production inputs, e.g. to cut wages or to slow down the growth of wages.[9] Thus, a slowdown or decline of the growth of real income is one of the first signs of the creation of restrictions on the domestic market, since it indicates the existence of severe competition in the market where competitive advantages can only be achieved through a reduction of the price of inputs. Figure 2 indicates that a declining tendency has been characterising both the growth of real wages and the increase in productivity in Estonia. At the same time, the real growth of wages exceeds the increase in productivity, which means that we should not expect an acceleration of the real growth of wages in the near future; the situation will rather be the other way round.

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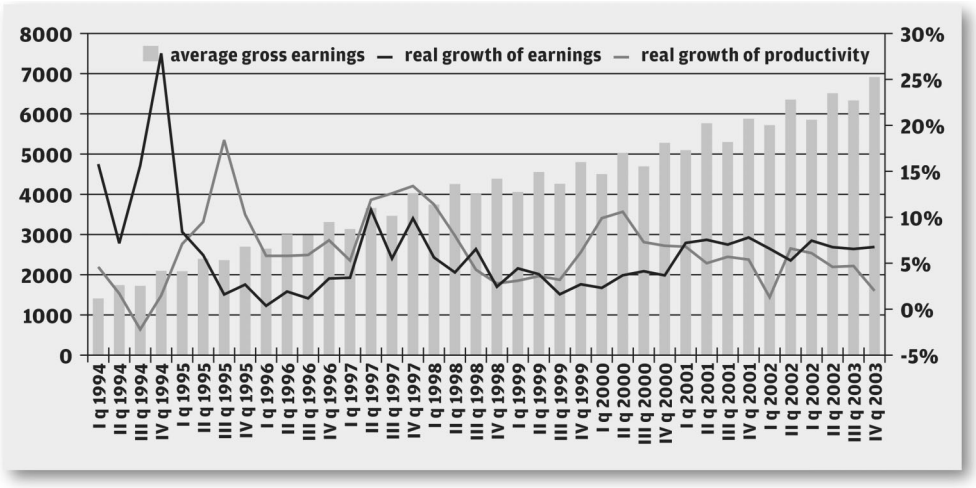
8 A growth in exports will not mitigate the problem if the growth rate of imports is quicker – that, too, expresses the weak competitiveness of products in the world market under open market conditions.

9 In the given context, a decline in currency exchange rates would occasion the wage reduction of practically all the people engaged in the economy. Estonia will not face that threat while the exchange rate is fixed.

Figure 2. Average gross earnings, real growth of wages, and increase in productivity in Estonia, 1994–2003.



Source: The Statistical Office of Estonia; calculations by PRAXIS.

In principle, the foregoing refers to the circumstance that, broadly speaking, the Estonian economy has a competitive advantage in cheap labour, which is almost the only factor that will make an increase in exports possible. However, competitiveness requires the reverse situation: the level of real income increases or is preserved at the current level, while exports grow.

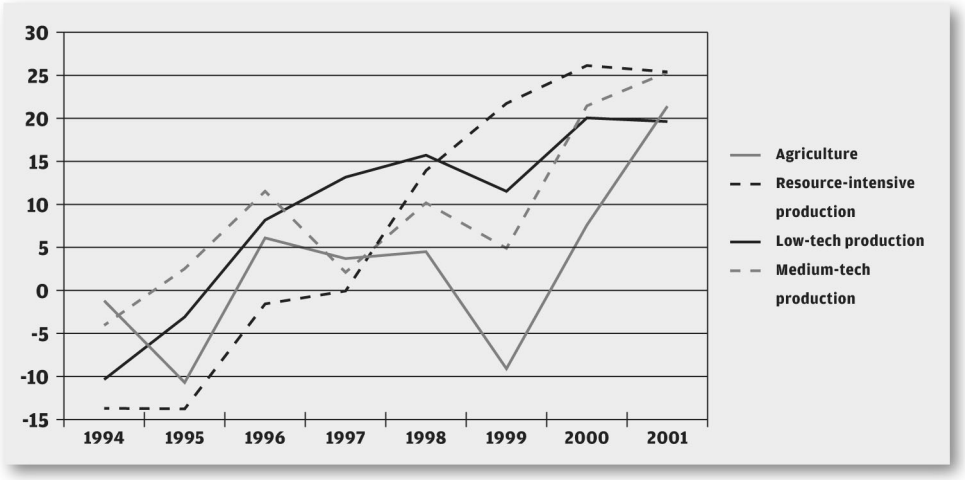
In sum, both external and internal factors indicate that the competitiveness of Estonian economy is declining, thus putting a question mark on the sustainable growth of Estonian economy. Since a substantial portion of the current account deficit derives from the negative trade balance,[10] the reasons for the current situation should be sought in the condition of industry and other production activities.

3. Estonian industry

Today's agricultural and industrial companies in Estonia have undoubtedly survived the problems of the early 1990s caused by the abrupt opening of the market that entailed substantial losses and, correspondingly, realignments for several companies. Figure 3 demonstrates that all industrial sectors and agriculture have become extremely efficient in terms of the relative share of operational profit in the value added: the operational profit accounts for one-fifth of the value that companies are capable of producing.

[10] That trend is characteristic of all new EU member states in Central and Eastern Europe (see Sneijers 2004).

Figure 3. Relative share of operational profit in value added, 1994–2001 (%).[11]



Source: The Statistical Office of Estonia; author's calculations.

