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Tacit Web: Entrepreneurial Discovery, Institutional Complexity and Internet Diffusion

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TACIT WEB: ENTREPRENEURIAL DISCOVERY, INSTITUTIONAL COMPLEXITY AND INTERNET DIFFUSION

A Dissertation Presented

by

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To Helin, Markus and Mia

ACKNOWLEDGEMENTS

I have wrestled with the ideas presented in this dissertation for almost two decades. My interest in politics and economics of internet started when I worked for a consulting firm in the 1990s and advised an internet service provider in Estonia. I went on to co-found an ecommerce start-up where we had to tackle differences in internet use on a daily basis. While the internet banking was widely used in Estonia already in the late 1990s, we had to set up a special entity in Delaware for accepting checks from our customers in the United States. This practical business experience was certainly eye opening for my academic and policy interests. I am grateful to my business partners and co-workers – Oliver, Pirkko, Risto, Allan and many others - from these turbulent times.

Since Estonia was a transition economy in the 1990s, then my first instinct was to explore whether any lessons can be learned from more advanced Nordic countries. I wrote my Master of Science thesis on political economy of internet diffusion in Finland and Sweden at the London School of Economics and Political Science in 2001. This was an attempt to apply traditional political economy ideas to what was then considered a field outside of traditional realm of political economy. I am grateful to my supervisor David Stasavage and professor Razeen Sally for the advice as well as to the Michael Peacock Scholarship Program for fully funding my studies at LSE.

However, the key understanding that resulted from these explorations was that there are not many lessons to be learned from Finland and Sweden. First, these countries had different political economy systems and had followed different development trajectories than Estonia. Second, Estonia was actually quite advanced in the use of internet and related technologies in comparison with Finland and Sweden. Hence, my interest shifted towards improving my understanding internet diffusion in Estonia and Central Eastern Europe.

Immediately after my graduation from LSE, I received international policy fellowship from the Centre for Policy Studies (affiliated with Open Society Institute and Central European University) to study Estonia and Slovenia, which were considered most advanced countries in the ICT development in the Central and Eastern Europe. This fellowship allowed me to travel to Slovenia in January 2003 and conduct first set of interviews there. As a side project I also travelled to Kazakhstan, Kyrgyzstan, Tajikistan and Uzbekistan to evaluate activities of the Global Internet Policy Initiative (GIPI) in the summer of 2002. This experience certainly deepened my understanding on how different institutional constraints and development trajectories of countries shape internet diffusion. I am thankful to Jerzy Celichowski, Darius Cuplinskas, Pamela Kipaldi and for others for making this fellowship possible.

I continued pursuing my research interest at the Fletcher School at Tufts University where I wrote my Master of Arts in Law and Diplomacy thesis in 2004 on the impact of economic openness on internet diffusion in Estonia and Slovenia. This was an attempt to combine my newly gained understanding of international trade economics with that of technology diffusion. I am very grateful for my supervisor Carsten Kowalczyk for his advice and support.   I would like to thank Fulbright Program of US State Department, Humane Studies Fellowship of Institute for Humane Studies at the George Mason University, Armand Hammer Scholarship Program, Lellep Scholarship of Estonian Students Fund in the US and Linna Scholarship of Estonian World Council for making my studies at the Fletcher School possible.

After the graduation from the Fletcher School, I pursued my research on internet diffusion in the PhD program at the University of Massachusetts Amherst. Simultaneously, I have presented early versions of different parts of this dissertation at numerous conferences of American Political Science Association, International Studies Association, Industry Studies

Association, Midwest Political Science Association, Oxford Internet Institute, Ronald Coase Institute, International Conference on Theory and Practice of Electronic Governance (ICEGOV), Electronic Government (EGOV) and Digital Government Society of North America. My contributions have also been published by Journal of Politics, Policy and Internet, Journal of Information Technology and Politics as well as by MIT Press, ACM and IOS Press. I am indebted to colleagues I have met in these conferences and many anonymous reviewers who have provided me feedback on my work. I am very thankful to the University Massachusetts in Amherst, US National Science Foundation, Hayek Fund for Scholars at the Institute for Humane Studies and Estonian Business School for funding my conference travels. I benefited tremendously from participating in the OECD workshops on broadband and internet economy in Paris, London and Washington, DC. I would like to thank the Ministry of Economic Affairs and Communications in Estonia for making it possible.

I am especially grateful to Jane Fountain, Eric Einhorn and Charles Schweik for serving in my PhD committee and for willing to read the whole manuscript under severe time constraints. My work benefited tremendously from their detailed and invaluable comments.

ABSTRACT

TACIT WEB: ENTREPRENEURIAL DISCOVERY, INSTITUTIONAL COMPLEXITY AND INTERNET DIFFUSION

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This dissertation investigates how institutional frameworks and entrepreneurial discovery processes condition internet diffusion. While internet and internet-based technologies have received considerable scholarly attention, the dissertation emphasizes tacit elements in understanding internet diffusion. In order to do so, it incorporates perspectives on insttitutional complexity stemming from interactions of formal and informal institutions and different institutional logics. Empiral part consists both macro level comparisons of Estonia and Slovenia as well as micro level analysis of internet diffusion processes within Estonia.

