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Innovation Policy and Development in the ICT Paradigm: Regional and Theoretical Perspectives

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Innovation Policy and Development in the ICT Paradigm: Regional and Theoretical Perspectives

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Declaration: Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for any other degree or examination.

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LIST OF ORIGINAL PUBLICATIONS

The dissertation is based on the following original publications:

I Kattel, Rainer; **Kalvet**, **Tarmo**; Randma-Liiv, Tiina. (Forthcoming 2009) "Small States and Innovation." In Steinmetz, Robert; Thorhallsson, Baldur; Wivel, Anders, eds., *Small States inside and outside the European Union: The Lisbon Treaty and Beyond.* Aldershot: Ashgate Publishing.

II **Kalvet, Tarmo**. (2008) "Az észt információs társadalom fejlõdése az 1990-es évek óta" [The Estonian Information Society Developments Since the 1990s]. *Információs Társadalom* [*Information Society*], Vol 8, No 3, pp. 51-81.

III Tiits, Marek; Kattel, Rainer; **Kalvet, Tarmo**; Tamm, Dorel. (2008) "Catching up, Pressing Forward or Falling Behind? Central and Eastern European Development in 1990-2005." *The European Journal of Social Science Research*, Vol. 21, No. 1, pp. 65-85.

IV Tiits, Marek; Kattel, Rainer; **Kalvet, Tarmo**. (2005) "Globalization of R&D and Economic Development: Policy Lessons from Estonia". In *United Nations Conference on Trade and Development. Globalization of R&D and Developing Countries. ISI Proceedings of an Expert Meeting on Impact of FDI on Development, 24-26 January 2005.* United Nations: New York – Geneva, pp. 155-171.

APPENDIX

V Vanhaverbeke, Wim; De Jong, Jeroen; **Kalvet, Tarmo**; Chesbrough, Henry. (2008) "Policies for Open Innovation: Theory and Framework." In: Huizingh, Eelko; Torkkeli, Markko; Conn, Steffen; Bitrain, Ian, eds., *Proceedings of the 1st International Society for Professional Innovation Management (ISPIM) Innovation Symposium, Singapore, 14-17 December 2008.* Manchester: ISPIM CD-ROM.

VI Drechsler, Wolfgang; Backhaus, Jürgen G.; Burlamaqui, Leonardo; Chang, Ha-Joon; **Kalvet, Tarmo**; Kattel, Rainer; Kregel, Jan; Reinert, Erik S. (2006) "Creative Destruction Management in Central and Eastern Europe: Meeting the Challenges of the Techno-Economic Paradigm Shift." In Kalvet, Tarmo; Kattel, Rainer, eds., *Creative Destruction Management: Meeting the Challenges of the Techno-Economic Paradigm Shift.* Tallinn: PRAXIS Center for Policy Studies, pp. 15-30.

VII Pobol, Anna; **Kalvet, Tarmo**. (2006) "Прямые иностранные инвестиции в высокотехнологичную деятельность в транзитивных экономиках" [Foreign Direct Investments Into Hi-tech Activities in Transitive Economies]. *Проблемы науки = Problems of Science, CIPIN of the Academy of Sciences of the Ukraine*, Vol 2006/6, pp. 32-37.

VIII **Kalvet, Tarmo**. (2006) "Digital Divide and the ICT Paradigm Generally and in Estonia." In Marshall, Stewart; Taylor, Wai; Yu, Xinghuo, eds., *Encyclopedia of Developing Regional Communities with Information and Communication Technology*. Hershey – London: Idea Group Publishing, pp. 182-187.

IX **Kalvet, Tarmo**; Kattel, Rainer. (2005) "ICT-Related Education in Estonia: Current Situation, Future Challenges." *Baltic IT&T Review*, No 4 (39), pp. 46-51.

X Kattel, Rainer; **Kalvet, Tarmo**; Jürgenson, Anne. (2005) "Riiklik innovatsioonipoliitika vajab põhimõttelisi muudatusi" [Profound Changes Needed in Estonian Innovation Policy]. *Riigikogu Toimetised*, No 2005/12, pp. 88-96.

XI **Kalvet, Tarmo**. (2004) "Estonia and Lisbon Strategy: What Challenges Lie Ahead?" *Baltic Economic Trends*, No 2, pp. 15-21.

XII **Kalvet, Tarmo.** (2004) *The Estonian ICT Manufacturing and Software Industry: Current State and Future Outlook*. European Commission, Directorate General Joint Research Centre Techncial Report EUR 21193 EN. Seville: Institute for Prospective Technological Studies.

XIII Tiits, Marek; Kattel, Rainer; **Kalvet, Tarmo.** (2004) "Teadmistepõhine Eesti 2010: kontekst ja poliitikasoovitused" [Knowledge-based Estonia 2010: Context and Policy Recommendations]. *Riigikogu Toimetised*, No 2004/10, pp. 31-38.

XIV **Kalvet, Tarmo**; Kattel, Rainer. (2002) "Majandusareng, innovatsioon ja tehnoloogilis-majanduslik paradigma: väljakutse Kesk- ja Ida-Euroopa riikidele" [Economic Development, Innovation and Techno-Economic Paradigm: Challenge for Central and Eastern Europe Countries]. *Riigikogu Toimetised*, No 2002/5, pp. 142-148.

INTRODUCTION

Scope and aim

This dissertation addresses matters that, while appearing to be highly technical and specific at first, actually are vital for creating the human opportunities for individual well-being and happiness in the 21st Century. This is so because the issue covered, innovation policy, forms a foundation, and probably the most important one, of economic development in any society, especially in today's society driven by information and communication technologies (ICT). Economic development is the result of innovations which originate in the private sector but greatly depend on public policies to advance them or even to make them possible.

However, "in spite of its obvious importance, innovation has not always received the scholarly attention it deserves" (Fagerberg 2004, 1), although this has somewhat changed in recent years. For example, the number of social science publications that deal with innovation issues has increased much faster than the total number of social sciences publications in general (1) and innovation is now a central topic in many sub-fields of economics, organisational change, etc.

Similarily, academic discourse on innovation policies has gained momentum since the 1990s. Innovation and innovation policy moved into the center of politics and public policy first in the Organisation for Economic Cooperation and Development (OECD; Sharif 2006), followed by the European Union (EU) with the approval of the Lisbon Strategy in 2000. It is a comprehensive strategy for the economic and social development of Europe based on the renewal of its economic base through a focus on knowledge and innovation in the face of new challenges: globalisation, ageing, and rapid technological change (see Lundvall and Rodrigues 2002; Rodrigues 2003). Innovation has also become the central concept of politics and policymaking in most countries (Soete 2007), including the less-developed member states of the EU (Török 2007).

At the same time, research on innovation and innovation policies originates from developed countries, most of them large economies (cf. Freeman 1987; Lundvall 1992; Nelson 1993) and it is still mostly done based on developed economies (cf. Edquist and Hommen 2008). There are, however, some excellent exceptions that consider contextual differences reagarding the economic and industrial aspects of developing states (e.g., Cimoli 2000) or transition economies (e.g., Radoševic and Reid 2006). The authors of the innovation systems concept themselves have turned their attention towards the developing countries as well (see Lundvall et al. 2009).