On the other hand, the relative share of value added in the value of output has changed in a much more uneven manner in 1994–2001[12] (Figure 4). When comparing the years 1994 and 2001, the agricultural sector is characterised by the greatest growth of value added in output. While technological complexity has increased, the relative share of value added in the output of Estonian companies was greater in the year 1994 than in the year 2001. There is nothing surprising in the level of value added in agricultural production – agriculture has exceeded industry in terms of productivity in almost all developed countries during the last one hundred years.[13]

However, profit derived from the technological development and innovation in agriculture (i.e. the reason that makes the growth of value added possible) is mostly

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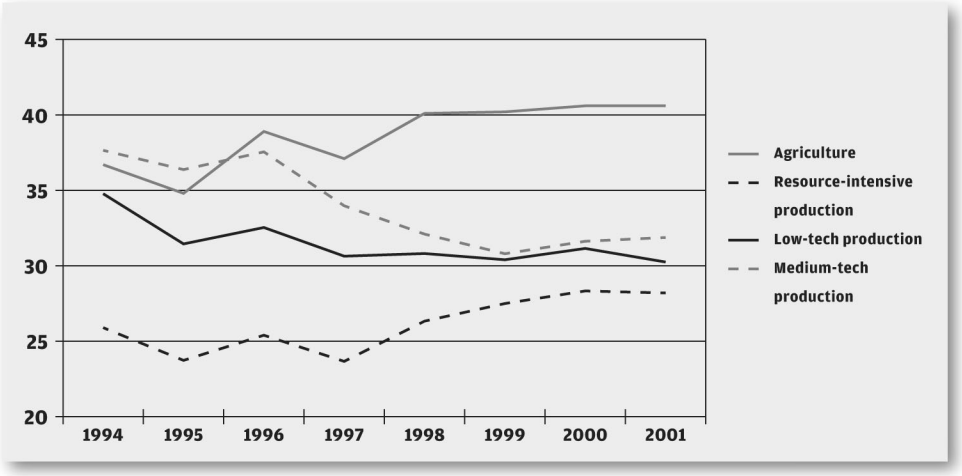
[11] The operational profit has been calculated as follows: value added minus employees' wages minus social tax minus other (indirect) taxes imposed on production minus depreciation of fixed assets. Agriculture includes hunting. The taxonomy of industry is based on Lall 2000, which, in turn, serves as the basis for calculation by UNIDO. Resource-intensive production includes: production of food and beverages; woodworking and manufacture of timber products; manufacture of other non-metallic mineral products. Low-tech production includes: manufacture of textiles and clothes; leather processing and manufacture of leather products; manufacture of paper and paper products; publishing, printing and reproduction of recordings; manufacture of rubber and plastic products; manufacture of metals and metal products; manufacture of furniture and other industrial goods. Medium-tech production includes: manufacture of chemicals and chemical products; manufacture of machinery and equipment; manufacture of electrical machinery and apparatus; manufacture of motor vehicles, trailers and semi-trailers; manufacture of other transport equipment. As regards high-tech sectors, data concerning the given period are missing. However, for developments in the IT sector, please refer to Kalvet 2004, and for the biotechnology sector see Kattel and Anton 2004.

[12] See the methodologically similar statistics for the European Union, Götzfried 2004.

[13] See, for example, Bowlby and Trant 2002.

Figure 4. Relative share of value added of Estonian industry and agriculture in the value of output (%), 1994–2001.[14]



Source: The Statistical Office of Estonia; author's calculations.

not retained by the agricultural producers, but rather by the industry that manufactures agricultural technology. Recent research carried out by the OECD concludes that any state aid to agriculture that is linked to production volumes inevitably causes the re-investment of subsidies, whereas more than one-third of the aid is transferred to input providers, i.e. to those who provide technological development (2003).

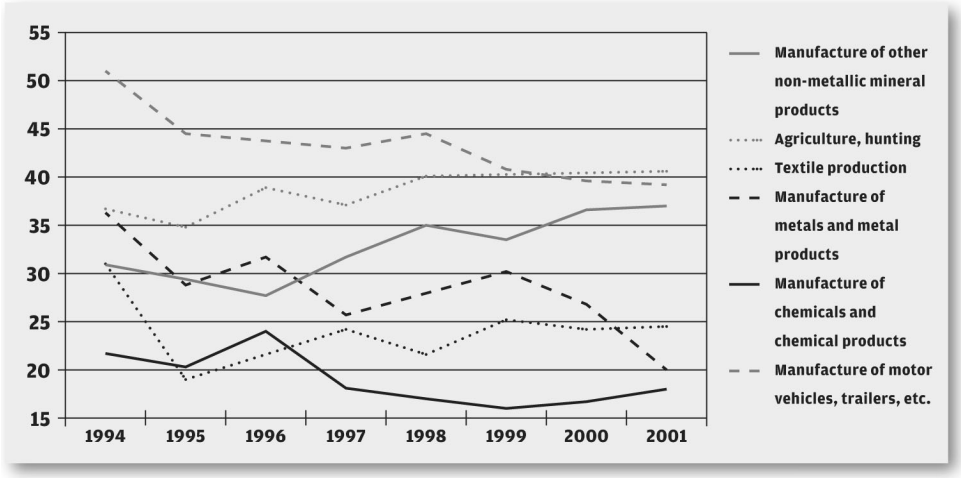
The increase of value added in agricultural and resource-intensive production has to some extent definitely been caused by the modernisation of means of production and facilities as a consequence of the corresponding requirement of the European Union (Ministry of Agriculture 2002/2003). On the other hand, as regards employment, the number of unskilled labour has remained basically the same from 1989 through 2002, the number of top specialists has decreased by almost one-third, the number of skilled labour and craftsmen has decreased by one-half, and the number of skilled labour in agriculture and fishing has declined by more than four times (the Statistical Office of Estonia (www.stat.ee)). That trend refers to intensive modernisation on the one hand, and probably to strong concentration and a decrease in specialisation on the other.