Estonia and Slovenia are selected for comparison because of considerable variance in insitutional frameworks. At the same time, both countries are relatively small and members of the European Union. This allows to focus on specific institutional configurations and path-dependencies in constraining and enabling the diffusion of internet. I find that internet is diffused more extensively and intensively in Estonia. Different socio-economic groups use more sophisticated online services in Estonia than in Slovenia. Once specific institutional configurations in general and in the telecom sector in particular are considered then it emerges that insitutional frameworks in Estonia have been more facilitative of entrepreneurial

discovery processes over time. As a result, supply and demand for innovative online services in Estonia is greater than in Slovenia.

After comparative perspective on two countries, the dissertation proceeds to analyze specific cases of online initiatives in Estonia such as internet banking and internet voting. Examination of outcomes shows how some of these initiatives have been successful and created reasons for adoption and use of internet on the individual level leading to a greater diffusion on macro level. My analysis demonstrates that positive outcomes have often been unintended result of experimentation through the process of entrepreneurial discovery within the context of institutions and path-dependencies. Evidence for this finding is bolstered by study of heterogeneous cases of various ICT initiatives. By emphazing institutional complexity and policy heterogeneity, the dissertation illuminates and explains the tacit nature of internet diffusion in a specific context of Estonia. This implies that Estonia has followed a unique developmental trajectory which cannot be generalized and transferred to other countries.

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CHAPTER 1

INTRODUCTION

1.1 Background of the Problem

Often the internet is perceived as a global borderless technology which is not limited by politics, morality and geography. Some governments may try to stop its use or regulate some aspects of its use but even these governments often face an uphill battle. In the early days of internet, internet activist John Perry Barlow published a “Declaration of the Independence of Cyberspace” where he argued that governments do not have sovereignty in the cyberspace (Barlow 1996). He told to “Governments of the industrial world” that “Cyberspace does not lie within your borders” (Barlow 1996). Following the true spirit of early internet pioneers, Estonian computer programmers created Kazaa in 2001 to facilitate peer-to-peer online file-sharing which soon became the most download computer app in the world. However, they soon discovered that there are clear borders in the cyberspace. According to the Hollywood-based entertainment industry they had violated some of these borders. The United States imposed its extraterritorial sovereignty in the cyberspace and Kazaa founders became fugitives of the US justice system. The case over different perception of borders was finally settled for 100 million dollars in 2006. Fortunately, Kazaa founders had just sold their other internet-border-testing venture called Skype to eBay for 2.6 billion dollars.

The internet clearly is not a borderless technology. The nature of its use and diffusion is clearly limited by geography, state sovereignty, economics, politics and numerous other factors. If the world would be flat and internet would be borderless, we would expect internet to be diffused evenly and its use to be uniform. Yet within the borders of developed countries internet is more diffused than among developing countries. In addition, among different countries of industrial world internet diffuses also with different speeds. This is quite revealing for at least two reason. First, it clearly indicates that internet is a global technology but its diffusion is not aspatial but spatial. As it reaches different countries in different points of time, then its diffusion is also not ahistorical but historical. It other words, history matters for how internet diffuses in time with different extensity and intensity in different locations. Second, if internet diffusion is dependent on historical, geographical, political, social and other factors, then it is important to understand how these factors enable and constrain the diffusion of the internet.

Understanding the relationship between internet diffusion and vast variety of social, political and economic factors has increasingly become a crucial issue as more and more societies rely on the internet for a wide range of interactions ranging from work to leisure. While there has been an increasing number of studies on internet diffusion which have used a variety of variables to explain diffusion, the specific contextual factors of internet diffusion is not well understood. Some scholars have emphasized the importance of national wealth. More income people have more likely can they afford to use internet and related technologies (Kiiski and Pohjola 2001; Kiiski and Pohjola 2002; Norris 2001; Beilock and Dimitrova 2003; Corrales and Westhoff 2006, 912). Other scholars have emphasized the role of institutions which are defined as rules of the game. Most scholars focus on what are called formal rules – laws and regulations of a country (Dasgupta et al 2001; Milner 2006; Guillen and Suarez 2005; Caselli and Coleman 2001). This is understandable because formal rules are easier to measure than informal rules such as social norms, expectations and culture. Some scholars have found that democracies have a greater rate of internet diffusion than authoritarian regimes (Milner 2006). This is not surprising because authoritarian governments often try to discourage their citizens from using internet for at least certain purposes and particularly for activities which may in some ways undermine the legitimacy of the government. However, other scholars have found that much more specific rules may matter for the diffusion of internet and related technologies. Particularly, how governments regulate telecom sector and how much competition they allow for offering various telecom services matters to a great deal (Dasgupta et al 2001; Guillen and Suarez 2005; Caselli and Coleman 2001).