This dissertation aims to explore some key aspects of innovation policies in the ICT paradigm, both as concerns theoretical aspects and regionally specific circumstances. The author's work has been focused mainly on Estonia as well as on other Central and Eastern European (CEE) countries, used as case studies, but also to illustrate and discuss wider and currently important issues that are directly relevant for developing countries in general. The theoretical framework of the dissertation draws mainly on evolutionary or Schumpeterian economics, development economics, economic history, governance, and policy analysis.

The work is based on seven years of research at the main centres of academic excellence in Estonia as well at a leading public policy think tank in Estonia. In both, the author has undertaken extensive academic research and policy analysis. The methodological approaches used include literature analysis, comparative studies, collecting original empirical information via interviews and web survey, and statistical analysis. Preliminary results have been discussed in numerous workshops and seminars held in Tallinn, Tartu, Brussels, Frankfurt, Lund, Riga, Rio de Janeiro, Seville, Singapore, Stockholm, Venice, and Vienna.

The most theoretical articles discussing techno-economic paradigms and the role of the state in development are **I, VI, X, XIV**. Articles **I** and **V** discuss some of the most important contemporary innovation policy themes in the context of the techno-economic paradigms driven by ICT. Estonian developments in the light of the ICT paradigm are discussed in articles **II, VIII** and **XII.** Discussion of innovation policies with a regional focus can be found in most of the articles but especially in **III**, **IV**, **VII, IX, XI**, and **XIII**.

The main reason for co-authoring many of the articles is that this work is the outcome of research and policy analysis that took place as a team effort, each team member representing slightly different competencies, leading to considerable synergies. Still, the author's own contributions to all articles is considerable and is mainly focused on ICT and techno-economic paradigms, the information society, global production and knowledge networks, innovation systems, and innovation policies in Estonia and the member states of the EU.

The introduction is divided into five major parts. In setting a framework for the following sections, the first part elaborates on innovation, techno-economic paradigms, and development. The second part describes the paradigm-based view of the state's role and especially its innovation policy in the ICT paradigm. Part three analyses innovation policies in Estonia and the CEE countries from the perspective of the ICT paradigm. Part four discusses one key theme related to modern innovation policies: open innovation. As one will see, the importance of this field has increased over the last few years as a result of changes in the

ICT paradigm. Part five includes discussion of governance and public administration issues, ending with conclusions.

1. Context for research: Innovation and development

The most widespread definition of innovation originates from Schumpeter (cf. 1934, 66), and with slight modification, it is still used by international organizations like the OECD, the EU, and others. Perhaps the best-known formulation is as follows: “An innovation is the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations” (OECD and Eurostat 2005, 46).

Innovations are produced by entrepreneurs, whose motives are more complex than profit maximisation and may include “the dream and the will to found a private kingdom, usually, though not necessarily, also a dynasty”; the “will to conquer: the impulse to fight, to prove oneself superior to others, to succeed for the sake, not of the fruits of success, but of success itself”; and the “joy of creating, of getting things done, or simply of exercising one's energy and ingenuity” (Schumpeter 1934, 93).

For Schumpeter, the connection of innovation with wider development is crucial: it is the “industrial mutation – if I may use the biological term – that incessantly revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one. This process of Creative Destruction is the essential fact about capitalism” (1950, 83). Economic growth, unlike economic development, denotes the slow, gradual, and cumulative (incremental) change of an economic system, resulting from factors such as population growth, that can be argued to stem from sources exogenous to the economic system. Economic evolution or development, on the other hand, is driven by innovation and its economic effects (1939, 58-61).

Other approaches have also acknowledged Schumpeterian economics. The exogenous growth model, a popular model of long-run economic growth, as introduced by Solow (1956), is based on two key factors of production: physical capital and (unskilled) labour. Unsatisfied with Solow’s explanation, other economists in the 1960s worked to "endogenise" technology (and the human capital behind it), but the literature on neoclassical models of endogenous technology started to grow rapidly only after the publication of Romer in 1986. In these econometric approaches, attempts were made to model research and development processes and technological advancement with externalities, spillovers, and knowledge obtaining particular importance. Although there have been numerous attempts, the models developed are still too restrictive for an innovation process that is far more complex (for critical analysis on entrepreneurial function in these models, see, for example, Bianchi and

Henrekson 2005). Neoclassical growth models have also been heavily criticised due to their inappropriate assumptions and methods (see Fullbrook 2004; Verspagen 2005; Reinert 2007), resulting in neoclassical growth models that shift towards Schumpeterian economics (Heertje 1993) and place enterpreneurship, technology, innovation, and human capital in the very centre of economic development.

For evolutionary economics and theories of industrial development, a firm is best served by a competence-based approach, where skills and tacit knowledge (individual or team competencies) are fostered and maintained by the firm. Examples are "irm as repository of knowledge" (Fransman 1998) and "the dynamic capabilities of firms" (Teece and Pisano 1998), which more or less focus on the capability to build internal competencies in a dynamic environment. For innovation processes to succeed, different competencies have to exist on a company level, including technical, managerial, and marketing (see Kelley and Littman 2005 for an excellent case study).

One of the central departure points of this thesis is the theory of techno-economic paradigms (see especially **I, VI, VIII, XIV**), a term coined by Perez (1983, 2002, 2006), which goes back to the theory of long waves of economic development originally developed by Kondratiev (in particular 1924) and Schumpeter's creative destruction.

According to Perez (2002, 2006), the paradigms last somewhere around a half century and consist of a common sense about how the capitalism of that particular period works and develops. The paradigm also explains how technological change and innovation in a given period are most likely to take place: what organizational forms and finance are conducive to innovations; what technological capabilities, skills, and infrastructure are needed; what policy changes potentially enhance innovation; and what kind of best practices of business development emerge and thrive. It is important to note that paradigms always form around a set of key technologies and innovations that then encompass and transform the whole economy.

From earlier paradigms we know, for example, that coal and iron, steel, oil, and plastic have been at the centre of influential technological innovations in the production sphere. Once a dominant pattern, a new common sense, is established, a period of broad stability occurs in which the innovation process conforms to a common set of criteria, and the design of technological artefacts changes in an incremental, evolutionary manner. In order to bring along a techno-economic paradigm change, radical innovations, together with incremental innovations, give rise to new technological systems, fuelled by the financial sector and affecting the entire economy. The social effects of all this change include the creation of demand for new structures in labour and education, the dismantling of old structures, and changes in key social and

cultural patterns of life. This change also challenges the basis of the political sphere, in that changed participatory structures transform the political cohesion of a community.

The current ICT-based techno-economic paradigm goes back to key innovations in the 1970s and is related to the rapid development of semiconductors, which are the building blocks of microprocessors, microcontrollers, and memory chips. In spite of the fact that ICT has already found its place in different applications, it continuously plays a central position in technological innovation and, especially, in the realisation of the "ambient intelligence" concept, where humans are surrounded by intelligent interfaces supported by computing and networking technology. This concept stems from the convergence of ubiquitous computing and communication (computer-based devices, due to their low price, interoperability, and ease of use are applied across a broad range of technologies) and intelligent, user-friendly interfaces (**VI**; for detailed discussion on ICT as a techno-economic paradigm leader, see Kalvet 2002) that lead to considerable changes in the social realm (see, for example, Compañó et al. 2006 and Abadie et al. 2008).