The decrease of value added in medium-tech and high-tech companies of Estonia in line with the increase in production volumes unambiguously indicates the limitedness of technological solutions applied by the companies, as well as to extremely severe price competition. This is also confirmed by the change in the structure of exports: the extent of application of technologies has declined since

[14] The following is partially based on Kattel and Anton 2004, although calculations presented therein contain some mistakes which are corrected in this publication.

1996, which, in turn, explains why Estonia's export competitiveness is not increasing in the international market (Tiits et al. 2002). In principle, it has been possible to observe since 1995 how medium-tech industries, such as manufacture of vehicles and other machinery, as well as the chemical industry (Figure 5), have accounted for the major part of the negative balance of payments of special trade (i.e. the principal part of the current account deficit of Estonia). Then again, resource-intensive and low-tech industries, such as timber and timber products, and products of animal origin are on the plus side (see Statistical Office of Estonia www.stat.ee; and see also Kaasik 2003:13).[15]

Figure 5. Winners and losers of the technological change in Estonian industry: relative share of added value in the value of the gross production (%).



Source: The Statistical Office of Estonia; author's calculations.

According to Havlik (2003), the competitiveness of Estonian industry is below that of the European Union in medium-tech sectors, and on the plus side in timber and textile production. In other words, competitive Estonian companies and sectors are developing thanks to technological modernisation, which, however, does not originate from Estonia's own industry, but rather from imports. The same is confirmed by the research of Kurik et al.2002, according to which 60% of industrial enterprises' expenditure relating to innovation is incurred in purchasing new equipment.

When comparing the relative growths of productivity (relation of the growth of productivity of an industrial sector to the growth of the entire industry) between

[15] The relative share of electronics is large in exports (almost 25% in the first quarter of the year 2004; www.stat.ee). However, as sub-contractual supply comprises a substantial portion in the electronics industry, the added value of exports of electronics is smaller than that of resource-intensive production (Kaasik 2003).

1994 and 1998 and between 1995 and 2000, it is evident that in the former period primarily low-tech sectors and the manufacture of electrical devices exceeded the average level of productivity, while in the latter period medium-tech sectors like chemistry neared the average productivity.[16] While low-tech industrial sectors have probably reached the ceiling in terms of technology, medium-tech sectors are approaching it, considering that value added is diminishing. Labour costs have played an essential role in the hitherto growth of value added: from 1996 until 2002, labour costs have grown by 11.6 percent in Estonia on an average, which is one of the highest growth percentages among the new EU member states. Yet the labour costs in Estonia were among the lowest in the new member states in the year 2001 (EUR 496 per month; Mittag 2004).[17]

To sum it up, it can be stated that Estonian agricultural producers and the manufacturers that use natural resources have been exceptionally successful in providing themselves with new technologies and these companies are very efficient today, but practically none of those technologies has been produced or developed in Estonia. In other words, a substantial part of revenues and, correspondingly, of the higher wages and improved living standard generated by these effective agricultural and other resource-intensive Estonian producers, **does not remain** in Estonia or create any additional specialisation in Estonia, but is transferred back from where the relevant technologies originated. The relatively high level of concentration in the agricultural, food and timber sectors only backs up the same.[18] Here it must be added that "companies based on foreign capital are more successful than domestic capital-based companies under most of the criteria. In most fields of activity the intensity of their capital and the productivity of their labour are greater, they pay more wages and export more than domestic companies. On the other hand, domestic companies invest more in intellectual capital and in new machinery and equipment." (Tiits et al. 2002, 23)[19]

The technological structure of Estonian industry is not becoming more complex or evolving toward higher value added. The other way round – specialisation is diminishing, skills and the number of skilled workers are decreasing, development possibilities are declining, as well as the possibilities of using new and emerging technologies.[20] Changes do not occur in an economy overnight – and this means that the development of the last decade refers to how and toward which technological structure the Estonian economy will develop in the near future, unless material changes occur in the economic environment.

Hence, the innovation policy of Estonia should put an emphasis on further modernisation of the hitherto relatively efficient resource-intensive, low-tech and

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16 The data originate from Havlik 2002 and 2003, respectively.

17 See also the comparison of minimum wages in EU member states, Paternoster 2004.

18 Although precise data are missing, we can probably conclude that these sectors are primarily those that belong in various value-added chains of the Nordic countries.

19 See also Sinani and Meyer 2001.

20 The development of the IT sector as a high-tech sector essential for Estonia manifests the same; see Kalvet 2004.

medium-tech sectors and, first of all, encourage the generation of value chains of the so-called next generation medium-level technologies, i.e. today's high technologies like information technology and biotechnology[21] in Estonia. That need became obvious back in the mid-1990s. The role of the innovation policy should been have comprised dealing with the said tasks.

The competitiveness of the Estonian economy is restricted primarily by the limitedness of the possibilities of technological development: Estonian entrepreneurs lack innovative inputs; alternatively, the inputs are too expensive or risky. Therefore it is important to map the status quo of research and development activities in Estonia. Financing of research and development activities (R&D) gives evidence about the preferences of the innovation policy.

