Erkki Karo. 2010. "Improving Governance of Science and Innovation Policies, or Just Bad Policy Emulation? The Case of the Estonian R&D System." *Halduskultuur – Administrative Culture* 11 (2), 174-201.

Improving Governance of Science and Innovation Policies, or Just Bad Policy Emulation? The Case of the Estonian R&D System

Erkki Karo
Tallinn University of Technology, Estonia

Abstract

This paper analyses a process where a catching-up economy, Estonia, has been designing the governance of the science and innovation system in the context of the institutional restructuring of Eastern Europe since the 1990s, influenced by international policy convergence in Europe and the US towards an optimal governance system. This is based on a move from the "public good" to the "network" rationale and a policy emphasis on increasing the direct and short-term societal relevance of science and innovation systems. The paper analyses the levels of convergence vs. divergence of the Estonian governance system and argues that the over-emphasis on policy features in the international policy debates has brought about an under-emphasis on crucial structural features of the governance system. The paper concludes that there are different levels of convergence and divergence that matter, and the Estonian science and innovation system faces both policy and also even more important structural challenges in making the governance system more responsive to socio-economic needs.

Key Words: state capacity, governance, science and innovation policy, commercialisation of science, Estonia.

1. Introduction

Historically sustainable catching-up development has partly been a learning process where countries that lag behind more developed countries are trying to emulate or learn from the success stories of countries at higher levels of development (e.g. Reinert 2007, 2009). To simplify, emulation can take the form of technology transfer and institutional learning, or can also be interpreted as the creation of state capacities to support technological development. One of the most obvious arenas where technological and institutional emulation are highly interlinked is the governance of science and innovation systems. In this context, Mazzoleni and Nelson (2009) have argued that the emulation of institutions may be a bigger challenge in the catching-up context than the emulation of technologies.

Evans (1995; also Evans and Rauch 1999) has famously argued that effective policies for catching-up development include sustainable state capacity as one critical precondition. State capacity is a dynamic and historically evolving (see Evans 2008) combination of policies and implementation structures that fit with each other and into the socio-economic context. Thus, neither policies nor implementation mechanisms should be developed, reformed, copied, transferred or evaluated in isolation from each other and outside the local context. The process of emulation of governance of science and innovation systems is further complicated by the technological cyclicality of economic development (e.g. Perez 2002) and changing cumulative understandings about proper institutional underpinnings of these developments (from a linear to a more systemic understanding of technological change). Thus, catching-up emulation is not merely a copying process, but a complicated learning challenge.

Over the last five or more decades, the theories and dominant policy approaches related to the governance of public science (and broadly innovation) have moved from a purely *"public good"* based rationale (e.g. Nelson 1959; Arrow 1962) to a more *"network"* based rationale (e.g. Gibbons et al. 1994; Etzkowitz and Leydersdorff 2000, 2001). On the policy level, the latter has been substituting the former as the core rationale of designing both policies and structures for government actions (see Geuna, Salter and Steinmueller 2003; Martin 2003 who argues that in a longer historical perspective, this is cyclical change of what is being prioritised). The former has emphasised academic autonomy and excellence as the underlying values of the system of science. The latter, together with the spread of "managerialism" in science policies, has emphasised the need for higher levels of accountability and relevance of the science system to society and industry. Therefore, some of the main (short-term and direct) criteria for policy makers to assess the effectiveness and accountability (societal relevance) of public science and innovation systems have become the capacity for commercialisation, the extent of use of intellectual property tools and the success of technology transfer.[1] As a result, the governance of public-science policies has become more embedded in and intertwined with the governance of innovation policies, requiring a broad interlinked perspective also in policy-analysis.

The main question this paper seeks to answer is: *how has the apparent international policy convergence on the network perspective of the governance of public science and innovation influenced the development of state capacities to design and govern the system of public science and innovation in Estonia?*

Thus, the paper analyses a process where a catching up economy (Estonia) has been designing the system of governance of public science and innovation (developing policies and governance structures) in a catching-up context (economic and institutional restructuring of Eastern Europe since the 1990s) influenced by the international (at least rhetorical) policy convergence (in Europe and the US) towards the idea of an optimal governance system of public science (a move from the public-good to the network rationale).

---

[1] The criticism of this change (e.g. Nelson 2004, 2006) emphasises that the network approach underestimates the relevance of basic institutional capacities of the governance system (in government, institutions of public science and in industry) and a sustainable system needs to be based on both (and firstly on the) "public good" and (at most secondly) on "network" rationale.

Recent literature has argued that in the case of Estonia, one can witness a convergence towards international policy rhetoric both from the perspective of science policy – emergence of project-based funding as a tool of policy-making etc. (Masso and Ukrainski 2009; Lepori et al. 2009) – and innovation policy – introduction of policy measures to increase the rate of commercialisation, patenting etc. (Karo and Kattel 2010; Karo and Kalvet 2009; de Jong et al. 2008). Earlier, Kattel (2004) analysed the Estonian R&D system and found significant similarities with the "network" model – the system has been based on market-based competition and partnership/networking as the core policy goal. At the same time, the system has lacked the tools to create sustainable state capacity to support technological development. Kattel has largely accounted this failure to narrow and mistimed policy learning. The argument of the current paper is that the over-emphasis on policy features in the international policy debates has led to an under-emphasis on crucial structural (or politico-administrative) features of the governance system (i.e. there are different levels of convergence and divergence that matter). Therefore, the paper looks in detail at the policy emulation of the structural features of the governance system.

The paper is structured as follows: first, the relevance of international policy convergence for the Eastern European catching-up process is explained and the international convergence towards the network perspective and the implications on policy-making are analysed; second, the case of Estonia is analysed.

2. International policy convergence and governance of science and innovation policies

2.1 Policy convergence and the case of catching-up development in Eastern Europe

The debate over convergence vs. divergence of different policies or governance structures can only be analysed in case there are indications of either structural or policy-level transformations (reforms) towards distinct international "models". The logic of policy-making and policy transfer implies that it may even suffice if there is an international rhetorical convergence as opposed to convergence on results or reform outcomes (i.e. Pollitt 2001, 2002, 2008). International rhetoric (or "myths" and "fads") can be used as a source of international policy transfer in the same way as real structural or policy reforms. This is especially the case with catching-up economies that are often under the conditionalities or international normative pressure for reforms.

In this context, it has been previously argued (Karo and Kattel 2010; also Kattel, Reinert and Suurna 2009) that since the beginning of the 1990s, the catching-up economies of Eastern Europe have been transforming their innovation systems under strong external pressures to converge – both in terms of policies and governance structures – towards distinct models of innovation systems that dominate the policy rhetoric and arena. At the beginning of the 1990s, these pressures were labelled Washington Consensus policies, and since around the 2000s, the more prevalent pressure has been related to the policies and conditionalities for accession to the EU. Due to contextual differences, historical legacies and path dependencies, this convergence may be eventually limited or even result in divergent outcomes (e.g. in the case of governance of public science in Eastern Europe, see Lepori et al. 2009; Jablecka and Lepori 2009). Still, the prevalence of external pressures may result in the dominance of de-contextualised policy-making (at least on the level of policy rhetoric and public debate), which means that policy choices are made without thorough analysis of local problems as the frames of policy analysis are set by the international discourse.

Indeed, Kattel (2004) argued that Estonia has been extensively emulating the Finnish R&D governance system, but only those Finnish developments that are relevant in the current policy rhetoric – the network perspective – and underemphasising earlier historical and long-term developments that created the capacities and capabilities that form the foundations of the Finnish innovation system. Also, Radosevic (2004, 2006, also Radosevic and Reid 2006) argues that reliance on "network"-type policy measures may not lead to sustainable innovation capacities as the problems of the innovation systems in Eastern Europe are strongly linked to core capacities and capabilities of both science and industry. At the same time, the governance systems of science in these countries are dominated by values that centre on fundamental scientific excellence (a long-term policy goal) while short-term socio-economic needs are related to increasing the societal relevance of the systems (Radosevic and Lepori 2009). Thus, there is the obvious pressure and need for reforms and at the same time also the pressure to emulate current international "best practices".

2.2 A distinct governance model of public science and innovation?

It can be argued that out of the network perspective, there has emerged a particular model that offers the distinct interpretation of the US governance system of public science and innovation. The model places the *Bayh-Dole Patent and Trademarks Act of 1980* (BD) at the centre of the governance system and perceives it as one of the critical reasons for the success of the US innovation and science system compared to Europe and other regions.[2] BD grants institutions of public science and also individual scientists the right to claim property rights (e.g. patents, trademarks, copyrights) on the scientific knowledge created through public funding. Granting property rights for publicly funded research is supplemented with the goal of transferring the property to commercial use. Thus, the regulatory reform is seen in tandem with policies to increase or foster the use of establishing property rights by science institutions and to transfer these rights to industry for industrial use. The effect of these activities is argued to lead to a higher relevance of public science to societal and industrial needs (increasing the accountability of the system) and higher social returns for society (i.e. better performance from the network perspective), or *"belief by policymakers ... that stronger protection for the results of publicly funded R&D would accelerate their commercialization and the realization of these economic benefits by U.S. taxpayers"* (Mowery et al. 2001, 102-103; also Pavitt 2001; OECD 2000).

---

[2] For reviews on the emergence of general research on "entrepreneurial science" and its impacts see Roethaermel, Agung and Jiang (2007); Siegel, Wright and Lockett (2007).