A basic feature of the ICT paradigm is the trend towards globalisation, towards facilitation of heterogeneity, diversity, and adaptability, which leads to market segmentation and niche proliferation as well as to production disaggregation and segment relocation (Perez 2006, 41-46). As discussed in **I**, the growing use of outsourcing and the breaking up of various production functions have created strong de-agglomeration pressures, both in highly industrialized as well as developing countries (for discussion, Samuelson 2004; Krugman 2008). While larger nations/regions are somewhat more hedged against imminent risks in the current paradigm, these processes have become the key challenge for many weaker national or regional economies whose dependency on international markets and production networks grows. Namely, gains from technological change and innovation do not "travel" within regional or national geographic boundaries so easily anymore. Large production units and mass employment are replaced by highly specialized networks that operate and source production and knowledge, often supra-regionally or even globally, creating a vicious cycle of increasing competition with pressures to cut costs and lower wages, thus luring foreign investors who often bring few fruits to the specific location yet demand extensive concessions (in taxes, etc.). As a result, enclave economies and de-linking effects emerge (Gallagher and Zarsky 2007). At the same time, the ICT-led paradigm enables the creation of niche production that has the potential to become supra-regional or even global. Although there is a lot of research done on ICT-sector innovation systems, discussion of the more profound logic of the current ICT-led paradigm and its increasing pressures for de-agglomeration, de-linking, and de-diversifying effects is just emerging.

2. Innovation policy in the ICT Paradigm: Theoretical perspective

The processes of creative destruction can go either way: there can be creative destruction or wasteful destruction. Consider, for example, the following from Perez (2006, 41) in discussing the state's role in the ICT paradigm:

> Left to themselves, free markets will continue taking production to China and India and feeding the housing, derivatives and hedge fund bubbles; they will continue putting pressure on companies to have high profits every quarter by whatever means and they will keep well away from the impoverished, within their countries and abroad. This means that there is bound to be an increase in economic instabilities as well as in various forms of political unrest, from the anger of those losing their pensions (or their mortgaged homes in a bubble collapse) to outright violence from abroad or from within.

Hence, processes of creative destruction need stewardship – creative destruction management. To be well managed, there has to be a framework in which creative processes can take place. So far, the only institution that can provide both management and framework is the state. Consequently, according to the Schumpeterian framework, it is the task of the state through appropriate and enlightened policies, as discussed in **VI,** to facilitate rather than fight the joining of the new paradigm with the state and its economy.

Throughout the history of capitalism, a range of institutions that protect individuals from bearing the full consequences of their actions has been developed in order to encourage risk taking and innovation. These institutions that socialize risk have been a key to the success of capitalism. Managing the process of creative destruction requires a process of building institutions that can use gains to socialize losses, both for entrepreneurs and workers. This must be done in a way that encourages innovation but minimizes the potential for moral hazard. Relatedly, creative destruction requires the removal of entry barriers for entrepreneurs in markets as well as in those networks and organizations that provide the general framework in which market activity can take place (**VI**).

From the concept of the techno-economic paradigm, it follows that different economic activities offer different windows of opportunity at any point in time (Perez 2001). This activity-specific priority setting, however, cannot be left to the market; such guidance is the task of the government (**VI**). It must focus on economic activities with a high potential for learning "high quality economic activities" (Reinert 2007), on medium or topmost range segments, instead of standardised, low price, narrow-profitmargin bottom segments (Perez 2006, 44).

Research and development, education and training must be accompanied by policies that target and nurture the industries demanding these same skills. A training and educational policy that fails to consider the demand side of the equation tends to just strengthen the brain drain. As argued in Kattel and Kalvet (2006, 16–19), research and educational policies must be paradigm-centred in order to prepare people who would be able to manage in the economic, social, and technological environment resulting from the paradigm and to develop it, irrespective of the sectors in which they operate.

So that the financial system can properly support the process of innovation mechanisms, it must provide innovating entrepreneurs with guarantees or other forms of collateral that allow banks to finance investment based on the future prospects of their investments in technology (**VI**). However, compared to the mass-production paradigm, the current paradigm is characterised by globalised and open financial markets that lead to financial instability and destruction in many weaker economies (**I**).

According to the framework, it is important that those who are the victims of this process become integrated into the new paradigm or are taken care of in an optimal way. This approach allows for a social policy that neither is nor looks harmful for economic development and innovation and that does not fight but, rather, supports the paradigm shift, a topic discussed in **VI** and, from the "digital divide" perspective, in **VIII**.

In the process of creative destruction, the economy always exercises an increasing pressure on the state as well as on societal structures upon which the economy itself rests. These social structures then increasingly fall under the influence of profit maximization and are less and less able to deal with the consequences of creative destruction and economic development. The need for social development is not defined by economic means or categories but through and by state and democratic structures of governance, emphasizing, e.g., stronger participatory elements and structures in local government as well as in labour market policies. In short, managing creative destruction and techno-economic paradigms also demands changes in the state's political structure (**VI**).

Also, institutional frameworks are always unique and country-specific, depending strongly on the general and specific political-economic situation and policies. On a political and policy level, it is of utmost importance to understand the specificities of the innovation system currently in place as well as its standing in terms of techno-economic paradigms relative to the world economy (**VI**). Different stages of techno-economic paradigms and their shifts demand thoroughly different policies to keep or get a system of innovation running (Perez 2001).