4. Research and development activities in Estonia

Knowledge-based Estonia. The strategy for Estonian research and development activities 2002–2006 is the fundamental document that serves as the basis for funding of R&D activities in Estonia and it is primarily characterised by the identification of the three key areas (biomedicine, user-friendly information technology and material technology).[22] *Knowledge-based Estonia* sees the establishment of technology programmes in all those three spheres as an essential tool for promoting the development of the key spheres. No programme has been launched yet. Thus, today other measures fulfil the functions prescribed in *Knowledge-based Estonia*. Figure 6 depicts the current R&D policy and the structure of financing in Estonia.[23] In principle, two spheres administrated by two Ministries can be distinguished: the research policy and financing thereof (the Ministry of Education and Research; hereinafter: MER) and the development policy and financing thereof (the Ministry of Economic Affairs and Communications; hereinafter: MEC). The financing of research activities encompasses the grants of the Estonian Science Foundation (hereinafter: EstSF) and the targeted financing of the MER. The financing of development activities includes the grants and loans issued by the Enterprise Estonia Foundation (hereinafter: EE) that operates in the jurisdiction of the MEC. In practice these two spheres are almost totally distinct from each other, mainly due to the reason that science funds have basically become an addition to overall state financing. Although both the grants issued by the EstSF and the targeted financing of the MER are project-based, which should facilitate the generation of so-called top science and enable certain direction of research activities, this has not been the case (see also PREST 2003).

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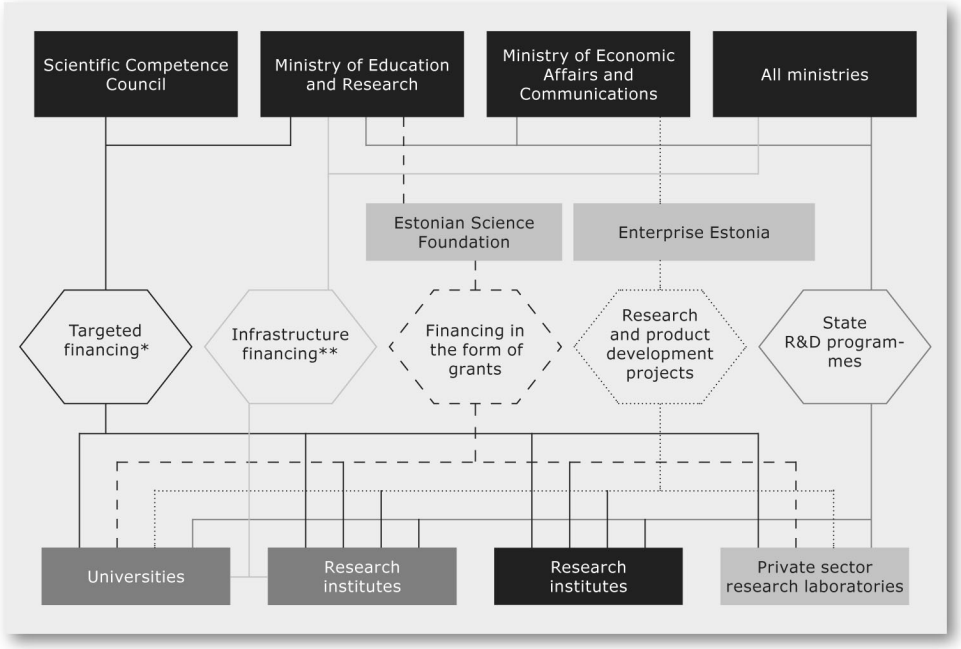
21 See Perez 2002.

22 The said strategy is still basically the only document that discusses the reasons for choosing these areas Tiits et al. 2002.

23 The R&D Council that advises the Government of the Republic, and the sub-committees of the Council, are missing here.

Figure 6. R&D financing in Estonia.[24]



Source: Tiits et al.2002; adjusted.[25]

The Programme for Centres of Excellence (2002–2006)[26] funded by the MER and, first of all, the Competence Centre Programme, which is managed by the EE

[24] For the year 2004, the EstSF has financed grants for a total of 80 million kroons (www.etf.ee); the MER issued targeted financing for research projects for a total of 254 million kroons, incl. additional financing for Centres of Excellence to the amount of 25 million kroons. However, it is unclear whether the Centres of Excellence and targeted financing are kept apart in statistics (www.hm.ee). See also note 27 below.

[25] * Targeted financing is channelled to research and development institutions in accordance with research subjects through the Ministry of Science and Research on the basis of the proposals of the Scientific Competence Council;

** Infrastructure costs of research and development institutions are reimbursed by the Ministry in whose jurisdiction a given institution operates. Within the given scheme, financing originating from the structural funds of the European Union functions, in principle, as a source of horizontal financing the use of which depends on the strategic decisions of the Government of Estonia. The framework programmes of the European Union are support schemes with independent logic and independent priorities.

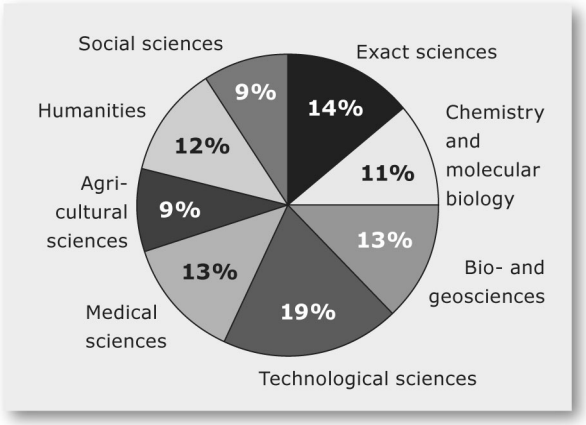
[26] The Centres of Excellence are: The Centre of Excellence for Gene and Environmental Technologies (headed by Toivo Maimets, the University of Tartu); the Centre of Basic and Applied Ecology (headed by Olevi Kull, the University of Tartu); the Centre of Behavioural and Health Sciences (headed by Jaanus Arro, the University of Tartu); the Institute of Physics at the University of Tartu (headed by Kristjan Haller, the Institute of Physics at the University of Tartu); The Centre of Cultural History and Folklore of Estonia (headed by Arvo Krikmann, the Estonian Literary Museum); the Centre of

and which is currently in the stage of negotiations,[27] seek to fill that gap between science and development funding and activities.