It has been argued that more and more countries both in Europe (Mowery and Sampat 2005, Pavitt 2001) and in developing regions (So et al. 2008) are adopting this 'regulation-centred' model of governance of public science and innovation, i.e. the countries are trying or planning to emulate the BD reform. Yet, the more critical accounts argue that the positive reading of the impact and relevance of the BD reform is largely *policy rhetoric* – the success of the US public science and innovation system stems from other aspects of the governance system.[3]

One of the core arguments of this critical perspective is related to policy learning and emulation (also in Pavitt 2000; Powell, Owen-Smith and Colyvas 2007) claiming that the BD should be seen as a continuation of long-term developments in the governance of the science and innovation system in the US. The increase of university patenting and licensing activities (and the spread of "entrepreneurial culture"), to simplify, would have happened anyway – BD reforms have at most sped up the emergence of this phenomenon with negative spillovers to the areas or fields with inappropriate conditions (e.g. over-patenting of research tools in biotechnology). Accordingly, one of the critical factors that the policy emulation of the BD often underemphasises is the specificity of the industries and institutions of public science and innovation that pre-date BD reforms and that have had the most pivotal effect on the development of the US innovation system. It is argued that compared to the rest of the world, the governance of the US public science and innovation system has been embedded in a unique institutional environment characterised by heterogeneity, competition and inherent incentives and need for entrepreneurial values in the public science system. Or, as stated succinctly by Mowery and Sampat (2005, 118):

> The US higher education system was significantly larger, included a very heterogeneous collection of institutions … lacked any centralized national administrative control and encouraged considerable interinstitutional competition … In addition, the reliance by many public institutions of higher education on 'local' (state-level) sources for political and financial support further enhanced their incentives to develop collaborative relationships with regional industrial and agricultural establishments. The structure of the US

[3] This critique (Mowery 2009; Mowery and Sampat 2005; Mowery and Ziedonis 2002; Mowery et al. 2001; Nelson 2004, 2009) goes back to the original theorising on the role of public science in the evolution of technologies and innovations – the "public good" perspective (originally Nelson 1959 and Arrow 1962; recently Pavitt 2001 and Nelson 2006). The critique is a reply to the network perspective and BD-centred approaches that argue that, first, due to globalisation and internationalisation, the public-good characteristics of science have transformed (resulting in the threat of free-riding on behalf of global competitors etc.) and therefore it is needed to enforce the property rights of public science. Second, as one can witness a growing distance between scientific and technological knowledge in high-technology fields (e.g. high-technology fields rely on high-level basic research that is followed by complicated applied research and development efforts that require high-level scientific knowledge and capacities), the enforcement of property rights needs to be complemented with policies that foster close networks between public science and industry. The core argument behind the critique of the network perspective has been that although public science has the properties of *public* good, it cannot be seen as a *free* good (Pavitt 2001, 764; also Callon 1994) because of the local or contextualised capacities like the existence of tacit knowledge, informal institutions etc. (for a further review see Salter and Martin 2001). Thus, the arguments of the network perspective have been "overly radical", i.e. there is a strong over-emphasis on the changes of the proprieties of public science and an underestimation of the local stickiness of knowledge; the interpretation of science only as a codified "good" and an under-emphasis on indirect social benefits (trained specialists, institutionalised networks etc.).

> higher education system thus strengthened incentives for faculty and academic administrators to collaborate in research and other activities with industry (and to do so through channels that included much more than patenting and licensing) long before the Bayh-Dole Act's passage.

This distinctiveness has also been emphasised in several other accounts. Mowery (2009), Mowery and Sampat (2005), Mowery et al. (2001), Mowery and Rosenberg (1993), Riccaboni et al. (2003) have discussed the uniqueness of the industrial and scientific systems, higher education system and the funding of the public science. Colyvas (2007), Powell, Owen and Colyvas (2007), Henrekson and Rosenberg (2001) have in addition emphasised the unique qualities on the organisational and individual levels (researchers) that have resulted in heterogeneous incentive and preference systems towards commercialisation and entrepreneurship in public research institutions.[4] From the governance perspective, it means that both policy-making and funding of science and innovation (i.e. implementation of science and innovation policies) have been diversified between state and federal levels, between scientific, mission-oriented and political agencies (for distinctions, see Braun 1993, 1998) and between different funding mechanisms (targeted funding for specific institutions or pre-determined "scientific" or industrial problems, competitive and negotiated project-based funding etc.). From these accounts, it emerges that the existence of the values that the network perspective seeks to enhance through specific policies has been a result of complex interaction between socio-economic context, politico-administrative system and specific policies of the governance of public science.[5] None of this can be analysed or emulated in isolation.

Therefore we can derive two contradicting perspectives or "policy lessons" and assessments of the US governance system of science and innovation – a narrow policy-instruments-centred approach that highlights a pivotal regulatory reform and a broader structural (or politico-administrative) approach that provides a historical institutional perspective of the system and its impacts. Both perspectives agree that "economic ambition" (or willingness to increase the economic and commercial relevance and applicability of public science) is a clear *sine qua non* for maintaining the competitiveness of the public science and innovation system. The difference comes from the logic of emergence (or creation) of this ambition. Table 1 summarises the two perspectives.

---

4 Powell, Owen-Smith and Colvyas (2007) have emphasised most systematically that there are three critical unique qualities of the US innovation system: multiple channels of university-industry cooperation (resulting in institutional diversity that is highly networked through both formal and informal channels); inter-industry differences in the use of technology (biotech being the only field relying on patents and licensing – even ICT has relied more on copyrights); and finally highly personalised incentive structures ("sink or swim") requiring individual researchers to seek personal rewards and formal recognition.

5 A parallel critique of the narrow BD rhetoric and potential misconception relates to the impact of commercialisation activities on the content and organisation of public science in terms of "secrecy" and "complementarity" problems (for an overview see Perkmann and Walsh 2009; also Colyvas 2007). The most critical and theoretical discussion is provided by Nelson (2004), who discusses the downsides of the "privatization of scientific commons" that might negatively affect both fundamental and more applied research efforts (see also Nelson 2006, 2009; the concept of the *tragedy of anticommons* in Heller and Eisenberg 1998; and *gridlock economy* in Heller 2008).

Table 1: **Two perspectives on the governance of public science and innovation**

Core policy issues	Policy instruments approach	Politico-administrative/structural approach
Existence of *"economic ambition"* (i.e. broader institutional context leading to closer ties between public science and industry)	Economic ambition is an "idealised" condition – in reality, it needs to be enhanced by BD-type policy reforms that result in creating better overall incentive and performance systems: a) at the system-of-innovation level (patents/licences etc. as indicators of increased codification of public science and indicators of societal relevance); b) at the organisations of public science (patenting/licensing etc. as source of performance, accountability and reward); c) for individual researchers (patenting/licensing etc. as source of personal recognition, reward and incentives for entrepreneurship).	Economic ambition has been a precondition for the effectiveness of BD policies. The economic ambition of organisations of public science and researchers has been the result of specific legacies and structural features that are the foundations of the US innovation system (both on the sides of demand for and supply of public science), i.e.: - heterogeneous, competitive and decentralised, but highly networked governance system of science (linked with organisational and personal competition for and diversity of funds) has resulted in competition between organisations and individuals; - problem-orientation of public research (in "land-grant" universities, induced by mission-oriented agencies that fund public research) has resulted in naturally close links between universities/researchers, local problems and industry; - emergence of technologies and progress in technological development (ICT and biotech) has led to inherently industrially applicable and commercialisable public (basic) research; it is supported by strong corporations with incentives and capabilities to demand, fund and conduct industrially relevant R&D activities and pursue large-scale technological breakthroughs. These characteristics have led towards heterogeneous public science and innovation systems where commercialisation is a tool for several goals: technology transfer, protection of science from industry, establishment of incentive and reward structures for scientists and public research organisation.
The role of formal regulatory, institutional and policy reforms	BD reforms are the key for the creation of economic ambition: - adoption of the BD-type legislation will increase the impact and scope of IP regimes on university entrepreneurship; - effects of legislation will be enforced through the creation of technology transfer organisations and supportive networks.	BD reforms should be seen as re-active adaptations with exogenous environmental changes: - adoption of the BD Act formalised the historical emergence of university patenting and licensing patterns (resulted in increasing the speed of the processes already in motion); - technology-transfer institutions and networks are characterised by heterogeneity and act more as support institutions (administrative agents) for transfer of technologies than facilitators of new types of relationships and practices between public science and industry.

Source: author

Thus, the more critical historical and institutional approach to the governance of public science and innovation in the US argues that in the current policy rhetoric, there is an overemphasis on few policy (mainly regulatory) instruments. The specific policy instruments and supporting reforms are taken out of the wider socio-economic and politico-administrative context. This is not an argument against the policy goal (increasing the relevance of public science) as it is taken as a normative societal consensus. Rather, it is a critique of the mode and depth of policy learning and the choice of grounding the lessons in a distinct theoretical model.

The lessons from the US science and innovation system should not be learnt in terms of what policies or what kind of reforms have been carried out, but in terms of what was the combined structural and institutional effect of different aspects of the governance system. In short, the research seems to emphasise the combined presence of different characteristics of the governance system from the politico-administrative perspective, i.e. heterogeneity, decentralisation, competition, problem-orientation of both policy-making (policy design, funding, implementation) and the structure of research performers that has resulted in high levels of linkages and networks between the state, public science and industry and also the emergence of distinct sectoral or technology-based perspectives. Thus, it does not matter in detail what the legislative, funding or institutional structures are per se; more important is the combined qualitative effect of different aspects of the system and whether they support the fulfilment of normative policy goals.