Nevertheless, most of the studies focusing on income or formal institutions rely on a limited set of variables to study a large number of countries. Ultimately, it means that many factors that may matter for the diffusion of internet may be assumed away. However, countries with similar levels of wealth and fairly similar institutional settings may still have different levels of internet diffusion. This suggests that a country's internet diffusion is not an issue to be explained by a small number of country-level variables but there are important elements outside overly simplistic formalized models which must be considered. Indeed, studies focusing on a small number of cases usually come to the different conclusions on factors that matter for internet diffusion than studies based on large number of cases (Howard et al 2009). Partially, such outcome is dependent on research methods. Case studies allow incorporating more details and to draw a richer picture. If we think how internet diffusion is limited by borders, then it is not just easily measurable borders that matter. Mental and epistemic factors are much more difficult to grasp than political, economic, geographical and legal borders of countries. Hence, it is important to incorporate both literal and metaphorical borders into analysis. This dissertation aims to do that by describing what it calls a tacit web. The metaphor refers tacit knowledge which is important for understanding how internet diffuses in different countries and domains as well as tacit nature of internet diffusion where important factors behind diffusion process are not easily visible, measurable and comprehensible.

Central and Eastern European (CEE) countries are particularly illustrative in this perspective. They had socialist economic and political systems until 1991 albeit with some important differences. They all went through economic, political and social transition in the 1990s towards democracy, freer markets and greater social openness. The most advanced of these countries joined the European Union in 2004 and 2007. However, the rate of internet diffusion varies considerably in these countries. This outcome cannot be explained by national wealth because countries with similar level of wealth can have different outcomes in internet diffusion. They are all democracies. The formal institutional framework of these countries is fairly similar as they all had to adopt the EU laws and regulations. To be clear, they have adopted also EU regulations in the telecom sector, which some scholars emphasize as important variable in explaining the diffusion of internet and related technologies. In order to understand differences in internet diffusion rates among these countries, I will undertake a more nuanced and detailed study of Estonia and Slovenia as well as seven specific cases within Estonia to characterize the processes behind internet diffusion.

This exploration contributes to our broader understanding of technology diffusion in general and to political science and political economy research on internet diffusion in particular. The internet is a relatively new technology making it an understudied topic in the broader systematic context of research concerning technology diffusion.

1.2 Statement of the Problem

This dissertation focuses on specific country level cases and cases within country in order to understand processes behind internet diffusion. I describe both country-level characteristics of internet diffusion in Estonia and Slovenia as well as specific processes in Estonia. Therefore, this dissertation has three research questions. The first question of this dissertation is the following: *How do Estonia and Slovenia differ in the outcomes of internet diffusion?*

Internet diffusion is understood in this study as a process indicating increased adoption and use of digital network technologies by growing numbers of people in their daily lives. Internet diffusion is understood both as a macro and a micro process in this study. Diffusion is usually seen how innovation spreads from its source to a wider public. Micro process of how individuals and firms adopt internet is also seen as part of diffusion process in this study. Essentially, macro and micro processes interact and are mutually interdependent. Macro process means diffusion of internet to a wider public while micro process means adoption of internet by individuals and groups of individuals such as companies.[1] Furthermore, this research offers methodologically sound conceptualization of the internet diffusion, which utilizes more sophisticated approach to the measurement of the internet diffusion than it is standard in the literature. This is vital for advancing our understanding of diffusion outcomes and processes behind, which is still limited due to weak conceptualization and measurement errors. Particularly, as the reliance by scholars on different non-correlated dependent variables has led to different causal explanations. This dissertation will measure internet diffusion by eleven different variables focusing on extensity and intensity of its diffusion instead of single datasets that dominate in most studies. The study tries to capture what Kitsing and Howard (2009) called "effective internet diffusion", not formal internet diffusion. Chapters Three and Four will discuss internet diffusion and its measurement in both conceptual and theoretical terms.

The second research question of this dissertation is the following: *How have the entrepreneurial discovery processes and internet diffusion intertwined in Estonia?* Entrepreneurial discovery process is understood as a combination of Schumpeterian and smart

[1] Appendix A offers definition and discussion of key terms and concepts used in this paper. Both Chapters Two and Three also discuss key concepts in a greater detail.

specialization scholars’ approaches (Schumpeter 1975; Foray, 2015; McCann and Ortega-Argiles 2013; 2014). An entrepreneur is a risk-taker and innovator who breaks routines by adopting new processes and bringing new products and services to the market. However, such entrepreneurs do not operate only in private sector but also in public and non-profit sectors. This means also involvement of entrepreneurs in policy-design as well as use of creation of entrepreneurs in public sector and vice-versa. Chapter Two offers theoretical discussion of entrepreneurial discovery process. Chapters Five and Six apply the concept in empirical analysis.