Figure 7 sums up research funding in Estonia by fields of activity. Based on the grants of the EstSF it can be concluded that, in principle, the distribution of grants between fields of activity has not changed since 1994.

Financing under the Fifth Framework Programme (1998–2002) of the European Union is difficult to divide by different fields of activity in Estonia. Table 1 shows the participation of Estonia on the basis of the subdivisions specified in the Framework Programme.

Figure 7. Research funding in Estonia in 2001–2003, average relative share of fields of activity (%).[28]



Source: EstSF (www.etf.ee); Scientific Competence Council 2003; author's calculations.

Excellence for Analytical Spectrometry (headed by Endel Lippmaa, the Institute of Chemical Physics and Biophysics); the Centre of Molecular and Clinical Medicine (headed by Raivo Uibo, the University of Tartu); the Centre of Excellence for Chemistry and Material Science (headed by Ilmar Koppel, the University of Tartu); the Centre for Non-linear Studies (headed by Jüri Engelbrecht, the Institute of Cybernetics at the Tallinn Technical University); the Centre for Dependable Computing (headed by Jaan Penjam, the Institute of Cybernetics at the Tallinn Technical University). See www.hm.ee.

[27] Negotiations are being conducted with regard to the following projects: The Competence Centre for Cancer Research that focuses on the development of methods for early diagnosis of cancer and on the development of cancer medicines of the new generation; the Nanotechnologies Competence Centre that deals with the development of gauges and sensors based on nanotechnology; the Competence Centre for Estonian Language Technologies aiming at creating computer support for oral and written Estonian; the Competence Centre for Healthy Dairy Products engaged in improving the quality of raw milk and in the development of healthy dairy products; the Competence Centre for Food and Fermentation Technologies that focuses on improving the quality and prolonging the shelf life of various foodstuffs; the Competence Centre for Info and Communication Technologies engaged primarily in the development of embedded systems. Planned financing amounts to 25 million kroons. See www.eas.ee.

[28] Grants issued by the EstSF and the targeted financing through the MER have been summed up here. Financing of the Centres of Excellence and Competence Centres is not included.

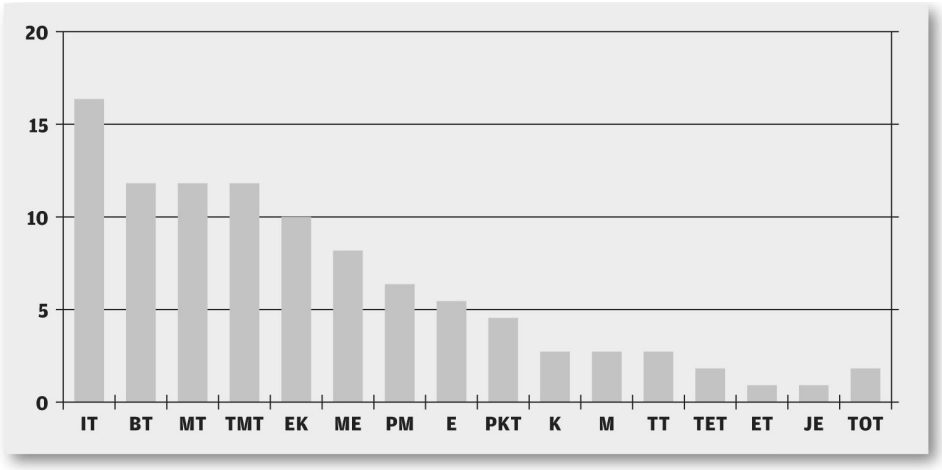
Table 1. Participation of Estonia in the Fifth Framework Programme (1998–2002) of the European Union.

Programme	Applications	Projects	Success (%)
Quality of life (QoL)	256	55	21.5
User-friendly Information Society (IST)	126	27	21.4
Competitive economic growth (GROWTH)	27	9	33.3
Natural environment (EESD)	156	56	35.9
Energy (EESD)	59	19	32.2
Confirming the international role of research (INCO)	18	7	38.9
Small and medium-sized enterprises (SME)	51	15	30.0
Improving human potential (IHP)	115	28	24.3
Total	**808**	**216**	**26.7**

Source: Archimedes 2002.

Figure 8 discloses the division of development projects financed by the EE in 2001–2003 (in the form of both grants and loans – the types of funding are not distinguished in the figure) by fields of activity.

Figure 8. Financing of Estonian R&D projects, 2001–2003, the relative share of fields of activity in the aggregate number of projects (%).[29]