2.3 The reasons for international policy convergence in Europe

One of the distinct characteristics of the European-level science- and innovation-policy-making has been, using the network perspective, to explain the relatively low competitiveness of the European innovation systems by pointing to the weaknesses (or narrow orientation) of the governance of public science and innovation. This is reflected in the so-called "European Paradox" (see European Union Green Paper 1995) based thinking and the understanding that the relative failure of Europe compared to the US in terms of innovation and competitiveness has been caused by the forces behind the paradox – or, the *"conjecture that EU countries play the leading role in terms of top-level scientific output, but lag behind in the ability to convert this strength into wealth-generating innovations"* (Dosi, Llerna and Labini 2006, 1450; also Dosi, Llerna and Labini 2005 and Bonaccorsi 2007).

The specific interpretation of the "European problem" has resulted in an extensive emphasis on the regulatory reform of commercialisation and creating institutions dealing explicitly with fostering networking, linkages and interactions between public science or research institutes and local industries. It can be argued that the convergence on the BD-centred understanding of the governance of science and innovation in the US has been one of the critical variables supporting this (i.e. Mowery and Sampat 2005; Pavitt 2000, 2001).

The works by Dosi et al. and Bonaccorsi have provided extensive arguments that from a theoretical perspective, the logic behind the paradox is unfounded, and also not proven by the empirical findings. By adding to the theoretical critique the lack of empirical proof that Europe excels in top-level science and highlighting the indications of structural differences between Europe and the US (in higher education systems, in modes of investment in S&T and innovation outputs, in structural features and the relative weakness of European corporations), Dosi et al. provide an alternative conjecture claiming that *"quite independently of the 'bridges' between scientific research and industrial applications, potential corporate recipients in Europe are generally smaller, weaker and slower in seizing novel technological opportunities than their transatlantic counterparts"* (2006, 1460-1461). Or, as summarised from a different perspective by Bonaccorsi (2007, 311), *"European science is severely under-represented in the upper tail of scientific areas, has poor citation performance in new science areas, is specialised in fields that grow slowly or tend to converge and less specialised in fields that grow more rapidly and more diversely."* Thus, the critical summary on the debate over the EP can be stated as follows (Dosi, Llerna and Labini 2005, 1461): *"No overall 'European Paradox' with leading science but weak 'downstream' links can be observed. On the contrary, significant weaknesses reside precisely at the two extremes with, first, a European system of scientific research lagging behind the US in several areas and, second, a relatively weak European industry."*

The study by Bonaccorsi seems to support these conclusions. Yet the views seem to differ slightly on the solutions to the crucial misinterpretation. The approach of Dosi et al. would support the approach in the line of Nelson's criticism (e.g. 2004, 2006), implying that Europe should revise policy priorities (or tactics and strategies for overcoming the problem of "societal relevance") – i.e. dealing (through explicit policies) with the weaker core capabilities of both public science and industry instead of relying mainly on policy reforms that intend to coordinate the existing actors into networks and linkages. Bonaccorsi seems to take a different approach arguing for a fundamental *"shift of attention from science policy to scientific institutions"* (2007, 313) as policies that are not embedded in a supportive institutional environment are likely to fail. The argument of this paper is that there is a certain valid message in both approaches. The former is more grounded in the socio-economic context (taking into account the weaknesses of the industry as well). The latter is more grounded in the specific policy area (scientific system) and offers a more detailed view for improving the effectiveness of the science system. Yet it lacks a perspective on the wider socio-economic capacities and also normative policy preferences.

The broader the view on the governance of science and innovation, the more complex the task of policy emulation becomes. Instead of simply learning or copying or transferring existing policy mixes, the level and scope of analysis and comparison become the more important issues (it is possible to limit the perspective to formal reform outcomes vs. looking also at the inherent processes behind policy reforms). This would also mean that the analysis of structural models, especially of issues like the funding structure of public science and innovation cannot be done without clear links to the normative policy priorities. It has been argued by Braun (1993, 1998) but also implicitly by Nelson (2004) that the structures of funding (e.g. creation of funding systems, modes of distributing funding) are the sources through which different stakeholders have an impact on the eventual outcomes of the cognitive content of science and research. Therefore, the design of governance structures also has an important impact on achieving policy goals and vice versa.

Despite this academic criticism of both BD- and EP-based policy approaches, they have remained rather popular. Some of the key reasons for this are the European-level policy-learning initiatives that try to increase the state capacity of European countries for developing innovation policy. The most notable initiatives are the *INNOPolicy Trendchart* and also *ERAWatch* (EU funded policy-learning and benchmarking initiatives) that have in recent policy mappings (e.g. INNOPolicy Trendchart 2006, 2008) emphasised both the challenge of increasing the commercialisation capacities of the public science and research systems and the need to learn from the US policy examples.

Yet the problem of these policy-learning initiatives is that they remain mainly descriptive, i.e. describing different policies (goals and instruments) and comparing the outcome variables without linking policies and variables with policy implementation systems (structures of governance) or institutional capacities and capabilities. One of the main reasons for this is linked to the use of the *systems failures approach* that has the theoretical scope to distinguish between *capability, institutional, network* and *framework* failures and also recognises the need to give special attention to *policy failures* but lacks the tools to truly integrate the latter into the theoretical model used to define the other failures (see INNOPolicy Trendchart 2008). The basic foundations of this evaluation approach (see Arnold 2004) emphasise that the success of the method (for the country using it) is conditioned by sufficient state capacity. Yet the universal existence of such capacity cannot be taken for granted. In addition it is claimed that (ibid., 7):

> … failures justify state intervention not only through the funding of basic science, but more widely in ensuring that the Innovation System performs as a whole – always provided that the state is actually capable of reducing failure. Because systems failures and performance are highly dependent upon the interplay of characteristics in individual systems, there can be no simple rule-based policy as is possible in relation to the static idea of market failure … Rather, a key role for state policymaking is 'bottleneck analysis' – continuously identifying and rectifying structural imperfections. In this way, it is possible pragmatically to make continuous improvements, without needing to have a general theory or complete understanding of the innovation system.

Clearly, this caveat or crucial precondition in the approach has more severe implications for catching-up contexts. By distinguishing between two views of the US science- and innovation-governance systems and major policy reforms, it is hopefully shown that the "bottleneck analysis" can go wrong (even at the level of the EU and in developed countries), especially without proper theoretically grounded analytical depth and effort. The argument that "bottleneck analysis" can be carried out without *"needing to have a general theory or complete understanding of the innovation system"* has at least one fundamental danger in it – in case of weak state capacity for policy analysis and policy making, the bottleneck analysis may be subject to different "normative captures" (or be just too narrow). It is easier to identify bottlenecks in areas that are politically more salient, methodologically easier to measure or support particular ideological stances or prescribe preferred modes of state intervention.

3. Governance of public science and innovation policy in Estonia

There are several reasons to use Estonia as a case study in this paper. First, Estonian legislation that grants property rights for outcomes of publicly funded science is designed according to the example of the BD Act – the legislation gives intellectual property rights to either institutions or individuals doing research financed by the government, i.e. the government does not enforce policies and regulations that would grant the property rights to the government itself.[6] At the same time, government innovation policy measures give incentives for enforcing intellectual property protection by the performers of public research. Namely, second, Estonia has been actively adopting new innovation policy initiatives that form the support structure to enforce the legislative effects of the intellectual property-rights regime such as support for the technology-transfer organisation of universities, competence centres, innovation vouchers and measures to increase general awareness of the relevance of commercialisation of public science (see de Jong et al. 2008, Karo and Kalvet 2008, 2009). The mode of policy design and planning is largely supportive of the international convergence thesis as the majority of policy measures are designed and evaluated relying on the competences of international experts, peers and consultants who are commissioned to conduct feasibility studies, mid-term and final evaluations of the measures (e.g. Technopolis 2001, 2002, 2006, 2008; SQW 2003, 2007). In addition, usually the preference is given to innovation policy measures that are perceived to be international "best practices".

Third, Radosevic already argued in 2004 that Estonia belonged to the group of countries in Eastern Europe (together with Slovenia, the Czech Republic and Hungary) that had the highest potential for catching up and converging with the EU, but also cautioned that Estonia was characterised by relatively weak R&D capacities. According to this study, Estonia ranked as the country with the highest "national innovation capacity" (a comparative index developed in this research) in Eastern Europe. Radosevic argued that the reasons behind this were the relatively high ranking on the indicators of *absorptive capacity* compared to all EU members and the relatively (for Eastern European standards) well-developed capacity to generate *demand for innovation* (because of highly developed stock markets, banking systems and high shares of FDI). At the same time, Estonia has presented comparatively low levels of *R&D capacities*, mainly because of the low level of business R&D expenditure and the low levels of R&D personnel and patenting activities (see also INNOPolicy Trendchart 2006 and 2008).[7]

---

[6] The IP regime of public-science outputs is regulated through the coordinated impact of several legislations that cover both *copyrights* and *industrial property rights*. The main legislations covering the issue are the *Copyright Act, Patents Act, Utility Models Act, Principles of Legal Regulation of Industrial Property Act, Industrial Design Protection Act.* For an overview of Estonian intellectual property and patenting system, see Estonian Patent Office – www.epa.ee. For recent studies on the relations between intellectual property system and innovation capacities see Kelli (2009a and 2009b).