The third research question of this dissertation is the following: *How has institutional complexity constrained entrepreneurial discovery processes and internet diffusion in Estonia?* Institutional complexity is understood as interactions of formal and informal institutions as well as interactions of formal institutions on different levels of government regulations. Different institutions, their interactions, conflicts and institutional logics behind these institutions creates institutional complexity (Greenwood et al. 2011; Room 2011; Smets et al., 2012; Thornton et al. 2012). The regulations of European Union may conflict with domestic government regulations or they may be against informal rules based on attitudes and expectations of people. Macroeconomic framework may conflict with government regulation on a micro level. Communities may not respect micro-level government rules because they conflict with their social norms. Chapter Two will discuss institutional complexity theoretically while Chapter Six will apply this concept to specific cases.

1.3 Scope of the Study

The research aims to connect a broad institutional perspectives and theories on entrepreneurial discovery process with the literature on technology diffusion. The dissertation argues that institutions and the entrepreneurial discovery process are crucial in understanding different outcomes of the internet diffusion. To add precision to the concept of institutions, the study factors in the interactions between informal and formal institutions. It explores how different institutions encourage greater social, economic and political use of the internet and how it is essential for understanding the spread of internet in local environments. This approach examines how institutions and entrepreneurial discovery processes facilitate spread of tacit and dispersed knowledge, which, in turn, facilitate internet diffusion. The technical aspects and transferable knowledge - which make the Internet seemingly global - represent only the tip of the iceberg in explaining the intensity and extensity of diffusion. My goal is to characterize complexity and heterogeneity in the internet diffusion process on the basis of case studies. I am convinced that such approach is more meaningful in understanding internet diffusion on the ground than overly deterministic studies based on assumptions of linearity. Obviously, my study comes with important limitations.

This dissertation research is explicitly descriptive and particularist. By descriptive I mean that I describe internet diffusion on basis of comparison between two countries and cases within one country. I do not make any causal claims. That's why research questions start with "how", and not "why". The use of "why" would imply causal inference and making if-then claims. By particularist I mean that I do not aim to generalize my findings for a larger population. I do not claim that Estonia and Slovenia are representative of all CEE countries or European countries. I also do not claim that seven cases within Estonia are representative of a broader set of cases outside of Estonia. Actually, I think that some of the cases such as narratives in Chapter Five on Skype, internet banking, internet voting and ID card are unique. Other cases in Chapter Six may bear closer resemblance to a broader population. Essentially, my aim is to explore some of these context-specific country differences through comparison of two countries and comparison of cases within one country.

I start by analyzing internet diffusion in Estonia and Slovenia, two countries in Central and Eastern Europe that joined the European Union in 2004. This comparative study focuses on particular critical junctures in their development, which is crucial in understanding the variance in the internet diffusion between two countries. I have chosen Estonia and Slovenia as cases from 1991 to present for country-level comparison because they offer high degree of comparability. In addition to the factors that I pointed out above which make CEE countries similar to each other, Estonia and Slovenia are both small countries with populations 1.3 and 2 million respectively and they are geographically, economically and culturally close to economically more advanced Western European countries. They are also most advanced in terms of ICT developments. In the early 2000s they were relatively similar in the diffusion of internet. However, Estonia has leaped ahead over time. Slovenia is also wealthier than Estonia, which rules out wealth as an explanatory variable for these differences. In other words, there are considerable similarities on a very general level, which allows focusing on particular institutional dimensions in understanding the differences between Estonia and Slovenia.[2]

The work on Estonia and Slovenia is a continuation of my earlier study, which emphasized the importance of economic openness for internet diffusion (Kitsing 2004). Meanwhile, significant time has passed which has re-enforced my view that economic openness is a crucial factor in explaining internet diffusion. At the same time, it is one factor among many and it is clearly not sufficient factor. Incorporation of newer and more comprehensive data allows offering a more detailed description of internet diffusion in Estonia and Slovenia in this dissertation.

The comparisons of Estonia and Slovenia will be followed by analysis of seven cases in Estonia. I have chosen cases within Estonia because Estonia is poorer than Slovenia and

[2] Appendix B offers an overview of Estonia and Slovenia.

~~has~~ had less sophisticated institutional frameworks in the 1990s and 2000s. Yet Estonia is a more advanced country in internet diffusion. Hence, case studies within Estonia allow to making a step further and offering an even more detailed study on how entrepreneurial discovery processes have been crucial for internet diffusion in some domains and how these processes have been constrained by institutional complexity in other domains.

I recognize that there are many variables that may influence outcomes in the internet diffusion. Essentially, internet diffusion outcomes are overdetermined. My aim is not to study all these variables and reveal their relative importance. My research methods do not allow me to do it because I use descriptive methods. However, I am focusing on how institutions and entrepreneurial discovery interact with internet diffusion and I aim to describe these processes. I realize that increased diffusion of internet has both advantages and disadvantages. The desired or undesired effects of the internet are certainly linked to the causes of its diffusion. However, my goal is not to make moral claims about the costs and benefits of diffusion but rather describe diffusion and related processes.