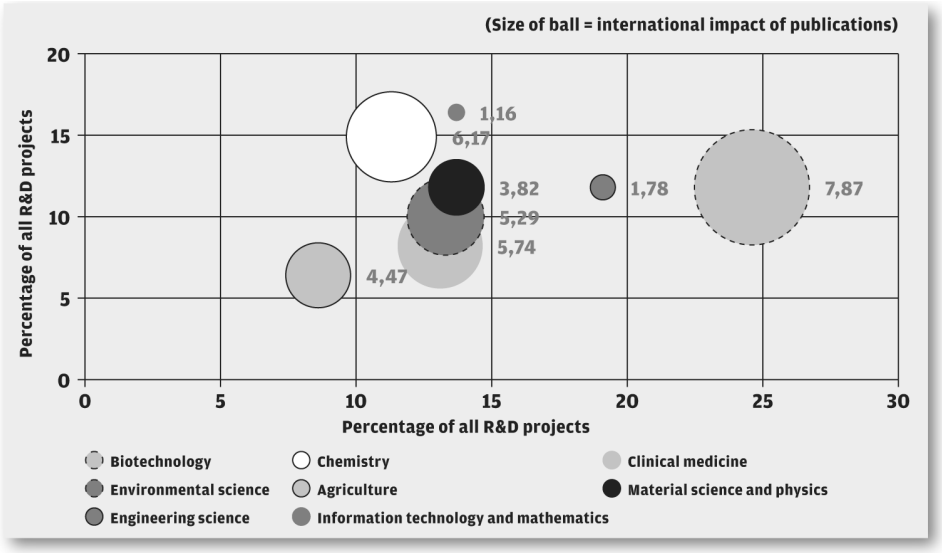


Source: EE (www.eas.ee).

[29] IT – information technology; BT – biotechnology; MT – material technology; TMT – product and material technology; EK – energy and environmental technology; ME medicine, medicinal equipment; PM –agriculture; E – electronics; PKT – oil shale chemistry and technology; K – chemistry; M – other; TT – food technology; TET – textile technology; ET – building technology; JE – power electronics; TOT – production technology. The financing of Centres of Excellence and Competence Centres and funding under the SPINNO programme is not included in the figure. Under the SPINNO programme, projects were funded for a total of 36 million kroons in 2001–2003 and the planned volume of financing for the years 2004–2007 amounts to 65 million kroons (www.eas.ee).

Even though Estonian R&D institutions can be classified as institutions operating in rather different fields of activity, which, in turn, differs from the international classification, Figure 9 provides a quite generalised picture of the international competitiveness of Estonian research, as well as of domestic financing of R&D in 2001–2003.

Figure 9. International competitiveness of Estonian research, and domestic support to R&D, 2001–2003.[30]



Source: Allik 2003; EE (www.eas.ee); EstSF (www.etf.ee); Scientific Competence Council 2003; author's calculations.

[30] Data presented in the figure are relatively superficial, because different Estonian R&D institutions classify fields of activity differently and that classification, in turn, differs from international classification. As regards biotechnology, publications about molecular biology, pharmacology, biology and microbiology have been summarised; as regards material science, publications about physics and material science have been summarised.

As to information technology, publications about mathematics and computer science have been summarised; as regards support to R&D in the field of chemistry, support to oil shale chemistry has been included; as regards clinical medicine, R&D support includes the spheres of medicine and medicinal technology; as to environmental science, R&D support in the fields of energy and environmental technologies has been included. As to agriculture, publications about plant and animal science were included.

Research funding (the EstSF and targeted financing through the MER in 2001–2003) includes exact sciences in the sphere of information technology; biotechnology includes chemistry and molecular biology, as well as bio- and geosciences; environmental sciences include bio- and geosciences as well; material science is included in exact sciences; engineering sciences are included in technology sciences; chemistry is included in chemistry and molecular biology. The international impact of publications is based on the data collected by Allik 2003 from the ISI Essential Science Indicators database as of November 2002.

The following relatively generalised conclusions can be drawn from the foregoing. **Firstly,** biotechnology is by far the most successful branch of Estonian science on international level. Moreover, support to biotechnology on the part of the public sector is outstandingly greater when compared to funding other scientific disciplines. On the other hand, development activities within biotechnology are clearly under-financed, considering the quality of the discipline. **Secondly,** internationally strong disciplines like chemistry and environmental science are probably under-financed as regards the basic research part, and chemistry (see Figure 8) and environmental science are under-financed as regards development activities as well. These disciplines, however, are extremely important from the point of view of technological development of Estonia. Importantly, many industries that experience technological difficulties as referred to above (e.g. timber, paper and textile industries) either are facing now or will face in the near future the problems that namely these disciplines are capable of solving. A substantial part of the added value and exports of Estonian industry can be associated with the mentioned low-tech and medium-tech sectors. Then again, these disciplines and technologies constitute now and, in particular, will constitute in the near future and in the coming decades a vital link between traditional industry and high-tech biotechnology. By the year 2010, the share of biotechnology in the chemical industry alone may well increase to $160 billion in the aggregate sales turnover (Herrera 2004: 671; for more details, see Tiits et al. 2004). In principle, chemical industry and environmental sciences are currently the key to the possible positive impact of the strong development of (biomedicine-related) biotechnology on the living standard of the entire country: these spheres make further material modernisation and internal clustering of Estonian low- and medium-tech industries, i.e. the generation of value added, possible. Hence, namely these spheres should form a cornerstone of the Estonian innovation policy. **Thirdly,** information technology and engineering science, even though not so strong on the international level, are essential in financing both research and development, because these disciplines represent the technologies that support the current technological paradigm (see Perez 2002). An increase of the scientific competence is vital in these spheres, or otherwise it would be extremely difficult for Estonia to improve its status, which currently is that of a cheap sub-contractor (see Kalvet 2004). **Fourthly,** all the disciplines specified in *Knowledge-based Estonia* have an important role in financing Estonian R&D.

One should also note the circumstance that financing Estonian R&D is substantially public sector-based. Unlike in developed countries, only one-third of R&D financing originates from the private sector in Estonia.[31] (Figure 10)

Two important conclusions can be drawn from the foregoing: Firstly, the Estonian innovation policy fails to encourage the private sector to invest in R&D, and secondly, the immediate innovation policy measures of the public sector have material weight.