[7] The results are supported by a more recent comparison where Estonia belongs to the group of "moderate innovators", presenting weaknesses in categories that are overlapping with the R&D-capacity perspective of Radosevic (European Innovation Scoreboard 2008). Thus, by most evaluative accounts, Estonia has been assessed to be doing rather well in developing innovation policies and governance structures, although there have also been considerable cautionary remarks about the sustainability and long-term catching-up prospects, even predicting that Estonia might start "losing ground" in policy performance (INNOPolicy Trendchart 2006).

These weaknesses have predominantly (at least in policy rhetoric) been interpreted as low effectiveness of the system to provide commercialisation and transfer of scientific knowledge from science institutions to industry – because of lack of trust, little tradition of cooperation between different sectors etc.[8] But equally it can be seen as a general weakness of the science and innovation system to provide basic capabilities and supporting governance structure and capacities for innovation-based economic restructuring. The latter interpretation would provide arguments for analysing the basic capacities and capabilities of the innovation system, including the approach to analyse the politico-administrative capacities of the system – the theme of the current paper.[9] The following sections will review the key policies related to traditional science funding and policies related to increasing the societal relevance of public science and linkages between science and industry. The measures will be discussed from the politico-administrative perspective (i.e. how the policies and the system as a whole are organised and implemented) analysing the levels of convergence vs. divergence of Estonian science and innovation policy in relation to international changes in policy rhetoric.

3.1 Convergence in policy rhetoric and policy contents in science policy?

In Estonia, the funding of public science is administered through three main mechanisms under the Ministry of Education and Research (MER) – the Council of Scientific Competence that advises the ministry on target financing; the Estonian Science Foundation that provides individual grants for researchers; the Archimedes Foundation that acts as the executive agency of EU Structural Funds transfers (e.g. support for infrastructure development, development of tertiary education, financing mobility etc.; no direct financing of research, besides management of EU subsidies for the Centres of Excellence Programme – financing decisions made by peer-review committees).

[8] The latter reasoning is often derived from the historical legacies of the Soviet industrial structure that was based on a planned economy with clear distinctions between different sectors and institutions (i.e. most industry actors were state-owned enterprises not pursuing independent R&D activities or linkages with science institutions; rather, the latter were doing R&D for industry based on centrally planned requirements and prescriptions – linkages between the two sectors were weak and externally managed; e.g. Radosevic 1998, 1999).

[9] As this paper analyses the development of state capacity, the issue of basic or core innovation capabilities of public science and industry is only looked at from the perspective of the ability of the government to objectively assess and evaluate the level of these core capabilities and derive proper policy responses.

Table 2: **Overview of the policy measures funding public science**[10]

Name of the measure	**Implementation mechanism**	**Relevant assessments of measures** (Nedeva and Georghiou 2003; Kattel 2004; Huisman et al. 2007; Masso and Ukrainski 2009)
Target funding (since 2001) – main policy measure for funding scientific research of institutional research groups.	Competitive project-based funding (up to 6 years) by MER based on the assessment by the Council of Scientific Competence (evaluation by international peer review)	A recent study (Masso and Ukrainski 2009) confirmed the assessments of previous evaluations and concluded that in terms of funding schemes (institutional vs. project-based allocation of funds), the Estonian system is largely based on project-based funding with most research-performing institutions deriving 70% or more funding from project funding. In addition, the majority of this science-oriented project-based funding is largely competition based.
Baseline funding (since 2003) – measure for financing new research topics, co-financing of national and international projects, financing strategic development of R&D institutes.	Allocations by the MER to R&D institutes based on the overall academic "outcomes" of the institution (international peer-review publications, patents, defended PhD theses, financial outcomes etc.). Funding allocated internally by R&D institutes.	
Estonian Science Foundation grants (since 1994) – grants for individual researchers (also including support funding for research students).	Competitive peer-review-based funding (2-3 years) by the MER through the Estonian Science Foundation.	In a small country like Estonia, this has resulted in an increasing concentration and stability of the market – i.e. larger research institutions (3 public universities) appropriate 70-80% of the funding (concentration), and this has resulted in relatively stable funding streams for the research groups (stability). Arguably, this can be expected in a small country like Estonia. But on the other hand, the system is also characterised by a reliance on homogeneous quality assessment (international peer review and count of publications) as a basis of competitive funding that does not differentiate between different fields of science or provide opportunities for government steering of different science sectors towards local problems and societal relevance.
Centres of Excellence (since 2001) – funding for the creation of cooperative centres (to sustain and create research capacities) in the fields where Estonia has recognised international scientific capabilities	Competitive international peer-review-based funding (subsidy for up to 6-7 years) by MER through the Archimedes Foundation and co-financed by the European Structural Funds.	

Source: author

It can be seen that there is a particular "academic capture" identifiable at the level of the structure of funding and management of public science – most of the science funding is highly competitive (based on the criteria of scientific excellence; mixture of open calls and concentration of funding lead to the tendency for accumulation of funding based on existing capabilities). This is partly due to the fact that Estonia has increasingly converged with the international policy practice of science funding. At the same time, Estonia seems to have "over-done" this process of convergence as most funding is based on project-based funding while in European practice, this is a measure ranked second after institutional funding (Lepori et al. 2007). Also, Estonia has relied comparatively heavily on horizontal competition-based competitive

[10] This overview excludes measures of generic infrastructure funding (separated from research funding and therefore not directly linked to the development of the content of the research), targeted programmes by MER (mainly programmes aimed at the preservation of the Estonian language and culture that make up 1-2% of the total national research funding and mainly directed at specialised research institutes and not the main universities that are at the centre of the innovation system).

funding schemes that take international academic excellence as the main benchmark. This, in turn limits the ability of the system to steer science towards local problems or new emerging scientific fields – indeed the policy measures leave this choice to the academic community, and thus the autonomy to decide on policy content has been delegated by the government. This leaves the government with an indirect control mechanism (mainly funding and managing the governance system as a whole – cf. Braun 1993), but especially in the case of Centres of Excellence (which are intended to concentrate the best of the scientific community around the financing scheme), the role of government control (and indirect steering) has been further limited by the rules set by the EU co-financing procedures.

From, the "network" perspective, this implies that the government lacks the capacity (presuming that at least rhetorically the societal relevance of public science is a top policy priority) to pursue the goal of increasing societal relevance of public science. Indeed, it has been often stated over the last decade (e.g. Nedeva and Georghiou 2003; Technopolis 2006; Huisman et al. 2007; Karo and Kalvet 2009; Ernst&Young 2009) that the Estonian innovation system has been characterised by a rather strong fragmentation between the Ministry of Education and Research (MER), which specialises in "academic" issues, and the Ministry of Economic Affairs and Communications (MEAC), which specialises in "innovation" issues.[11]

Indeed, the former rector of the largest public university (Aaviksoo 2003, 35) has argued:

> … the science community has taken the lead and power [of the Estonian R&D system], since nobody else cares. It has been a good choice, however, because both funding bodies [the Council of Scientific Competence and the Estonian Science Foundation] have adopted a reliable evaluation policy based (solely) on academic achievement and innovativeness. This approach, although neglecting the practical need of the society, guarantees that surviving science is science indeed and able to deliver if real demand is (again) there.

Yet, over the last few years, there has been a significant shift in the overall financing of and emphasis in the science and innovation policy. The MEAC was relatively under-represented in funding and steering the innovation system until the introduction of the EU Structural Funds in Estonia (in 2002, the MEAC funded approximately 14% of the total state budget for R&D, by 2006 it has increased to approximately 40%; the rest of the funding has come through the MER with other ministries playing an increasingly marginal role funding up to 1-2% of the R&D budget) (Technopolis 2006, 10).[12] This has introduced innovation policy proper into the Estonian policy arena.

[11] Although Estonia has adopted a joint Research and Development and Innovation Strategy, *Knowledge-based Estonia*, it should be only seen as a formal change in policy rhetoric towards a more coordinated policy arena – direct policy measures to coordinate both the design and the implementation of R&D&I logic like *National Technology Programmes* (which are merely tools of coordination) have not been fully implemented (first two programmes starting in 2009).

[12] The same proportions have largely persisted although the widespread budget cuts due to the recent economic crises have affected the balance slightly as the science budget has been more dependent on "national" budgetary sources that have been subject to cuts, and the innovation budget (being based on transfers from the EU) has been affected less.

3.2 Convergence in policy rhetoric and policy contents in innovation policy?

Based on the former analysis, it can be argued that in terms of increasing the societal relevance of the Estonian R&D system and linkages between science and industry, the policy measures of the MEAC have become the key tools for steering the innovation system. Here we see a particular dominance of commercialisation-related policy measures.