1.4 Summary of Chapters

The next chapter reviews literature on internet diffusion as well as political science and related literature on institutions. This synthesis of literature aims to demonstrate how institutionalist perspectives can be linked to a number of theoretical perspectives on innovation and diffusion of internet. It emphasizes the importance of epistemological nature of technology and role of tacit knowledge. It points out the necessity to look beyond formal institutions in researching internet diffusion. The chapter pays particular attention to institutional complexity combining both formal and informal institutions in understanding the technology diffusion processes. It highlights the interactions between entrepreneurial discovery processes and internet diffusion and reveals how institutional complexity constrains entrepreneurial discovery in different economic, political, social and geographic context from contributing to technology diffusion.

Chapter Three offers an overview of the research methodology, which incorporates discussion of conceptualization, use of variables and the measurement issues and rationale for case-selection and elite interviewing. It offers a critique of quantitative approaches relying on one or two measures of internet diffusion and limited number of explanatory variables, which cannot demonstrate the complexity of diffusion process. This chapter introduces the idea of index of “effective internet diffusion” and shows how this concept can be operationalized on the basis of 11 different indicators measuring network nature, sophistication of use and social distribution of internet. It highlights the benefits of thick description, which focuses on diffusion processes on the basis of a limited number of cases.

Chapter Four turns to comparative and descriptive analysis of Estonia and Slovenia. It focuses on outcomes of internet diffusion as measured by 11 variables in the last available year of data availability and change in outcomes over time. Estonia and Slovenia are compared on the basis of internet users per 100 inhabitants, households with internet access and broadband access at home, enterprises with broadband access, regular use of internet by males and females, by individuals with low formal education as well as by age. It also compares internet use by households in the areas with high and low population density as well as by income distribution. It further compares countries on the basis of supply side indicators such as broadband penetration rate, mobile broadband coverage and download and upload speed. This is followed by the discussion of national wealth and income distribution in Estonia and Slovenia. Then the chapter explores institutional framework in general and formal rules of the telecom sector in particular with the focus on reforms undertaken by both countries prior their membership in the EU. The chapter concludes by discussing human capital in the form of ICT skills in Estonia and Slovenia.

Chapter Five explores four positive cases within Estonia. It starts by discussing the emergence of Skype in order to demonstrate how open ecosystem and competitive telecom market facilitated new entrant, which quickly become a global player. The narrative on Skype aims to highlight a broad institutional framework governing businesses in Estonia as well as how entrepreneurial discovery process was unleashed in this post-socialist country. This is followed by discussion of how start-up retail banks introduced internet banking 1996, which essentially becomes a critical juncture in path-dependent process of encouraging internet use. Internet banking was not just about making banking transactions online but by providing secure online identification method it becomes a platform for offering various public and private sector online services. The chapter discusses the option to submit tax declarations online which was introduced by the Estonian Tax Authority in 2000.

This is followed by the case of national ID card which was introduced in 2002 to serve as identification method in online and offline environments. The chapter emphasizes the cooperation between two largest retail banks, two largest telecom companies and Estonian government as a fundamental factor in the success of ID card. It also emphasizes that ID card builds on the path-dependent process started by internet banking. Chapter Five concludes by discussion of internet voting in internet voting in Estonia from 2005 to 2015. It highlights the use of national ID card as mobile ID in the voting process as well as outcome of internet voting and its distributional impact.

Chapter Six explores three heterogeneous cases within Estonia in order to balance emphasis on agency in Chapter Five. It starts by challenging conventional wisdom on Estonian policy-making in the area of ICT which often sees Estonian policy design as homogeneous, centralized and smart. On basis of secondary data and interviews it characterizes Estonia as an average innovator and not particularly innovative in its policy design. It argues that Estonian approach to ICT policy has been relatively de-centralized and hands-off by focusing on general rule-making. This is followed by a case on network neutrality legislation in the context of 2009 EU telecom package. It shows how Estonian policy was heterogeneous by design and outcomes concerning network neutrality issues in spite of presence of powerful vested interests and considerable experience in telecom policy-making. The last case focuses on government venture capital, which has primarily benefited ICT companies. It shows how this government initiative has led to heterogeneous outcomes and straightforward policy failures in capturing positive externalities of innovation. Common theme to all cases in Chapter Six is a focus on institutional complexity as a constraint entrepreneurial discovery and how this leads to policy heterogeneity in various Estonian ICT policies and initiatives. Chapter Seven offers the discussion and conclusion of main findings, discusses the limitations of the dissertation, and offers recommendations for future research and highlights policy implications.