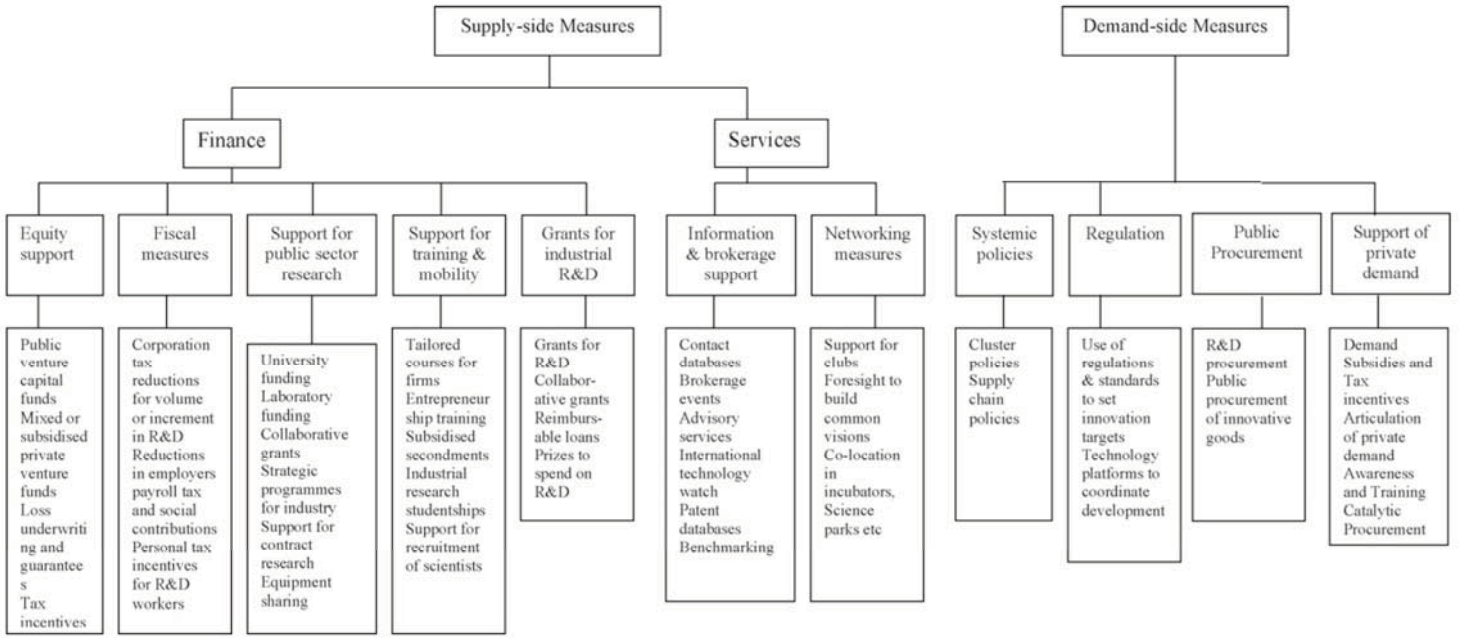
3. Innovation policy in the ICT Paradigm: The regional perspective

As discussed in **VI** and **XIV**, Schumpeterian creative destruction – destroying in order to build something new and better – is stronger in the CEE countries. Here the transformation since the fall of the Berlin Wall has presented additional, specific problems that are different from those in other parts of Europe and, indeed, of the world. In addition to the (re)establishment of political and economic independence and the transition from a planned to a market economy, these countries have been experiencing the transition to the new techno-economic paradigm as well.

Usually, the move to a market economy was guided by neoclassical economic theory and followed the neo-liberal "laissez faire" approach (**III, VI, XIV**), tilted towards financial capitalism that extolled the free market as the Archimedean point of a new utopian project of social engineering, much the same way as Communism's virtues were extolled decades before (Stiglitz 2001). In such a perspective, markets should be allowed to do their work of achieving optimal allocative efficiency. The focus of government policy is to reduce barriers for firm entry, growth, and exit and to inrease competition. The main rationale for government intervention is market failures. With the joining of the EU and especially with the approval of the Lisbon Strategy, the push for a more active role for the state emerged all over the CEE (**III**). Beyond market failures, attention has mainly turned to network and capability failures associated with innovation systems.

Today the principles of Schumpeterian economics are generally intrumentalised in public policy via the concept of a national innovation system – the most developed theoretical and policymaking discourse about innovation and concepts closely related to it, like Porter's clusters (1990) and regional innovation systems (Cooke 1992). This means that factors that influence innovation processes have been mapped within national innovation system (NIS) studies. NIS consists of the network of institutions in the public and private sectors whose activities and interactions initiate, import, modify, and diffuse new technologies (Freeman, 1987, 1). An activity-based framework has been developed, with ten of the most important activities taking place within NIS (see Edquist 2005; Chaminade and Edquist 2006). The most widespread approach to innovation policy seems to derive from looking at how policies affect various activities within the NIS (see Hommen and Edquist 2008 for application). Comparing the taxonomy of innovation policy measures (Figure 1) and mapping respective policy measures in the new member states of the EU (see INNO-PolicyTrendChart 2009) allows the conclusion that many innovation support schemes do exist in those countries, although supply-side innovation policy measures dominate.

Figure 1. Taxonomy of innovation policy tools



Source: Edler and Georghiou 2007, 953.

When analysing Estonian developments in the ICT paradigm context, one has to acknowledge that since the 1990s Estonia has achieved remarkable successes in information society related developments. As argued in **II**, the major factors that have affected and contributed to the evolution of Estonia's information society include economic factors, the active role of the public sector, technological competency, and socio-cultural factors. It is argued that the telecommunications and banking sectors are the cornerstones of the Estonian information society; they are also behind major initiatives dedicated to computer training and raising public awareness. Public-sector activities have not only been crucial in providing a favourable legislative environment but also in launching infrastructural projects and implementing innovative e-services (via application of public procurement for innovation). Public-sector developments have been strongly influenced by some non-governmental organisations such as the Open Estonia Foundation. ICT skills and R&D competencies, largely inherited from the Soviet era, have also been crucial (see Högselius 2005).

At the same time, as argued in **XII**, empirical evidence shows that the Estonian ICT manufacturing sector has become part of the larger Nordic ICT manufacturing cluster. ICT manufacturing-network flagships generally consist of Finnish and Swedish companies, which have subsidiaries, affiliates, and joint ventures in Estonia. Empirical evidence does not support the widely held view that Estonian ICT manufacturing has been gradually moving from low value-added manufacturing towards higher value-added production, supporting instead the more general conclusions of **III** and **VI** that enterprises in the CEE are typically on the lower end of the global value chain; the innovations they introduce are typically less knowledge-intensive; and, most importantly, the competitiveness of CEE economies shows that they have not been catching up with (and in fact are falling behind) industrialised economies. A lot of this has to do with policies applied.

One of the central arguments of creative destruction management is paradigm-based, activity-specific priority-setting – focusing on economic activities with a high potential for learning, the so-called "high quality economic activities" and policies promoting economic restructuring that have been always important for successful states (Reinert 2007). Similarily, industrial policy – policy "aimed at particular industries (and firms as their components) to achieve the outcomes that are perceived by the state to be efficient for the economy as a whole" (Chang 1994, 60) – has been a cornerstone of economic policy in Europe since the post-war period (Soete 2007). However, the concept has changed considerably in the core countries (see Bianchi and Labory 2006) to reflect the move from mass production to an ICT paradigm and development level. The following describes vividly the change in discourse:

> Small northern European countries, namely Sweden, Finland and Denmark implement a future-oriented industrial policy, they invest

> heavily in research, education, information technology and life long learning: these countries spend little money on state aid; their regulation of product and labour markets can be characterised as low to medium. As expected, the "outcome" of this policy is a high share of technology-driven and skill intensive industries (Aiginger 2007, 305),

although the author immediately warns readers that simple correlations do not prove causality (305). International organisations have also been looking for new ways how to revitalize policies aimed at economic restructuring due to the clear failure of a no-policy-policy[1]. The reality is, however, that the common and only features of CEE industrial policies include a focus on incentives to FDI and a strong emphasis on R&D and innovation. These continue to be strong priorities in future (Török 2007). A policy convergence occurs within frontier economies where industrial policies have recently merged with innovation policy, science and technology policy, and education (Soete 2007). At the same time, the authors of the national innovation systems concept warn that the innovation systems approach needs to be adapted to developing countries if it is to be applied to system building (Lundvall 2007, 32). The failure of Estonia and other CEE economies to fully adapt to the ICT paradigm confirms the limitation of the concept.