Table 3: **Overview of the main R&D policy measures**

Name of the programme and main goal	Implementation mechanism	Relevant assessments of the programmes (e.g. in terms of increasing the commercialisation capacities and rate)
SPINNO programme (since 2001) – enhancement of the commercialisation capacities and activities of public research institutes.	EE under MEAC providing grants (co-financing) for public research institutes for creation of spin-off organisations and capacities. Co-financed by the ERDF.	SQW (2007; 2003), Technopolis (2001). In general the policy measure has been evaluated as a success, but not in terms of "ideal" outcomes (rates of patenting, returns from licensing, amount of spin-offs created), but more "intermediate" outcomes (increasing the knowledge about commercialisation and technology transfer in research institutes; creation of basic legislation, procedures and technology transfer organisations).
R&D Financing programmes (since 2001) – support of R&D activities by industry (product development, feasibility and marketing studies) and research institutes (applied research projects).	EE under MEAC providing grants (co-financing) for enterprises and public research institutes (open competitive funding). Jürgenson (2007) has noted that more successful applications were joint projects between enterprises and science institutions. Co-financed by the ERDF.	Jürgenson (2007), Kalvet and Jürgenson (2009). The policy measure (and its subsequent modifications) is considered to be one of the more effective measures (one of the higher rates of "additionality" of the Estonian policy measures; not as significant as in the case of similar measures internationally). The success stories are mostly limited to technological progress through the measure. Many private sector developments have failed because of wider capability problems (marketing, problems of strategic planning etc.). Academic R&D projects have not led to commercialisation as the latter has used the measure to finance its research with limited emphasis on commercialisation.
Competence Centres Programme (since 2003) – support of joint R&D consortia by industry and research institutes.	EE under MEAC provides co-financing (open competitive funding – broad horizontal priority areas) for creation of centres by consortia of industry and academia. Co-financed by the ERDF.	Technopolis (2002; 2008). In general considered to be one of the more effective commercialisation related policy measures (in terms of "ideal" outcomes). Yet assessments show that academia uses the measure for its own core interests and the industry uses the measure for developing its lacking capacities that are not at the level that effective competence centre measures presume (see below).

Source: author

The main characteristics of the innovation funding system in Estonia are twofold. First, the funding is implemented mainly through an agency under the MEAC – the foundation Enterprise Estonia (EE; similar to the Archimedes Foundation under the MER). The majority of funding is based on transfers from the EU Structural Funds (together with government co-financing), and therefore the criteria for funding, administration and accountability are set by both the principal – MEAC – and the general rules for EU co-financing (e.g. on state aid, application procedure etc.). Thus, the freedom for government selectivity and steering are limited and externally imposed. Second, the funding system of policy measures is largely project-based and decided through open calls and competitive assessment (given the horizontal target groups of the measures – either SMEs, public research institutes, exporting enterprises etc.). This further increases the problem of selectivity, detailed targeting and customisation of policy measures.

In all of these cases, the assessments of policy measures have indicated that the positive impacts of the measures have so far been linked with more “indirect” or “intermediate” outcomes as opposed to “ideal-type” outcomes that these measures usually seek to achieve (i.e. increased rate of patents – both private and public – and income from licensing and commercialisation). In terms of the theoretical argument, these accounts seem to support the criticism of the “European Paradox” as the results indicate that often the low rate of commercialisation has not been caused mainly by the lack of “arenas” for commercialisation. Instead, the measures that are expected to increase the rate of commercialisation mostly succeed in increasing the awareness of the issue, creating administrative capacities for future commercialisation activities and creating missing capabilities that in the future will lead towards higher rates of commercialisation, conditioned by the future qualitative shifts in core capabilities of both science and industry. A more detailed and stylised analysis of one of the above-mentioned policy measures seems needed to highlight this need for a qualitative shift of core capabilities and relevance to a structural analysis of the governance system.

One of the main Estonian policy measures to tackle the issue of low social relevance and commercialisation of public science has become the *Competence Centres Programme*. It is considered to be one of the more complex (and expensive), but also more successful policy measures that seeks to bridge the science and technology spheres of the innovation systems. The measure was initiated in 2002 and launched in 2003. Currently there are eight competence centres funded by the government covering different fields of biotechnology (food and medicine), nanotechnology, ICT (hardware and software solutions), and machine technologies. The public budget for the 2007-2013 period is approximately 58 MEUR; projected co-financing from the industry and research institutes is approximately 27 MEUR. The policy measure finances eight competence centres that include approximately 100 enterprises (mostly SMEs). On average the government subsidy has added up to 75% of the total budget of the centres (excluding also co-financing from publicly financed research institutes, co-owners of the centres). The centres are in general formed as private law bodies as according to the legislation, a competence centre can be created only in the form of a private law body or a non-profit organisation.

A recent official evaluation (Technopolis 2008) of the measure was both based on government-commissioned mid-term evaluation and relied on the results of the independent international peer-review-based scientific evaluation (also commissioned by the government). The evaluation argued that although the measure is functioning according to its intended policy goals (financing joint research intended to bridge public science and industrial needs), the long-term outcome of the measure, i.e. self-sustainability of most of the centres may be questionable unless significant qualitative and quantitative development will occur in the near future (at the time of the evaluation in 2008, only five of the eight centres were functioning). Given the short time of the functioning of the centres, these conclusions have been preliminary. Nevertheless, the problems of sustainability are largely due to a partial academic and industry "capture" of the policy measure.

First, in terms of "academic capture", it can be seen that academic interests dominate some of the centres – i.e. in the field of nano-technology, the centre is largely based on scientific research, and the industrial partnership is weak; the centre for cancer research represents good scientific capacity but lacks market and industrial capacity for competitive application-related research but is also not willing to open the centre for foreign partners, as this would open its IPR ownership to a wider set of stakeholders (e.g. Technopolis 2008, 24-38). Another feature of the centres is the occasional close professional linkages or overlapping between science institutes and industrial partners (academics owning or working for industrial partners). For universities in general, the centres act as complementary resources for their main academic missions (almost in all cases, both university and industry co-investments into the centres are "earned back" through sub-contracts or transfers between the centres and their owners).

Second, in terms of "industrial capture", or from the perspective of industry partners and their perceptions on the goals of the centres, the evaluation noted (based on the industry perceptions) the following (Technopolis 2008, 45):

> It is striking that most companies rated very few things as unimportant … there is little discrimination within a long list of potential goals. However, the overall priority given to improving existing products and processes (top priority) is striking. Most collaborative research and competence centre scheme participants prioritise the production of 'intermediate knowledge outputs' that can in their turn be input to future R&D processes and the enhancement of commercial and technical networks, rather than seeking immediately applicable results. Improving in-house ability to perform R&D (8^{th}) and recruiting trained R&D personnel (20^{th}) are goals we would expect to associate with competence centres, so their rankings are surprisingly low. Companies seem to see the CCs much more as an external source of technical help than as a research partner, playing roles that might elsewhere be filled by applied research institutes or even in some cases technical consultants, but with a high level of subsidy.

Thus, it could be argued that the measure is built on the hope that by providing additional funding, public science and industry will increase incentives to align respective academic and R&D strategies and practices. At the same time, the evaluation indicates that the problems differ between technological sectors and are more often than not linked to the weaknesses of core capabilities of public science and industry, rather than being narrowly commercialisation-related or resulting from a lack of "arenas" for cooperation and linkages. The problem of "academic and industrial capture" indicates that the structural model of implementing the policy may also have problems in it. Also the evaluation (Technopolis 2008, 40) noted that two out of the five centres evaluated ended up in principle misusing the private law autonomy given to the centres (initially aimed to block public research institutes from monopolising the centres) by trying to appropriate both private and public goods generated through centres or having the staff of research institutes or the centre also acting as owners of industrial partners.

This problem is eventually a reflection of the general mode of governance of the public science and innovation system in Estonia. The measures are largely homogeneous (defining horizontally a universal problem for all technological sectors), rely on market forces as tools of policy-making (making different industries and technological fields compete for funding) and thus lack tools for "selective" government involvement and steering of different technological sectors. The evaluation results of the Competence Centres measure would imply that different sectors and technological fields could benefit from more customised and targeted government support (or even in some cases stronger government control and intervention). This implies that there is a need for a strong state policy and administrative capacity – or appropriate governance structure as a basis for government capacities – for customised and coordinated government policies.

3.3 Divergence or convergence in the broad governance structure?

The thesis by Evans (1995) emphasised that countries with weak state capacities need to show extreme care in investing the state capacity in different policy endeavours. Thus, state capacity is preserved, supported and increased through government "selectivity" in policy-making, i.e. what the government targets with policies and how. If one can witness a convergence of policy rhetoric and contents in the case of Estonia, is it complemented with an overall governance structure that creates a supportive value system for policies?

It could be concluded that Estonia has developed a rather Western-type science and innovation system. Estonia has adopted project-based funding of the science and innovation policies through independent funding agencies, which is a Western practice (e.g. Lepori et al. 2007; Braun 1993, 1998), and policy recommendation/conditionality from the West (e.g. Kattel, Reinert and Suurna 2009). The largest difference in this respect seems to be that in Estonia, competitive project-based funding has become the main source of funding of public scientific research and innovation in general while in other Western countries, it tends to complement institutional and more negotiated/targeted project funding.

From a structural perspective on governance, another interesting source of divergence emerges. Namely, the issue of funding agencies and their tasks and roles seems to offer new important insights into the convergence vs. divergence question of governance systems. From this perspective, Estonia seems to be relatively homogeneous. Most of the R&D&I funding is divided between two ministries. MER is in charge of science policy, and MEAC specialises in innovation and commercialisation activities. The overlapping policy issues are somewhat coordinated through strategies, coordination programmes and councils. Each ministry has a rather distinct vertical role division with the ministry acting as a principal and policy designer and agencies being delegated subsidiary tasks. The impact of the EU funding distorts the classical principal-agent model.