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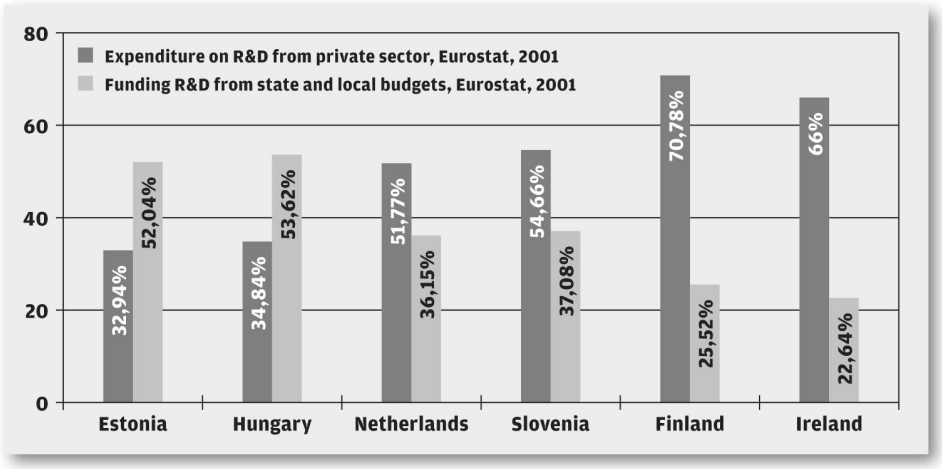
[31] For statistics concerning the educational sector and international comparison, see Kattel et al. 2004.

Figure 10. Expenditure on R&D in private and public sectors.



Source: Eurostat.

5. Estonian innovation policy measures

Following the accession to the European Union, structural funds were opened for Estonia, the purpose of which is to enable less developed countries to set priorities based on their respective situations and needs.[32] By now, practically all the Estonian innovation policy measures are being financed (at least partly) from the structural funds. A significant part of these measures have accumulated in the hands of Enterprise Estonia. Very broadly speaking, some 10–12 innovation policy measures can be specified that are being carried out or that have been launched in 2004.[33]

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[32] See Council Regulation No 1260/1999, http://www.legaltext.ee/et/andmebaas/tekst.asp?dok=T30423&keel=et

[33] All these measures are available for examination on the website of Enterprise Estonia Foundation at www.eas.ee, and they have been published in the State Gazette. The following measures are considered here: Start-up Programme, Regulation No 75 of the Minister of Economic Affairs and Communications dated 13 April 2004; Business Infrastructure Development Programme, Regulation No 72 of the Minister of Economic Affairs and Communications dated 13 April 2004; Spinno Programme, Regulation No 122 of the Minister of Economic Affairs and Communications dated 3 May 2004; R&D Financing Programme, Regulation No 73 of the Minister of Economic Affairs and Communications dated 13 April 2004; Consultation Support, Regulation No 74 of the Minister of Economic Affairs and Communications dated 13 April 2004; Export Planning Programme, Regulation No 145 of the Minister of Economic Affairs and Communications dated 7 June 2004; Training Support; Regulation No 154 of the Minister of Economic Affairs and Communications dated 15 June 2004; Tourism Product Development and Marketing, and Increasing Knowledge about Estonia as Travelling Destination, Regulation No 126 of the Minister of Economic Affairs and Communications dated 7 May 2004; Regional Competitiveness Improvement Programme, Regulation No 36 of the Minister of Internal Affairs dated 11 June 2004; and Innovation-Awareness Programme, the regulation is being drafted. The Competence Centre Programme is available on the website of the Enterprise Estonia Foundation. The establishment of a Risk Capital Fund is being discussed, see Zernicke 2003.

The following generalised conclusions can be drawn from these measures. Firstly, notwithstanding the purpose of the structural funds (the opportunity to set priorities) and the key areas prescribed in *Knowledge-based Estonia*, just one priority sphere – tourism – can be identified in the Estonian innovation policy measures discussed herein. All other measures avoid highlighting any priority areas or channelling of financing otherwise. Yet, the establishment of priorities should be basically the only purpose of the innovation policy. Secondly, all the measures are unambiguously competition and partnership-based. The latter feature derives from the nature of financing from the EU structural funds, which is characterised by the inevitability of partnership in designing, implementing and evaluating policies. Thirdly, the narrower purpose of measures is to bring scientists of high-tech disciplines and businesses together and thereby to create both markets and competition for the benefits of the scientific process. Then again, that would need strong patenting actions on the part of scientists, which are basically non-existent in Estonia (see Götzfried 2004, 6). Estonia has very few patented high-tech scientific products that could be brought on the market. On the other hand, the Estonian market alone would be too small for high-tech solutions.

Fourthly, direct entrepreneurship support instruments are directed either toward infrastructure or training. Entrepreneurs operating within traditional industries face substantial difficulties in finding public sector support for R&D. The fifth aspect consists in that both the scope and fragmentation of funding R&D have been criticised in view of the circumstance that, in principle, one and the same or similar projects receive financing from several different sources (Zernicke 2003, Reid and Kurik 2003, PREST 2003). The situation with financing development activities is basically the same as that with financing research: financing by the public sector is carried out through several different measures; thus, resources are fragmented and administration costs increase, wherefore the actual funds received for R&D constitute an additional source of covering the costs of core activities, not a source triggering new projects.

Basically, a situation has occurred where the three key disciplines specified in *Knowledge-based Estonia* have acquired a firm position as regards financing both research and development (although information technology is remarkably weaker than the other two in terms of the quality of research). Then again, all innovation policy measures have been based upon an extremely strong competition and market-based decision-making scheme by now. The latter can hardly be justified, considering that scientifically strong disciplines (e.g. biotechnology) also receive substantial R&D support, whereas problems existing in the real economy – manifested by the aforementioned difficulties in developing the industry, as well as the export complications of the economy as a whole – have basically been left without any attention whatsoever. Instead, systems have been created that dictate the need of scientifically strong research groups to apply for financing from several special measures. That, in turn, brings about an increase in the administration costs of both the public and the private sector, whereas the competition for the R&D financing instruments is essentially artificial. To sum it up, the public sector

has practically voluntarily given up all opportunities of directing R&D activities in both the public and the private sector.