In fact, economic reality shows that although many companies in Estonia and in other CEE countries have been highly innovative (**III, XII**), they largely rely on methods and measures characteristic of previous levels of development, the previous techno-economic paradigm, which can be called "Fordism". These characteristics include process and organisational innovations that rely heavily on mass-production and assembly-line technologies. This development has been largerly facilitated by FDI and no-selectivity policies (**V**)**.** However, the radical opening of markets and the specific quality of FDI has led to a peripheralisation of much CEE industry, meaning that productivity increases take place in some sectors only and do not spill over to others. These leading sectors, in turn, tend to be mainly low-tech, labour-intensive, and low-wage industries relying on economies of scale and continuing FDI (for a case study on Estonian manufacturing, see **XII**).

To a large extent, research on innovation systems has focused on activities related to the production and use of codified scientific and technical knowledge:

> When one turns to policy analysis and prescription, as well as to the quantitative survey-based studies that support and justify policy, we

[1] Consider, for example, the following from the World Bank (2009): "How to promote economic restructuring and technological dynamism in developing and transition economies? New Industrial Policy is a set of innovative interventions which is distinct from the 'old' functional/ horizontal industrial policy of the 1980s and 1990s and capable of avoiding its familiar pitfalls of 'picking winners'."

> would contend there is a bias to consider innovation processes largely as aspects connected to formal scientific and technical knowledge and to formal processes of R&D (Jensen et al. 2007, 684).

In Estonia and the CEE, focusing innovation policies on "high-technology elements" (like emphasis on venture capital funds, support on patenting, technology transfer) has been strengthened by the fact that until the early 2000s, scientists were almost the only promoters of science and technology policies in the CEE (**III**), leading to a specific and often mystifying way of understanding innovation (for a case study on Estonia, see Kalvet et al. 2005). Innovation was seen, in line with post-World War II tradition, as a phenomenon related to science – a belief that there is a more or less linear correspondence between scientific discovery and increased innovation. The technology-push linear innovation models thus prevailed. In many CEE countries, the priority is to focus on ICT, biotechnologies, and materials technologies as well as their cutting-edge aspects (**III, IV**). However, it is rather the application of these technologies (and especially ICT today) that should be the content of respective technology programmes (**V**). While there seems to be general agreement regarding the principles, implementation remains to be seen in Estonia.

A case study on Estonia (in **X**) also shows that innovation policy elements currently in place do not encourage risk taking and innovation by low-, middle-, and high-technology manufacturers, resource-based industrial companies, or knowledge-based service firms. These economic agents are central to the Estonian economy and could have a significant impact on the Estonian living standard. Existing state R&D system and innovation policies have essentially nothing to do with the average Estonian producer.

The existing educational system does not produce human capital with the right skills. As argued in **X**, based on a case study on Estonia, lack of skilled labour is the main factor hindering development of ICT companies in Estonia. There are problems with the curricula of vocational and higher education institutions, their teaching staffs, practical training systems, and cooperation between education establishments and the private sector. In sum, the ICT-related education policy does not depart from the paradigm-centred perspective and does not prepare students to manage in the economic, social, and technological environment resulting from the current paradigm.

Compared to the mass-production one, the current paradigm is characterised by globalised and open financial markets that, in case of Estonia and the CEE, has enforced speculative economic growth that is fuelled by domestic consumption and is based on foreign borrowing. This wider issue has a clear impact on creative destruction in many other weaker economies (**I**).

Many of the problems discussed here are the result of policy transfer, sometimes involuntary. To some extent, it is also a response to ongoing globalisation and liberalisation processes, limiting the capacities of nation-states or regions to select and implement policies supporting creative destruction. Related issues will be discussed in more detail in section six below.

4. Innovation policy for organisational innovation: The case for open innovation

Since 2003 the concept of "open innovation" – "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively" (Chesbrough et al. 2006, 1) – has gained increasing popularity in innovation discourse, especially in innovation management (see, for example, Dodgson et al. 2008, 54-93). Both national policymakers and the international policy community, especially the OECD, show great interest for this approach (see for example OECD 2008). Some believe that the open innovation-based approach is replacing the national innovation systems-based logic of innovation policies.

The open innovation model is closely related to the systems of innovation approach. Although they have developed in different disciplines (managerial vis-à-vis economics), there are considerable similarities in their underlying principles. Both emphasize that innovation is the result of complex and intensive interactions among various actors and that knowledge spillovers are crucial to a successful innovation process. Further, the open innovation approach is complementary to the innovation systems approach, adding to the innovation systems literature (and related debate on policymaking) by detailing how innovation processes take place in the "nodes" of innovation systems (i.e., enterprises) in relation to "outside" world (de Jong et al. 2008, 28-30).

Feedback linkages among companies (both vertical and horizontal), and thus cooperation, have always belonged to innovation and, thus, to economic development (Reinert 2007). The change in the techno-paradigm, however, has led from mass manufacturing and huge hierarchical organization towards ICT-enabled productivity growth and networks of companies in manufacturing and services (see Perez 2002, 2006). The resultant growing mobility of highly experienced and skilled people, growing presence of private venture capital, increasingly fast time to market for many products and services, growing competition from foreign firms due to ongoing globalisation, and wider stock of knowledge from various sources have all enabled the growth of a wide range of cooperation patterns previously unthinkable and, more than ever pose, a need for policies that consider this aspect. The very first attempt to develop a comprehensive framework detailing what ideas of open innovation mean for policymaking, can be found in **V**.

Because approaches to innovation systems and open innovation are similar, then they might also share similar problems as far as weaker economies are concerned. The original developers of the concept also raised the possibility of such problems (see Chesbrough et al. 2006, 299-301). Article **V** confirms that the proposed framework for policy assessment is broad and offers many guidelines. In weaker economies, one especially has to be careful about following these guidelines. Other policymaking priorities could exist due to the low absorptive capacity of incumbent enterprises and under-developed innovation institutions.

We conclude in Karo and Kalvet (2008) that the most important shortcoming arises from implementing the principles of open innovation, which does not change the structure of economies that are oriented towards low value-added (subcontracting) activities and where the intensity of skills is rather limited. It is argued that the Estonian and CEE context is better described by the "doing, using, and interacting" mode of innovation than the "science, technology, and innovation" mode of innovation (see Jensen et al. 2007), while the open innovation paradigm follows from and assumes mainly the existence of the latter. Therefore, as modes of innovation are different, imitating the open innovation-based policies without understanding the differences might lead to limited or even negative effects. Also, more advanced public policymaking capacities and policy-analysis skills seem to be needed than are present in the current innovation policymaking environment.

5. Governance and public administration

As already argued, innovation-based productivity explosions create enormous competitive advantages through agglomeration, clustering, positive externalities, and economies of scale and scope that cumulatively engender virtuous cycles of growth and rapidly rising living standards. At the root of such complex interactions is highly embedded policymaking of increasing coordination, dialogue, and cooperation that is managed by a highly capable public administration (Wade 1990; Evans and Rauch 1999; Drechsler 2009a). However, while the state is generally considered as an important factor influencing how a concrete innovation system develops in academic discourse, linkages to policymaking and administrative capacities are quite missing (for a discussion on the Lisbon Agenda and public administration, see Drechsler 2009b).