MER differs in this respect from MEAC in the sense that it is a principal to two key scientific funding agencies (the Council of Scientific Competence and the Estonian Science Foundation) that are autonomous in their scientific evaluations. Yet, as has been argued above, the evaluation practices and criteria set by the MER (evaluation based on international peer-review and count of publications) are rather homogeneous, with no distinction between scientific fields. These agencies cover the core of public science and pursuit for excellence.[13] Given the normative policy goals of increasing the societal relevance of public science, the rest of the governance system should then be designed to increase the bridge between academic and scientific excellence and industrial and societal relevance. This is where the divergence from the international "best practices" seems to be the largest. One of the core lessons from the US seems to be that one of the sources for increasing the societal relevance of the science and innovation system has been the combined and shifting impact of heterogeneity, decentralisation, competition, problem-orientation of both policy-making (policy design, funding, implementation) and the structure of research performers that has resulted in high levels of linkages and networking between the state, public science and industry and also the emergence of distinct sectoral or technology-based perspectives.

It has been noted (e.g. Mowery and Rosenberg 1993; Braun 1998; Lepori et al. 2009) that in the international practice, the sources of science and innovation funding have been diversified between different levels of government (e.g. it has been argued that the success of the US "problem-oriented" research has partly stemmed from the high level of state – as opposed to federal level – involvement in funding R&D and universities) or between different types of agencies (e.g. the generic science-funding agency NSF in US is complemented by several mission-oriented agencies – NASA, NIH etc. – that finance more specifically targeted and pre-determined research topics in different areas of science). Braun (1998) has argued that the best "structural tool" for creating a common vision between scientific excellence and normative policy goals has been the use of "strategic funding agencies" (next to "science-based" and "political", i.e. ministerial) that act as "mission-oriented" research and funding entities (usually created and managed in a negotiated manner without the dominance of either science or politics). Of course the entire "network"-based approach and also systemic views on innovation have criticised the effectiveness of the "mission-oriented" perspectives ("picking winners") (Braun 2003). At the same time, these approaches cannot overlook the potential learning experience of these mission-oriented policies as they have highlighted the strengths and weaknesses of government capacities.

Looking at the Estonian case, it can be concluded that the science funding is extremely centralised (based on central government funding) and structurally con-

---

[13] The biggest science-policy reform of the upcoming years is the planned merger of these two agencies with a proposed increase of institutional funding. As the emphasis on international peer-review and scientific excellence remains, the changes are likely to have very little effect on creating a change of value systems and government steering capacities.

solidated (in the MER and MEAC). Most of the science funding is administered through science-based agencies. There are no mission-oriented or strategic funding agencies.[14] The second source of funding (directed to innovation and linkages between science and innovation) is administered through funding agencies that do not seem to be well identified in science-funding research. Both Enterprise Estonia (MEAC) and the Archimedes Foundation (MER) can be considered administrative or executive agencies. These agencies are assigned tasks from the respective ministries in the form of administrative contracts to implement government legislation in specific fields (e.g. funding of competence centres and centres of excellence). These agencies lack policy autonomy and capacity (e.g. mission-oriented agencies often carry out independent research in their own laboratories, decide on the content – either basic or applied – of research to fulfil the missions, conduct foresight exercises etc. that help to customise or create more detailed policy initiatives; administrative or executive agencies lack the legitimacy and capacity for this) and are mainly in charge of designing administrative principles within the broad guidelines set by the respective ministries and (often in more detail) by the regulations on the administration of the EU Structural Funds.

Thus, it can be concluded that the structure of the governance of the public science and innovation in Estonia can be analysed on several levels of convergence vs. divergence. There are clear indicators that the Estonian system in converging with the "Western" or developed countries' governance structures. Some of this is an evolutionary process respecting the specificities of the policy field (e.g. autonomy of scientific funding agencies). Some of this is a partial convergence under the international normative pressures and conditionalities – e.g. administrative or executive agencies have become the centre of the innovation policy and governance system because of the EU co-financing practices. Yet, the international policy rationale of creating these agencies has differed crucially from the logic behind "mission-oriented" agencies. If mission-oriented agencies can be seen to have had important effects on government policy capacity (selection, steering and foresight), then administrative agencies are created merely to increase the administrative capacity of the government (for implementation, accountability and transparency of the EU structural funding).

Of course, given the size of Estonia and the dominant policy rhetoric, it would not be feasible to create effective sectoral or mission-oriented agencies, as the size of the science and innovation system is too small. But the crucial lesson from this analysis is to highlight that the current challenges in creating a socially more relevant science system should not be defined as merely "policy" challenges, but more fundamental 'politico-administrative' and structural challenges. The crucial question for Estonia seems to be how to create sectoral or "problem-based" capacities in government. And this seems to be a mixture of policy and structural challenge.

Based on the thesis by Evans (1995) and arguments about de-contextualised policy-making (Karo and Kattel 2010), the isolated development of policy or admin-

---

[14] Indeed, Academies of Science that could be theoretically seen as a potential counterpart of "mission-oriented" initiatives have been consciously dismantled in most of Eastern Europe (Radosevic 1998, 1999) and also in Estonia.

istrative capacity does not lead to sustainable solutions. At the same time, it is almost always easier to initiate new policies than to change structural characteristics or old policies of a particular system. Therefore, it is not surprising that new policy initiatives, such as the National Technology Programmes are initiated in Estonia in another attempt to create a horizontal coordinating mechanism into a structurally fragmented system that is not likely to produce the desired outcomes.

4. Conclusions – convergence in policies and divergence in governance, implications for state capacity development

This paper has provided an overview of dominant views on how to increase the societal relevance of the public science and innovation system. The paper has been based on the premise that achieving certain normative policy goals can be done through the coordinated development of both policy and administrative systems. More developed countries have an advantage of existing policy and administrative capacities (existing structures, experience, institutional memory etc.). Of course, this can work either as a facilitator or an obstacle to carrying out (fundamental) reforms that are needed to fulfil wider policy goals. Catching-up countries seem to always have a different kind of disadvantage, as there tends to be a need to develop both policy and administrative capacity in tandem (as both tend to be insufficient for successful catching-up). Catching-up almost by definition implies that this is done (at least on some level) in the context of international benchmarks, policy learning and emulation.

The paper has argued that in the international policy discourse, a convergence has emerged on the need to prioritise the societal relevance of the science and innovation systems. This can be seen as a normative policy goal. This paper has intended to show that this normative convergence has been supplemented by *policy-centred rhetorical convergence* on what the "best practices" are for achieving this policy goal. This convergence has taken the form of an over-emphasis on policy features in the international policy debates and an under-emphasis on crucial structural or politico-administrative features of governance systems of science and innovation. Thus, there are different levels of convergence and divergence that matter.

This paper has argued that there has been a policy convergence that has travelled from the US policy rhetoric to the European policy rhetoric and practice and to the centre of Estonian science and innovation policy. Namely, an understanding has emerged that to increase the societal relevance of the science and innovation system, a country should adopt a legislation and policies that support the commercialisation of public science through supporting closer linkages, networks and transfers (of technology and knowledge) between science and industry. The legislation and policies should centre mainly on providing incentives and subsidies for joint or cooperative R&D endeavours. The success of the innovation system should be measured in terms of rate of commercialisation, technology transfer, and appropriation of intellectual property rights.

This paper has also argued that there is a more critical view of the convergence process. Namely, the US innovation system has not been successful because of the policy-mix that most of the world has tried to converge on. Rather, the success of the US innovation system has been embedded in a unique structural and institutional system characterised by heterogeneity, decentralisation, competition, problem-orientation of both policy-making (policy design, funding, implementation) and the structure of research performers that has resulted in high levels of linkages and networks between the state, public science and industry and also the emergence of distinct sectoral or technology-based perspectives and state capacities.

The analysis in the paper shows that there are crucial differences in the latter aspects that have not travelled together with the policy rhetoric from the US to Europe and to Estonia. In the case of more developed European countries, it could be hypothesised that the relevance of structural or politico-administrative features has been under-emphasised, but in most countries, the structure of the innovation system is largely (based on contextual modifications) in line with the politico-administrative perspective of the US. The main problem of Europe seems to be the misguided emphasis on policy priorities that results from limited analysis and understanding of local contextual problems (e.g. capabilities and quality of science and industry).

In the case of catching-up country like Estonia, the structural divergences are more pronounced. Regarding the narrow governance of science, Estonia has been largely converging on the international model of funding and administering the system, but crucially also “over-doing” it with international practices resulting in the concentration of the science system and homogeneity of the governance system. In the case of implementing policies for increasing the societal value of the science and innovation system (the wider governance of science and innovation), the divergent developments seem to be even more pronounced. Estonia has adopted (mainly based on a mix of international learning and conditionalities) a governance structure that differs from the “ideal-types” as it lacks features to create policy initiatives and measures that take an explicit sectoral perspective or centre on local technological problems. Regardless of policy rhetoric, emphasis on the latter perspectives has been a characteristic (at least as a relevant “learning” legacy or institutional memory) of most successful countries at the technological frontier. In the case of Estonia, it seems to be a persistent challenge to catching-up policies.

“Over-doing” with the implementation of the international reform trends in the narrow science system and diverging from the “ideal-types” in the wider governance of innovation policies creates a vicious circle where it becomes increasingly difficult for the combined development of policy and administrative capacity. The emerged administrative structure has “delegated” the creation of policy priorities (and policy capacity) and making detailed choices to market forces and to the international peer community. From the perspective of linking science and industry (or innovation), different parts of this system tend to act in isolation. Also retrospective policy analysis and learning from one’s own mistakes is becoming increasingly difficult. Thus, it becomes the only obvious solution to overflow the innovation arena with increasingly more complex policy initiatives, many of them becoming policies that coordinate other policies to overcome the increasing fragmentation of the innovation policy arena. The other option would be a more difficult process of “un-learning” the legacies and experiences that have created this contradictory situation of policy convergence within structural divergence.