CHAPTER 2

ANTECEDENTS OF INTERNET DIFFUSION: FORMAL AND INFORMAL INSTITUTIONAL PERSPECTIVES

The purpose of this chapter is to discuss how scholars have understood and explained internet diffusion. What have been causal claims made in the literature about internet diffusion as well as descriptive accounts on diffusion of internet? In order to accomplish this goal this synthesis of literature draws from the scholarship in economics, economic history, economic geography, political economy, political science and public policy for understanding diverse set of explanations concerning the internet diffusion. This chapter uses the terms internet diffusion, penetration, adoption, connectivity, access, use and digital divide interchangeably to describe the same phenomena which is internet diffusion. Usually, internet diffusion is seen as macro phenomena (Dholakia et al 2004). While adoption is defined as a micro process where individuals make decisions about the use of internet. However, micro and macro processes interact. Often macro outcomes are simply aggregates of multiple micro processes. Adoption of internet by groups of individuals such as students or businesses in manufacturing sector, for instance, increases diffusion of internet on per capita basis on macro level.

Although the internet is now 20 years old, the research subject remains a relatively new phenomena and the literature available on the internet diffusion has still considerable gaps, then the chapter discusses perspectives on the diffusion of different information and related technologies with an assumption that these insights are applicable for understanding the internet diffusion. One of the main contributions of this literature review is to connect different theories in different branches of social sciences in order to understand better how internet diffuses in different countries. Scholars are often creatures of their habits in conducting research tend to rely on theories and methodological approaches that they feel comfortable with. This implies that theoretical explanations and methodological approaches applied to understanding internet diffusion have been limited in different scholarly domains. Over the years a specific literature on internet and electronic government has emerged. Nevertheless, this literature often lacks strong links to crucial theories in social sciences, which allows us to understand better important features of technology diffusion.

Bearing this in mind, this literature review and synthesis starts with linear and unidimensional accounts in offering causal inference for internet diffusion. Some scholars have found that income is key explanatory variable of internet diffusion (Kiiski and Pohjola 2002). Wealthier people and wealthier nations can afford to connect to internet and purchase necessary hardware and software while poorer nations and people can do it to a lesser extent. These wealth based accounts have been challenged by scholars who emphasize the institutions as explanatory variable for internet diffusion. Since most of these studies have relied on quantitative methods and a large sample of countries, then the concept of institutions have been operationalized in a reductionist fashion. Institutions are seen as formal institutions meaning formal rules of the game such as laws and regulations of a country. The concept is operationalized through the use of datasets showing whether a country is a democracy or not, has certain type of telecom regulation, is economically open or some other variable.

However, such reductionist approaches ignore institutional complexity as it is argued in the pages that follow. First, institutions are not just formal rules of the game but also include informal rules such as culture, informal networks, habits and so on. Both informal and formal institutions interact and impact outcomes. Second, focus on some formal institutions because they are easily measurable implies that method drives particular social science inquiry and determines the research question. It needs to be other way around. Third, reductionist approaches based large samples use a limited number of variables and assume that the relationship between variables is linear. As it is demonstrated in this chapter, technology diffuses in a non-linear way. Markets and government policies are characterized by non-linerarity as well. Thus, institutional complexity (defined precisely under key terms and in the following parts of this chapter) means interactions of formal and informal rules in a non-linear world characterized by path-depence and imperfections in markets as well as government policy.

In order to grasp the nature of institutional complexity and its interactions with agency, the chapter discusses literature on geography, international trade, smart specialization and entrepreneurial discovery to emphasize how technologies diffuse differently in different contexts. Trade openness and environments that encourage entrepreneurial discovery processes tend to encourage internet diffusion. At the same time, geographical location may enable or impose serious constraints how the diffusion of technology takes place. It also interacts with the entrepreneurial discovery process, which is important for bringing new technologies to markets and to governments. This chapter emphasizes the role of entrepreneur and their discovery processes as characterized by Schumpeter and more recent literature on smart specialization. It defines entrepreneurship more broadly including entrepreneurial discovery processes in private, public and non-governmental sector. The agency of entrepreneurs is important but as this chapter emphasizes they do not operate in a vacuum. The entrepreneurs face institutional complexity, an imperfect market and the network nature of internet as well as policy environments where path-dependencies on previous decisions may enable or constrain their ability to bring new technologies to the market. While there are many factors which may constrain agency, the chapter also draws from the literature on social capital and networks emphasizing the role of entrepreneurial networks and communities in overcoming constraints imposed by uncertainty and complexity of their external environment. This chapter’s aim is not to offer a deterministic and universal approach on how entrepreneurship and institutional framework interacts, but. rather, to emphasize the nuances and details which often tend to be overlooked in the studies of technology diffusion. The complexity and uncertainty in the diffusion process highlights a high degree of fragility. Galvanizing changes influencing internet diffusion are often spontaneous and not a result of some masterplan. It can be success without strategy (Kitsing 2011). The same institutional framework may produce both successes and failures in the diffusion processes. As Paul Pierson argues in his influential book on institutional analysis: "Every step and every movement of the multitude, even in what are termed enlightened ages, are made with equal blindness to the future; and nations stumble upon establishments, which are, indeed, the result of human action, but not the execution of any human design." (Pierson 2004, 102)

This points towards accidental nature of diffusion outcomes. The chapter concludes by emphasizing the importance of decentralized and tacit knowledge in understanding the internet diffusion. The success of internet diffusion is highly dependent on its nature as a decentralized network, which facilitates the use and exploitation of vast variety of related actors by diverse set of agents in different institutional environments. This chapter calls it "tacit web".