As evidenced in **X**, entrepreneurs in Estonia believe that the state should improve opportunities for entrepreneurs to provide feedback on the development of policies and measures. Indeed, the importance of involving economic agents in policymaking – establishing an effective and rapid system for collecting feedback from entrepreneurs – is discussed in several articles,

especially in **IV**, **IX**, **X, XIII**. While studies conducted among entrepreneurs provide partial feedback, such studies do not reveal more specific problems, and thus consistent monitoring of the economic sectors has been proposed. The main focus should be related to technology and skills in the respective sector and should possibly involve, in addition to Estonian entrepreneurs, the foreign owners of companies operating there and should be mandatory for the development and evaluation of policies in the respective ministries.

Relatedly, the design and coordination of public policy with special emphasis on horizontal coordination is crucial in paradigm-based policymaking (**IV, IX, X, XIII**). As summarised in **IV,** an Estonian case study found such horizontal coordination to be very weak. Due to the lack of a political and administrative mechanism, regular coordination of policies in education, employment, research and development, and innovation is almost nonexistent as is any evaluation from such a perspective. Although considerable improvements have taken place in Estonia since the elaboration of National Development Plans for the application of the EU Structural Funds, technological programmes that enhance competitiveness among economic clusters are still missing.

In **I,** public administration in small states is discussed. Since the early 1980s, many countries have been influenced by new public management (NPM) ideas and reform trajectories with its "economic rationalism" and managerialism. A number of international organizations promoted NPM reforms with no critical or context-related assessment. Such neo-liberal administrative reforms have hollowed out the state at a time when the state's capacity to steer the economy is direly needed. Drechsler (2009a) also argues that the post-NPM system, the Neo-Weberian state, is the most appropriate administrative system for the support of innovation (see also Drechsler and Kattel 2009).

Another important dimension is related to governance and international organisations. The problems developing countries have with dominant international organisations like the IMF and the World Bank are well argued. The policies international organizations advocate serve the interests of developed countries and enforce the destructive side of creative destruction while leaving the creation of new structures aside (see Stiglitz 2003; Chang 2007; Reinert 2007). In addition, as argued in **I**, the ICT-paradigm poses challenges for policymaking in weaker nation-states: when mass-production innovation policy is local (creating local technological capabilities and markets, and then moving to exports), the ICT-paradigm innovation policy of small states has to be supra-regional (for instance, within the EU) from the start. In fact, hardly any small country in Europe is capable of or is practicing such policies yet. Also, encouraged by national innovation systems theory and the success of developed countries in the application of those principles led to the situation (described in **V**) where CEE innovation policies attempted to imitate those of advanced industrial economies, concentrating on R&D-related

activities, such as the commercialization of public research and the development of technology parks for research-intensive start-ups, etc. So, even since EU accession, when changes towards a more active role of the state in supporting the existing industry has taken place, mainly following from the policy discussions and coordination with EU officials, the effectiveness of such policy interventions has been questioned (Reinert and Kattel 2007).

Summary and conclusions

Innovation policy forms a foundation, and probably the most important one, of economic development in any society, especially in today's society driven by information and communication technologies (ICT). Although positive information-society developments in Estonia seem to confirm Estonia's full adoption of the ICT paradigm, the central conclusion of the thesis is that in Estonia and other CEE countries, compliance with the previous techno-economic paradigm can be observed and that those countries have not benefitted from the profound logic of the current ICT-led paradigm. They are under increasing pressures from de-agglomeration, de-linkaging, and de-diversifying effects.

Although innovation and innovation policy have moved into the centre of politics and public policy in the less-developed member states of the EU, including Estonia, marking a change from the earlier "market-failure" centred approach, there are considerable problems. The principles of Schumpeterian economics are today generally intrumentalised in public policy via the concepts of a national innovation system and the need to address networking failures. However, the main problems of companies are related to the lack of absorptive capacities, resulting in less incentive to innovate other than by cutting costs. While innovation is taking place, it is specific and does not contribute to Schumpeterian creative destruction – destroying in order to build something new and better. Mainly using Estonia as a case study, the thesis concludes that the innovation policies widely applied in CEE countries are missing several crucial elements.

First, one of the central arguments of creative-destruction management is paradigm-based, activity-specific priority-setting, i.e., a focus on economic activities with a high potential for learning, the so-called "high quality economic activities." Such wide-scale selection mechanisms have been and are still missing, and innovation policies by themselves can not lead to economic restructuring or creative destruction, in spite of such expectations.

Second, the whole concept of innovation systems has to a large extent focused on activities related to the production and use of codified scientific and technical knowledge. Innovation policies in Estonia and the CEE in general have "high-technology elements" at their centre. As the case study on Estonia

shows, however, innovation policy elements currently in place do not effectively encourage risk taking and innovation by low-, middle-, and high-technology manufacturers; resource-based industrial companies; or companies that provide knowledge-based services, i.e., of economic agents that are central to the Estonian economy and can have a significant impact on the Estonian living standard. A general conclusion is that the existing state R&D system and innovation policies have essentially nothing to do with the average Estonian producer.

Third, research that studied the education system from a paradigm-specific perspective showed that the ICT-related education policy in Estonia does not depart from the paradigm-centred perspective and does not prepare students with the skills needed to manage in the economic, social, and technological environment resulting from the current paradigm.

Such policy problems are partially – but only partially – the result of compliance with the rules and norms facilitating further globalisation and liberalisation processes, as imposed by some international organisations, that limit the capacities of nation-states or regions to select and implement policies supporting creative destruction. Compared to the mass-production paradigm, the current one is characterised by globalised and open financial markets which, in case of Estonia and the CEE, have enforced speculative economic growth, fuelled by domestic consumption and based on foreign borrowing. At the same time, the incorporation of other modern approaches into respective innovation policies is voluntary.

While the state is generally considered an important factor influencing how concrete innovation systems develop in academic discourse, linkages to policymaking itself and administrative capacities are quite missing and need to be revived, including the reconsideration of governance. The case study on Estonia confirms that the problems entrepreneurs perceive as hindering innovation and thereby growth (financing, qualified workforce, lack of markets) need long-term and systematic solutions or rather a set of solutions which would solve the systematic and structural problems of the Estonian industry.

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SUMMARY IN ESTONIAN

Innovatsioonipoliitika ja areng IKT paradigmas: regionaalsed ja teoreetilised aspektid

Innovatsioon ja innovatsioonipoliitika on tänasel päeval omandanud äärmiselt tähtsa rolli nii arenenud kui arenevates riikides. Erasektoris aset leidvas innovatsioonis ning seda edendavates riiklikes poliitikates nähakse põhjendatult majandusarengu alustalasid. Käesolev väitekiri käsitleb teemat info- ja kommunikatsioonitehnoloogial (IKT) põhineva tehnoloogilis-majandusliku paradigma kontekstis, avades mitmeid uusi teoreetilisi aspekte ning analüüsides innovatsioonipoliitika kujundamisega seonduvaid probleeme Eesti, aga ka üldisemalt Kesk- ja Ida-Euroopa riikide kontekstis.