Acknowledgments

The research for this paper was partially supported by the Estonian Ministry of Education and Research (grant no B614) and the Estonian Science Foundation (grants no 7441 and 8418).

References

Aaviksoo, Jaak. 2003. "Estonian R&D Policy: Still to Be Defined." *Trames* 1, 32-39.

Arnold, Erik. 2004. "Evaluating Research and Innovation Policy: A Systems World Needs Systems Evaluations." *Research Evaluation* 13 (1), 3-17.

Arrow, Kenneth J. 1962. "The Economic Implications of Learning by Doing." *Review of Economic Studies* 29 (3), 155-173.

Bonaccorsi, Andrea. 2007. "Explaining Poor Performance of European Science: Institutions versus Policies." *Science and Public Policy* 34 (5), 303-316.

Braun, Dietmar. 2003. "Lasting Tensions in Research Policy-Making: A Delegation Problem." *Science and Public Policy* 30 (5), 309-321.

Braun, Dietmar. 1998. "The Role of Funding Agencies in the Cognitive Development of Science." *Research Policy* 27, 807-821.

Braun, Dietmar. 1993. "Who Governs Intermediary Agencies? Principal-Agent Relations in Research Policy-Making." *Journal of Public Policy* 13 (2), 135-162.

Callon, Michel. 1994. "Is Science a Public Good?" *Science, Technology & Human Values* 19 (4), 395-424.

Colyvas, Jeannette A. 2007. "From Divergent Meanings to Common Practices: The Early Institutionalization of Technology Transfer in the Life Sciences at Stanford University." *Research Policy* 36, 456-476.

Copyright Act. (Autoriõiguse seadus). RT I 2009, 62, 405. Available at https://www.riigiteataja.ee/ert/act.jsp?id=13246706.

De Jong, Jeroen P.J., Wim Vanhaverbeke, Tarmo Kalvet and Henry Chesbrough. 2008. *Policies for Open Innovation: Theory, Framework and Cases*. VISION Era-Net, Finland: Helsinki.

Dosi, Giovanni, Patrick Llerena and Mauro S. Labini. 2006. "The Relationships between Science, Technologies and their Industrial Exploitation: An Illustration through the Myths and Realities of the So-Called 'European Paradox'." *Research Policy* 35 (10), 1450-1464.

Dosi, Giovanni, Patrick Llerena and Mauro S. Labini. 2005. "Science Technology-Industry Links and the 'European Paradox': Some Notes on the Dynamics of Scientific and Technological Research in Europe." *LEM Working Paper Series* 2005/2, available at http://www.lem.sssup.it/WPLem/files/2005-02.pdf.

Ernst&Young, PRAXIS, Institute of Baltic Studies and Säästva Eesti Instituut.

2009. *Struktuurivahendite rakenduskava hindamine, uuringuaruanne* [Report on the Evaluation of the Implementation Plans of the EU Structural Funds]. Tallinn.

Etzkowitz, Henry and Loet Leydesdorff (eds.). 2001. *Universities and the Global Knowledge Economy: A Triple Helix of University-Industry-Government Relations*. Continuum.

Etzkowitz, Henry and Loet Leydesdorff. 2000. "The Dynamics of Innovation: From National Systems and 'Mode 2' to a Triple Helix of University-Industry-Government Relations." *Research Policy* 29, 109-123.

European Commission. 1995. *Green Paper on Innovation*. Brussels: EC.

European Innovation Scoreboard 2008: *Comparative analysis of innovation performamce*. PRO INNO Europe Paper 10/2009.

Evans, Peter. 2008. "In Search of the 21st Century Development State." *CGPE Working Paper Series* 4.

Evans, Peter. 1995. *Embedded Autonomy: States and Industrial Transformation*. Princeton University Press.

Evans, Peter and James Rauch. 1999. "Bureaucracy and Growth: A Cross-National Analysis of the Effects of Weberian State Structures on Economic Growth." *American Sociological Review* 64 (5), 748-765.

Geuna, Aldo, Ammon J. Salter and W. Edward Steinmueller (eds). 2003. *Science and Innovation: Rethinking the Rationales for Funding and Governance*. Edward Elgar.

Gibbons, Michael, Camille Limoges, Helga Nowotny, Simona Schwartzman, Peter Scott and Martin Trow. 1994. *The New Production of Knowledge, the Dynamics of Science and Research in Contemporary Societies*. London: Sage.

Heller, Michael A. 2008. *The Gridlock Economy: How Too Much Ownership Wrecks Markets, Stops Innovation, and Costs Lives*. Basic Books.

Heller, Michael A. and Rebecca S. Eisenberg 1998. "Can Patents Deter Innovation? The Anticommons in Biomedical Research." *Science* 280 (5364), 698-701.

Henrekson, Markus and Nathan Rosenberg. 2001. "Designing Efficient Institutions for Science-Based Entrepreneurship: Lessons from the US and Sweden." *Journal of Technology Transfer* 26, 207-231.

Huisman, Jeroen, Paulo Santiago, Per Högselius, Maria Jose Lemaitre and William Thorn. 2007. *OECD Reviews of Tertiary Education: Estonia*. OECD.

Industrial Design Protection Act [Tööstusomandi kaitse seadus]. RT I 2009, 62, 405. Available at https://www.riigiteataja.ee/ert/act.jsp?id=13251158.

INNOPolicy Trendchart. 2008. "European Innovation Progress Report 2008." *PRO Inno Europe, Inno Policy Trendchart*. EC, Enterprise and Industry.

INNOPolicy Trendchart. 2006. "European Innovation Progress Report 2006." *Trendchart*. EC, Enterprise and Industry.

Jablecka, Julita and Benedetto Lepori. 2009. "Between Historical Heritage and Policy Learning: The Reform of Public Research Funding Systems in Poland, 1989-2007." *Science and Public Policy* 36 (9), 697-708.

Jürgenson, Anne. 2007. "Teadus- ja arendustegevuse finantseerimise programme mõjude hindamine" [Impact Assessment of the R&D Financing Programme]. *Praxise Toimetised* 36.

Kalvet, Tarmo and Anne Jürgenson. 2009. "Assessing Impacts of the Estonian R&D Financing Programme on the Business Enterprise Sector." *Paper at FIB-RISC Conference 2009*. Available at http://portale.unibocconi.it/wps/allegatiCTP/Kalvet_20-07-09.pdf.

Karo, Erkki and Tarmo Kalvet. 2009. "'Open Innovation' and Innovation Policy in the Eastern European Countries." In Susan E. Gozzens and Pablo Catalan (eds). *IEEE Conference Proceedings, Atlanta Conference on Science, Technology and Innovation Policy*. Atlanta, GA: IEEE, 1-6.

Karo, Erkki and Tarmo Kalvet. 2008. "New Concepts around Innovation and Implications for Innovation Policy Making in Estonia." *Paper Presented at the EGPA 2008 Conference "Innovation in the Public Sector"*.

Karo, Erkki and Rainer Kattel. 2010. "The Copying Paradox: Why Converging Policies but Diverging Capacities for Development in Eastern European Innovation Systems?" *International Journal of Institutions and Economies* 2 (2) (forthcoming).

Kattel, Rainer. 2004. "Governance of Innovation Policy: The Case of Estonia." *Trames* 8 (4), 397-418.

Kattel, Rainer, Erik S. Reinert and Margit Suurna. 2009. "Industrial Restructuring and Innovation Policy in Central and Eastern Europe since 1990." In Mario Cimoli, Giovanni Dosi and Annalisa Primi (eds). *Learning, Knowledge and Innovation: Policy Challenges for the 21st Century*. Oxford: Oxford University Press, forthcoming.

Kelli, Aleksei. 2009a. "Improvement of the Intellectual Property Systems as a Measure to Enhance Innovation." *Juridica International* 16, 114-125.

Kelli, Aleksei. 2009b. "Developments of the Estonian Intellectual Property System to Meet the Challenges of the Knowledge-Based Economy." *Dissertationes Iuridicae Universitatis Tartuensis* 25.

Knowledge-Based Estonia: Estonian Research and Development and Innovation Strategy 2007-2013. Available at http://www.akadeemia.ee/_repository/File/ALUSDOKUD/Knowledge-based%20Estonia%20II.pdf.

Lepori, Benedetto, Peter van den Besselaar, Michael Dinges, Bianca Poti, Emmanueal Reale, Stig Slipersaeter, Jean Theves and Barend van der Meulen. 2007. "Comparing the Evolution of National Research Policies: What Patterns of Change?" *Science and Public Policy* 34 (6), 372-388.

Lepori, Benedetto, Jaan Masso, Julita Jablecka, Karel Sima and Kadri Ukrainski. 2009. "Comparing the Organization of Public Research Funding in Central and Eastern European Countries." *Science and Public Policy* 36 (9), 667-681.

Martin, Ben R. 2003. "The Changing Social Contract for Science and the Evolution of University." In Aldo Geuna, Ammon J. Salter and W. Edward Steinmueller (eds). *Science and Innovation. Rethinking the Rationales for Funding and Governance*. Edward Elgar, 7-29.

Masso, Jaan and Kadri Ukrainski. 2009. "Competition for a Public Project Funding in a Small Research System: The Case of Estonia." *Science and Public Policy* 36 (9), 683-695.