The focus of measures, i.e. the objective of bringing science and entrepreneurship together, is concentrated in encouraging university researchers to engage in business. At the same time, to entrepreneurs almost no measures have been channelled in Estonia that would motivate them to invest in R&D projects. For entrepreneurs, innovation and R&D are too expensive and risky today, and the public sector in principle fails to do anything to hedge those risks. On the contrary, motivation of entrepreneurship on the part of the public sector forces entrepreneurs to take advantage of the almost inevitably short-term competitive edge – cheap labour and resources: a mere reduction of the tax burden is seen as the only way of advancing the economic environment. That step could only lead to the cheapening of resources, but not contribute to an increase of value added or productivity. Furthermore, such a development would essentially add risks to the external restrictions on the Estonian economy, which are already intense. The role of the Estonian Government in promoting innovation has become almost non-existent and thus rendered sustainable development basically impossible as well. It could only be by chance if Estonian innovation supported the transition of Estonian entrepreneurs to sectors of higher value added and increased the export capacity of the economy in the future.

6. Why has Estonian innovation policy evolved like that?

Three closely interrelated reasons for such a development of the Estonian innovation policy could be specified. **Firstly,** as a high innovation policy official has stated: "How should the government know" which sector ought to be supported, and why and when? That rapprochement to the drastic market ideology which has been characteristic of the Estonian economic policy throughout the period after regaining independence and which, at the same time, presents a sharp contrast with the policy applied in Estonia before World War II,[34] creates artificial competition in the innovation policy and leads to the denial of the role of the government. **Secondly**, the example of Finland has had a remarkable impact on the development of the Estonian innovation policy.[35] Indeed, the Estonian innovation policy has followed the innovation policy measures applied in Finland in the 1990s (e.g. support to development activities by the EE; programmatic approach to measures; emphasis on market signals and partnership). However, two essential mistakes were made in the policy transfer. For one thing, Finland has implemented very aggressive R&D

[34] The role of Karl Selter, the then Minister of Finance, in developing industry was particularly remarkable; see Kõll and Valge 1998.

[35] See also the speeches of Tõnis Lukas, the then Minister of Education, and Raul Malmstein (the then Deputy Secretary General of the Ministry of Economic Affairs) in the Riigikogu, which introduced the *Knowledge-based Estonia*, on 6 December 2001 (Riigikogu report, VI session, 6 December 2001, www.riigikogu.ee).

policies since the 1960s, where the public sector played an important role, which created essential preconditions for the genesis of relatively strong R&D which are aware of the needs of the economy. Secondly, Finland's current innovation policy programmes are based on social and economic signals, which refers to the existence of a firmly organised civil society, science and industry (Lemola 2003). Neither Estonia's science, society nor economy meets these preconditions today.[36] It would be unreasonable to add more measures stimulating competition to the under-financed and fragmented R&D system, while competition is basically missing and the interests of entrepreneurship lie elsewhere.

Hence, the strong concept of market and an equally insistent concept of partnership (between universities and entrepreneurship) are intrinsic in the Estonian innovation policy: "First ascertain the needs and priorities among yourselves, and then come to us," an Estonian innovation policy official told an industry association. The impact of these concepts is intensified by the introduction of the EU structural funds, which is dominated by the application of the first factor – market mechanisms – in Estonia.

And **thirdly,** the emergence of certain modern administrative innovations, which can be observed in the Estonian innovation policy that fall under the concept of governance. Governance is an ideological orientation in the reformation of the public sector, which rapidly rose to the front especially in the 1900s and which designates the form of public policy-making where emphasis is laid on the cooperation between three sectors (the public, private and non-profit sectors) and the implementation of market mechanisms in public policy.[37] The need to improve the competence of public servants and to reinforce the structures of the public sector has been an important lesson learned in implementing the administrative innovations (Schick 2003).

Both sides of the governance ideology are firmly represented in Estonian innovation policy. However, it would probably be correct to state that such a transition of ideology and policies has been predominantly spontaneous. Yet the very same circumstance explains why the Estonian innovation policy lacks any principal opportunities to contribute to the economic development of Estonia. Practically no element of the innovation policy fails to live up to expectations: the Estonian innovation policy does not motivate entrepreneurs to contribute to sectors with high skill-intensity and value added.

Owing to the foregoing, Estonian innovation policy measures should, **firstly**, take guidance from the priorities that stem from the key areas specified in the *Knowledge-based Estonia* as well as from the technological shortcomings of the existing industry.[38] Additionally, these measures should be channelled more

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[36] "We cannot take over the Finnish structure of research and development activities – we lack both the funds and people to do that," Raul Malmstein, *Äripäev,* 6 May 2004.

[37] For governance in the public administration, see Peters and Savoie 1994, Minztberg 1996, Peters and Pierre 1998, Drechsler 2003, Suleiman 2003, Hood and Peters 2004. For governance and good governance, see Drechsler 2004.

[38] See already Hernesniemi 2000, 56.

toward entrepreneurs. **Secondly,** the fragmentation of R&D financing should be reduced materially. **Thirdly** and probably most importantly, more resources should be channelled in the training of innovation policy officials, because the ability of the public sector to create and implement policies is first of all contingent on officials.

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