2.1 Income versus Institutions in Explaining Internet Diffusion

The main debate and key streams of theory and research regarding the internet and information technology diffusion can be summarized as emphasizing either the role of income or institutions. Institutions are rules of the game in society consisting both formal and informal rules (North 1990; 2005). Pierson says that they are "humanly devised constraints that shape human interaction" (Pierson 2004, 27). A more detailed definition will be offered in the following parts of this chapter. To start with income-based explanations, economists and other scholars have often taken a reductionist approach by looking at the relationship between relative prices at which Internet is supplied and demand for Internet by looking at per capita income. A standard microeconomics approach assumes that both supply and demand are equally crucial. The father of neoclassical microeconomics, Alfred Marshall, pointed out that supply and demand are like blades of scissors where it is hard to argue which blade is more important for cutting (Marshall 1920, Bk VI, Ch. II, 16). Individuals in richer countries may have more income for paying for the Internet connectivity and, thus, supply of Internet has to meet the demand. Whether Marshallian assumptions about supply and demand are correct will be discussed in a detailed way in this chapter.

Some studies have revealed a strong correlation between the rate of per capita internet diffusion and per capita gross domestic product (GDP) (Kiiski and Pohjola 2001; Kiiski and Pohjola 2002; Norris 2001; Beilock and Dimitrova 2003; Corrales and Westhoff 2006, 912).[3] Norris (2001) finds that the level of economic development is a crucial aspect in understanding the different outcomes in the internet diffusion. Howard et al (2009) argue that when scholars study technology diffusion in global and comparative setting, they find that economic productivity explains diffusion patterns. Productivity is directly related to income as countries with higher productivity levels have also higher income. Jorgensen et al (2008) have demonstrated how the use and diffusion of information and communication technologies (ICT) contributes to productivity growth. This may lead to circular reasoning where wealthier countries adopt ICTs and diffusion of internet and related technologies, in turn, increases their productivity, which increases their income and which in turn allows them to use more ICTs. In other words, studies using per capita GDP or other measures of income as explanatory variables for internet diffusion are able to establish correlation at best. True but the effect may be genuinely “self-reinforcing” as is often the case with economic development. It is difficult

[3] The synthesis of literature was first developed by Kitsing (2008) and Kitsing and Howard (2009), which demonstrated that such approached rely on a limited number of biased variables in explaining internet diffusion and proposed a concept of effective internet diffusion incorporating broader set of variables.

to entertain the possibility of causality on the basis of such models – even when their statistical analysis are robust. It can, however, be argued that internet diffused first in countries with high levels of productivity, and thus income, than in countries with low levels of productivity and income. Thus certain level of productivity and income are pre-condition for internet diffusion and it can be argued that correlation between internet diffusion and productivity equals causation because high productivity level existed before high level of internet diffusion. However, there is considerable scholarly literature on how the European Union, a relatively wealthy economic bloc with a high productivity in a comparative perspective, has not been able to utilize ICTs as well as the United States (Jorgenson 2001; 2008; Oliner 2007; Inklaar 2008). The failure of EU to turn ICTs into productivity gains indicates a possibility that the link between productivity and internet diffusion is not as automatic and linear as the studies discussed above suggest. Certainly, EU has also lower productivity than the US but it is still questionable that certain degree of productivity would translate automatically into certain degree of internet diffusion in a linear fashion. These insights have led to an emergence of literature on smart specialization in Europe, which will be discussed in a more detailed manner later in this chapter. Most importantly, we have to incorporate other variables, which may be crucial in explaining internet diffusion.

The focus of empirical part of this research is on comparison of Estonia and Slovenia and comparisons of different cases of internet use within Estonia. Since Slovenia has higher level of productivity and national income than Estonia, but internet diffusion per capita terms is greater in Estonia, then an interesting puzzle emerges. Most importantly, the literature which emphasizes the importance of national wealth and productivity in explaining internet diffusion cannot solve this puzzle. Hence, the literature review has too look beyond the studies on income, productivity and internet diffusion. The argument developed in empirical part cannot refute their findings entirely because it is based on case studies which are not generalizable for a wider population. However, theoretical part can demonstrate as a matter of logic their shortcomings. On one hand, the difference may stem from a level of analysis. In a highly abstract universe, where stylized analysis aims to explain internet diffusion for all or most countries in the world, wealth and income may seem important variables. In a messier, more detailed look on activities on the ground, different explanations emerge. As Howard et al (2009) point out studies on regional, national and subnational level find politics and culture to be main reasons for different internet diffusion outcomes. Certainly, the scale of analysis matters and a research about single or some case studies is not sufficient for rejecting hypotheses found in papers based on a large number of cases.