Töö autor põimib oma lähenemises evolutsioonilise Schumpeterliku majanduskäsitluse kaasaegse arenguökonoomika, majandusajaloo, riigiteaduste ning poliitikaanalüüsi käsitlustega. Töö keskseks lähtekohaks on tehnoloogilis-majanduslike paradigmade kontseptsioon ning arusaam, et viimase kümnendi, aga ka lähikümnendi areng saab jätkuvalt olema mõjutatud IKT arengust. Üheks IKT arengust johtuvaks põhjapanevaks muutuseks on suund globaliseerumisele, mitmekesisusele ning tootmisprotsesside lahutamisele nende koostisosadeks ja nende üksuste geograafiline ümberpaigutumine (uurimus **I).**

Tehnoloogilis-majanduslikel paradigmadel põhineva poliitikakujundamise keskseid elemente, ja just IKT paradigmaga seoses, käsitletakse uurimustes **I, VI, X** ja **XIV** ning järeldatakse, et paradigma muutus, nagu seda väljendab ka Schumpeteri mõiste "loominguline hävitusprotsess", on nii loov kui ka hävitav nähtus – kaovad vanad tööstusharud ja nendega seonduvad sotsiaalsed struktuurid, nende asemele tekivad uued. Iga paradigma muutuse ja arenguga kaasneb paratamatult sotsio-institutsionaalse raamistiku muutus ja areng, ning mida kiiremini see toimub, seda valutum see on. Sellise tulemuse tagamine on aga riikliku poliitika ülesanne, mille kesksetеks elementideks on ettevõtjatel innovatsiooniga kaasnevate riskide maandamine ning majanduse struktuuri suunamine "kõrgekvaliteediliste tegevuste" suunas. Vastavaid arenguid peab toetama teadus- ja arendustegevus, haridussüsteem ning samuti finantssüsteem, ehkki globaalsete finantsturgudega on kaasnenud märkimisväärne globaalne majanduslik ebastabiilsus (**I**). IKT paradigma seisukohast on analüüsitud ka infokihistumist (**VIII**).

Eesti infoühiskonna märkimisväärselt kiire areng (**II**) annab alust arvata, et Eesti on IKT paradigmaga hästi kohanenud. Samas, kui analüüsida arengut tehnoloogilis-majanduslike paradigmade vaatenurgast, tuleb paraku järeldada, et Eesti, aga ka üldisemalt Kesk- ja Ida-Euroopa riikide erasektori arengut kirjeldab pigem kohaldumine eelmise, masstootmisel põhineva tehnoloogilis-

majandusliku paradigmaga. Seda kinnitab ka Eesti IKT-sektorit käsitlev süvaanalüüs (**XII**).

Ehkki innovatsioonipoliika on kujunenud keskseks poliitikavaldkonnaks Kesk- ja Ida-Euroopas, ja võrreldes eelneva "turutõrgetel" baseeruva lähenemisega on tegemist märkimisväärsete positiivsete arengutega, on innovatsioonipoliitika mõjususes võimalik siiski kahelda (**III, VI, XIII, XIV**). Nimelt, innovatsioonipoliitika baseerub tänapäeval rahvuslike innovatsioonisüsteemide lähenemisel ning peamiselt keskendutakse võrgustumisega seonduvate tõrgete ületamisele. Samas, Eesti ning teiste Kesk- ja Ida-Euroopa riikide majandusstruktuuri taolisel kontseptsioonil põhineva innovatsioonipoliitikaga ei ole võimalik muuta. Läbi aegade on majandusstruktuuri muutmisele suunatud poliitikad olnud tähtsal kohal, peale Teist maailmasõda näiteks tööstuspoliitikana. Samas Kesk- ja Ida-Euroopa riikides on põhiline majanduse restruktureerimisele nii lähiminevikus kui ka eeldatavasti lähitulevikus olnud seotud välismaiste otseinvesteeringutega, millistega pole aga oodatud laiamastaabilist positiivset efekti siiski kaasnenud (**VII**). Rõhuasetus rahvuslikel innovatsioonisüsteemidel põhinevale lähenemisele, mis on enamjaolt olnud suunatud kodifitseeritud teadmistega seonduvale (ning seetõttu ka kõrgtehnoloogilistele sektoritele) ning keskendunud vaid väikesele osale ettevõtjatele, on samuti jätnud põhiosa reaalmajandusest tähelepanuta (**IV, X**).

Võtmevaldkonnaks on ka haridussüsteemi, ja eelkõige IKT-alast haridust puudutava, kaasajastamine. Eesti kaasusanalüüs (**IX**) näitab, et vastava inimkapitali puudumine on põhiliseks Eesti IKT sektori ettevõtjate arengut takistavaks elemendiks. Oluline on tegeleda õppekavade arendamisega erinevatel õppetasanditel, õpetajaskonnaga ning, mis olulisim, praktikasüsteemi kaasajastamisega.

Osad innovatsioonipoliitika probleemid johtuvad rahvusvaheliste organisatsioonide poolt, mis seotud süveneva liberaliseerumise ning tingimusteta globaliseerumise jätkumisega, soovitatu järgimisest. Teisalt toimub arenenud riikides rakendatud innovatsioonipoliitikate kopeerimine (**V**). Üheks selliseks näiteks on "avatud innovatsiooni" kontseptsioon, mis rõhutab sisemiste ja väliste teadmiste voogude ärakasutamist ettevõttesisese innovatsiooni kiirendamiseks ühelt poolt, ja teisalt, innovatsiooniprotsessi "kõrvalproduktide" kommertsialiseerimist. Samas, selle lähenemise kaudu innovatsioonipoliitikate arendamine ei pruugi nõrgema majandusega riikides efekti anda, kuivõrd kontseptsiooni eeldused – tugevad teadus- ja arendusasutused, absorbeerimisvõimelised ettevõtted jne – ei pruugi olemas olla ning mida Eesti kaasusanalüüs (**V**) ka kinnitab.

Valitsust peetakse üldiselt kaasaaegsetes innovatsiooniteooriates tähtsal kohal olevaks, samas põhjalikumaid käsitlusi, kus innovatsioonipoliitika seotakse ära valitsemise ja avaliku haldusega, on vähe. Eesti ettevõtjad ootavad samas

selgelt, et poliitikakujundamise mehhanisme muudetaks märkimisväärselt just suurema kaasamise osas (**X**). Kuivõrd innovatsioonipoliitika on oma olemuselt horisontaalne poliitika, siis tuleb selle kujundamisse kaasata ka erinevate valdkondade arenguid koordineerivad ministeeriumid (**IV, X, XII**), ehkki olulise probleemina on tõstatumas asjaolu, et rahvuslike poliitikate mõju on tulenevalt IKT paradigmaga kaasnevatest tootmise ümberkorraldamisest kahanemas ning on vaja poliitikate koordineerimiset riikide (gruppide) vahel (**I**).