Mazzoleni, Roberto and Richard R. Nelson. 2009. "The Roles of Research at Universities and Public Labs in Economic Catch-Up." In Mario Cimoli, Giovanni Dosi and Joseph E. Stiglitz (eds). *Industrial Policy and Development. The Political Economy of Capabilities Accumulation*. OUP, The Initiative for Policy Dialogue Series, 378-408.

Mowery, David C. 2009. "*Plus ça change*: Industrial R&D in the 'Third Industrial Revolution'." *Industrial and Corporate Change*. Advanced Access, published 12 January 2009, 1-50.

Mowery, David C., Richard R. Nelson, Bhaven N. Sampat and Arvids A. Ziedonis. 2001. "The Growth of Patenting and Licensing by U.S. Universities: An Assessment of the Effects of the Bayh-Dole Act of the 1980." *Research Policy* 30 (1), 99-119.

Mowery, David C. and Nathan Rosenberg. 1993. "The U.S. National Innovation System." In Richard R. Nelson (ed.). *National Innovation Systems. A Comparative Analysis*. New York: Oxford University Press, 29-75.

Mowery, David C. and Bhaven N. Sampat. 2005. "The Bayh-Dole Act of 1980 and University-Industry Technology Transfer: A Model for Other OECD Governments?" *Journal of Technology Transfer* 30 (1/2), 115-127.

Mowery, David C. and Arvidas A. Ziedonis. 2002. "Learning to Patent: Institutional Experience, Learning, and the Characteristics of U.S. University Patents after the Bayh-Dole Act, 1981-1992." *Management Science* 48 (1), 77-89.

Nedeva, Maria and Luke Georghiou. 2003. *Assessment of the Estonian Research and Development Technology and Innovation System*. Manchester, UK: PREST and the Victoria University.

Nelson, Richard R. 2009. "Technology, Institutions and Economic Development." In Wolfgang Drechsler, Rainer Kattel and Erik S. Reinert (eds). *Techno-Economic Paradigms: Essays in Honour of Carlota Perez*. London: Anthem.

Nelson, Richard R. 2006. "Reflections on 'The Simple Economics of Basic Scientific Research': Looking back and Looking forward." *Industrial and Corporate Change* 15 (6), 903-917.

Nelson, Richard R. 2004. "The Market Economy, and the Scientific Commons." *Research Policy* 33, 455-471.

Nelson, Richard R. 1959. "The Simple Economics of Basic Scientific Research." *The Journal of Political Economy* 67 (3), 297-306.

OECD. 2000. *A New Economy?* Paris: OECD.

Patents Act. (Patendiseadus). RT I 2009, 62, 205. Available at https://www.riigiteataja.ee/ert/act.jsp?id=13249806.

Pavitt, Keith. 2001. "Public Policies to Support Basic Research: What Can the Rest of the World Learn from the US Theory and Practice? (And What Should They Not Learn)." *Industrial and Corporate Change* 10 (3), 761-779.

Pavitt, Keith. 2000. "Why European Union Funding of Academic Research Should Be Increased: A Radical Proposal." *Science and Public Policy* 27 (6), 455-460.

Perez, Carlota. 2002. *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages*. Cheltenham: Elgar.

Perkmann, Markus and Kathryn Walsh. 2009. "The Two Face of Collaboration: Impacts of University-Industry Relations on Public Research." *Industrial and Corporate Change*. Advance Access, June 3 2009, 1-33.

Pollitt, Christopher. 2008. *Time, Policy, Management: Governing with the Past*. Oxford: OUP.

Pollitt, Christopher. 2002. "Clarifying Convergence: Striking Similarities and Durable Differences in Public Management Reform." *Public Management Review* 4 (1) 471-492.

Pollitt, Christopher. 2001. "Convergence: The Useful Myth?" *Public Administration* 79 (4), 933-947.

Powell, Walter W., Jason Owen-Smith and Jeanette A. Colyvas. 2007. "Innovation and Emulation: Lessons from American Universities in Selling Private Rights to Public Knowledge." *Minerva* 45 (2), 121-142.

Principles of Legal Regulation of Industrial Propert Act [Tööstusomandi õigus-korralduse aluste seadus]. RT I 2009, 4, 24. Available at https://www.riigiteataja.ee/ert/act.jsp?id=13122234.

Radosevic, Slavo. 2006. "The Knowledge-Based Economy in Central and Eastern Europe: An Overview of Key Issues." In Krzysztof Piech and Slavo Radosevic (eds). *The Knowledge-based Economy in Central and Eastern Europe: Countries and Industries in a Process of Change*. Basingstoke: Palgrave Macmillan, 31-53.

Radosevic, Slavo. 2004. "A Two-Tier or Multi-Tier Europe? Assessing the Innovation Capacities of Central and East European Countries in the Enlarged EU." *Journal of Common Market Studies* 42 (3), 641-666.

Radosevic, Slavo. 1999. "Transformation of Science and Technology Systems into Systems of Innovation in Central and Eastern Europe: The Emerging Patterns and Determinants." *Structural Change and Economic Dynamics* 10 (3-4), 277-320.

Radosevic, Slavo. 1998. "The Transformation of National Systems of Innovation in Eastern Europe: Between Restructuring and Erosion." *Industrial and Corporate Change* 7 (1), 77-108.

Radosevic, Slavo and Benedetto Lepori. 2009. "Public Research Funding Systems in Central and Eastern Europe: Between Excellence and Relevance: Introduction to Special Section." *Science and Public Policy* 36 (9), 659-666.

Radosevic, Slavo and Alasdair Reid. 2006. "Innovation Policy for a Knowledge-Based Economy in Central and Eastern Europe: Driver of Growth or New Layer of Bureaucracy?" In Krzysztof Piech and Slavo Radosevic (eds). *The Knowledge-Based Economy in Central and Eastern Europe: Countries and Industries in a Process of Change*. Basingstoke: Palgrave Macmillan, 295-311.

Reid, Alasdair and Silja Kurik. 2003. "Optimising the Design and Delivery of Innovation Policy in Estonia: An Evaluation of Policy Instruments for Intensifying Business Innovation." *Innovation Studies* 2.

Reinert, Erik S. 2009. "Emulation versus Comparative Advantage: Competing and Complementary Principles in the History of Economic Policies." In Mario Cimoli, Giovanni Dosi and Joseph E. Stiglitz (eds). *Industrial Policy and Development. The Political Economy of Capabilities Accumulation*. OUP: The Initiative for Policy Dialogue Series, 79-106.

Reinert, Erik S. 2007. *How Rich Countries Got Rich and Why Poor Countries Stay*

Poor. London: Constable & Robinson.

Riccaboni, Massimo, Walter W. Powell, Fabio Pammolli and Jason Owen-Smith. 2003. "Public Research and Industrial Innovation: A Comparison of US and European Innovation Systems in the Life Sciences." In Aldo Geuna, Ammon J. Salter and W. Edward Steinmueller (eds). 2003. *Science and Innovation: Rethinking the Rationales for Funding and Governance*. Edward Elgar, 169-193.

Roethaermel, Frank T., Shanti T. Agung and Lin Jiang. 2007. "University Entrepreneurship: A Taxonomy of the Literature." *Industrial and Corporate Change* 16 (4), 691-791.

Salter, Ammon J. and Ben R. Martin. 2001. "The Economic Benefits of Publicly Funded Basic Research: A Critical Review." *Research Policy* 30, 509-532.

Siegel, Donald S., Mike Wright and Andy Lockett. 2007. "The Rise of Entrepreneurial Activity at Universities: Organizational and Societal Implications." *Industrial and Corporate Change* 16 (4), 489-504.

So, Anthony D., Bhaven N. Sampat, Arti K. Rai, Robert Cook-Deegan, Jerome H. Reichmann, Robert Weissman and Amy Kapczinsky. 2008. "Is Bayh-Dole Good for Developing Countries? Lessons from the US Experience." *PLoS Bilology* 6 (10), e262 (Open Access).

SQW. 2007. "Impact Evaluation of Spinno Programme in 2001-2006. Implications for the EU Structural Funds Programming Period 2007-2013." *Innovation Studies* 8.

SQW. 2003. *Evaluation of the SPINNO Programme. Final Report to Enterprise Estonia*. Available at http://www.proinno-europe.eu/appraisal/evaluation-spinno-programme-final-report-enterprise-estonia.

Technopolis Group. 2008. "Mid-Term Evaluation of the Competence Centre Programme." *Innovation Studies* 12.

Technopolis Group. 2006. "Evaluation of the Design and Implementation of Estonian RTDI Policy: Implications for Policy Planning." *Innovation Studies* 6.

Technopolis Group. 2002. "Competence Centre Programme Estonia Feasibility Study." *Innovation Studies* 1.

Technopolis Group. 2001. *High-Tech Venturing in Estonia: Background Report for the ESTPIN Programme*. Available at http://www.riigikantselei.ee/failid/Hich_Tech_Venturing_in_Estonia___Technopolis_BV_2001.pdf.

Utility Models Act [Kasuliku mudeli seadus]. RT I 2009, 62, 405. Available at https://www.riigiteataja.ee/ert/act.jsp?id=13248156.

Erkki Karo is a Research Fellow at Tallinn University of Technology, Department of Public Administration. His main research interests include governance of innovation policy in catching-up economies, linkages between public administration and innovation policy research. Correspondence: Erkki Karo, Department of Public Administration, Tallinn University of Technology, Akadeemia tee 3, Tallinn 12618, Estonia; E-mail: erkki.karo@ttu.ee.