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PUBLICATIONS (Articles I – VI)

Article I

Kattel, Rainer; **Kalvet**, **Tarmo**; Randma-Liiv, Tiina. (Forthcoming 2009) "Small States and Innovation." In Steinmetz, Robert; Thorhallsson, Baldur; Wivel, Anders, eds., *Small States inside and outside the European Union: The Lisbon Treaty and Beyond*. Aldershot: Ashgate Publishing.

Article II

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APPENDIX (Articles V – XIV)

Article V

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Article VI

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Article IX

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Article XI

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Article XII

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Article XIV

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University of Tartu	2002	*Master of Public Administration (cum laude)*
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Summer 2004	Global Network for Economics of Learning Innovation and Competence Building Systems (GLOBELICS), GLOBELICS Academy, ISEG/UTL - Economics and Management Institute, Technical University of Lisbon, Portugal
Summer 2003	Cambridge Advanced Program on Rethinking Development Economics, University of Cambridge, Trinity Hall, Cambridge, England

6. Professional Employment

2006-	Tallinn University of Technology	Research Fellow
2001-2008	Praxis Center for Policy Studies	Director of the Innovation Policy Research Program
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7. Scientific work

Co-ordinator and principal researcher for many research projects, including

2009-2011	Innovation Policy and Uneven Development
2009	Business Models of Intellectual Property Based Firms: Open Innovation Based Business Models and their Applicability in Estonia
2008-2013	Public Administration and Development in Small States
2008	Open Innovation Policies Assessment Framework
2007-2008	Digital Stratification in Estonia: Users and Non-Users of the Internet
2007-2008	Strategic Development Concept of Transnational Cooperation in the Field of Innovation Promotion in the Via Baltica Nordica Macro-Region
2005-2007	Next steps in developing Information Society Services in the New Member States: The cases of eGovernment and eHealth
2006-2007	Feasibility Study for Policy Scheme Favoring Recruitment of Innovation Staff in Enterprises and Science-industry Mobility
2006	Impact Evaluation of the Public Business Support Measures (Financed from ERDF and ESF), Including R&D Financing Programme from 2001-2004
2005	Business Support Instruments in the Estonian State Budget Strategy for Years 2007-2013
2006	Private Sector R&D in the New Member States
2005	Innovation Awareness in Estonia
2004-2005	Knowledge-based Economy and ICT-Related Education: Overview of the Current Situation and Challenges for the

	Education System
2003-2005	eVikings II: Establishment of the Virtual Centre of Excellence for IST RTD in Estonia
2003-2004	Biotechnology Foresight and Information Society Technologies Foresight in Estonia
2003	Risk analysis of Estonian Innovation Policy instrument SPINNO at the Tallinn University of Technology
2002-2003	ICT Infrastructure and E-Readiness Assessment
2001-2003	Creative Destruction Management in Central and Eastern Europe: Meeting the Social Challenges of the Techno-Economic Paradigm Shift

8. Defended theses

"Theoretical Issues and Practical Plans of Information Policy in Developed Countries" (*Baccalaureus Artium)*

"ICT as Techno-Economic Paradigm Leader: General Issues and the Case of Estonia" (*Master of Public Administration)*

9. Main areas of scientific work

Innovation policy; small states; business models and innovation

10. Selected additional publications

De Jong, J.P.J., Vanhaverbeke, W., Kalvet, T., Chesbrough, H. (2008). *Policies for Open Innovation: Theory, Framework and Cases*, Research project funded by VISION Era-Net, Helsinki: Finland, http://www.visioneranet.org/files/408/OIPAF_final_report.pdf.

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1999-2002	Sihtasutus Archimedes	teadur
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Paljude teadusprojektide koordinaator ning teadur, sealhulgas

2009-2011	„Innovatsioonipoliitika ja ebaühtlane areng"
2009	„Intellektuaalsel omandil baseeruvate ettevõtete ärimudelid: avatud innovatsioonil põhinevad ärimudelid ning nende rakendatavus Eestis"
2008-2013	„Avalik haldus ja areng väikeriikides"
2008	„Avatud innovatsiooni edendavate poliitikate hindamisraamistik"
2007-2008	„Infokihistumine Eestis: Interneti kasutajad ja mittekasutajad"
2007-2008	„Balti- ja Põhjamaade regioonis piiriülese innovatsiooniaalase koostöö arendamise strateegiline kontseptsioon"
2005-2007	„Järgmised sammud infoühiskonna teenuste arendamisel uutes liikmesriikides: eValitsemise ning eTervise kaasusanalüüsid"
2006-2007	„Innovatsiooni toetava töötajaskona ning tööstuse-akadeemia töötajate mobiilsusskeemi eeluuring"
2006	„Ettevõtete toetusmeetmete (sh T&A programmi) mõjude hindamine, 2001-2004"
2005	„Ettevõtete toetusmeetmed Eesti riigieelarve strateegias aastatel 2007-2013"
2006	„Erasektori T&A investeeringud EL-i uutes liikmesriikides"
2005	„Innovatsiooniteadlikkus Eestis"
2004-2005	„Teadmistepõhine majandus ning IKT-alane haridus: ülevaade hetkeolukorrast ning väljakutsed

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2003-2005	„eViikingid II: Virtuaalse infoühiskonna tehnoloogiate teadus- ja arenduskeskuse asutamine Eestis”
2003-2004	„Biotehnoloogia ja infoühiskonna tehnoloogikate tulevikuseire Eestis”
2003	„Eesti innovatsioonipoliitikainstrumendi SPINNO riskianalüüs Tallinna Tehnikaülikoolis”
2002-2003	„IKT infrastruktuuri ja e-valmisoleku hindamine”
2001-2003	„Loova hävitusprotsessi juhtimine Kesk- ja Ida-Euroopas”

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„Infopoliitika teoreetilised küsimused ning rakenduskavad arenenud riikides” (*Baccalaureus Artium)*

„Info- ja kommunikatsioonitehnoloogia kui tehnoloogilis-majandusliku paradigma liider: üldised küsimused ja Eesti kaasus“ (*Master of Public Administration)*

9. Teadustöö põhisuunad

Innovatsioonpoliitika; väikeriigid; ärimudelid ja innovatsioon

10. Täiendavate valitud publikatsioonide loetelu

De Jong, J.P.J., Vanhaverbeke, W., Kalvet, T., Chesbrough, H. (2008). *Policies for Open Innovation: Theory, Framework and Cases*, Research project funded by VISION Era-Net, Helsinki: Finland, http://www.visioneranet.org/files/408/OIPAF_final_report.pdf.

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TALLINN UNIVERSITY OF TECHNOLOGY
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6. **Ülle Madise**. Elections, Political Parties, and Legislative Performance in Estonia: Institutional Choices from the Return to Independence to the Rise of e-democracy. 2007.

7. **Tarvo Kungla**. Patterns of Multi-Level Governance in Europe: The Challenge of the EU's Enlargement. 2007.

8. **Mikk Lõhmus**. Avaliku halduse detsentraliseerimine Eestis. 2008.

9. **Tarmo Kalvet**. Innovation Policy and Development in the ICT Paradigm: Regional and Theoretical Perspectives. 2009.