However, the difference in explanations is more fundamental and does not stem simply from the different levels of analysis. Scholars who emphasize the role of institutions in explaining the outcomes of internet diffusion have studied the diffusion by comparing a large number of countries in the world (Dasgupta et al 2001; Milner 2006; Guillen and Suarez 2005; Caselli and Coleman 2001). More conceptually, the institutionalist approach reveals both shortcomings of wealth based approached as well as technological determinist explanations. The former was discussed above. The latter claims that technology impacts society independently of institutional framework (Fountain 2001, 84). Technological determinists would see the spread of the Internet as the objective technology as sufficient for spreading openness or increasing productivity (Rogers 1995; Jensen 2007). The key difference between institutionalist approaches and income and technologically determinist views concerns constraints and enablers of internet diffusion. Income-based approaches would assume that main constraint for internet diffusion is income. As was explained above once higher level of income is achieved, it will correspond to higher level of internet diffusion. Technological determinism is idea that availability and changes in technology drives the development of society and its culture. Though most studies on internet diffusion and income are probabilistic rather than deterministic, it could be argued that technological determinism is directly linked to income and productivity as demonstrated above. More income leads to new and better technologies, which increases productivity, which in turn translates into more income.

Most importantly, these approaches assume institutions away or see institutions as by-products of technological economic processes. Institutionalist approaches see institutions as rules of the game, which facilitate diffusion of technologies. Availability of income and technology may be necessary but it is certainly not sufficient condition for diffusion of internet. The differences in internet diffusion outcomes are result of institutions because institutions increase or reduce transaction costs for diffusion in society. These institutions can be formal such as laws and regulations. For instance, in a telecom market dominated by monopoly with high prices and poor quality of internet connections, internet diffusion may be lower than countries with competitive markets, lower prices and superior quality of connections. As will be discussed below, many studies focusing on technology diffusion operationalize formal institutions because of data reliability and availability.

However, institutionalist approaches can be broadened by incorporating both formal and informal institutions. The latter is defined as social norms, culture and other nonformalized rules of the game shaping the behavior of agents. Thus, broader understanding of institutions-based approaches to internet diffusion, must incorporate earlier studies on technology diffusion, which highlight the role of institutions and organizations in “social shaping”, which impacts technology adoption (Mackay and Gillespie 1992). Economic historian Joel Mokyr emphasizes the vitality of broader institutional environment by arguing that the importance of openness to new information and "exposure effects" to new knowledge as crucial elements for technology diffusion (Mokyr 1990, 186-190). Sociologist Manuel Castells argues on the basis of the empirical example of the Soviet Union that the politics of information control was a crucial barrier for diffusion of new technologies of information processing (Castells 2000, 35). The ICT threatened the power of the Soviet state, but by blocking the inflow of the new information technologies the Soviet state undermined its economic position in the world particularly in the times when the economies around the globe became more information-based than ever before (Castells 2000, 35-37).

As far as internet and openness is concerned, then Beilock and Dimitrova's (2003) statistical study found that openness of a society was strongly correlated with outcomes in the internet diffusion. They defined openness as a non-economic factor. Openess was important in their study in addition to the level of infrastructure development and national income. Guillen and Suarez (2005) how, using data about 121 countries from 1997 through 2001, that democracies tend to have higher levels of internet use. Corrales and Westhoff (2006) have confirmed this finding by providing evidence that authoritarian regimes tend to have lower levels of internet diffusion than democracies. They also found that per capita income in authoritarian countries is be more important explanatory variable than it is in democratic countries (Corrales and Westhoff 2006, 912). In other words, open political institutions serve to some extent as substitutes for the level of per capita GDP. An authoritarian country with same level of wealth as a democratic country cannot expect to have same level of internet diffusion. In order to achieve the same level of internet diffusion as democracy, the authoritarian country either has to increase its wealth or become more democratic.

This is consistent with earlier finding by Przeworski et al (2000) that "democracies benefit more from technical progress and use labor more effectively" than dictatorships (p. 153). Democracies with per capita income more than $2500-3000 use labor more productively than dictatorships in the same level of development (Przeworski et al 2000, 166-176). Along the same lines, Milner (2006) researches 184 countries and finds that on the average democracies have higher levels of internet diffusion than autocratic countries. Milner's findings confirm that political institutions are important in understanding internet diffusion.

As was highlighted in the introductory part of this chapter, institutions are rules of the game and incorporate both informal and formal rules. However, Milner’s explanatory variables are narrow, focusing on one set of formal institutions, and she takes a rationalistic view of institutions by arguing that

> “…political institutions in particular matter for the adoption of new technologies because they affect the manner and degree to which winners and losers from the technology can translate their preferences into influence. Groups that believe they will lose from the Internet try to use political institutions to enact policies that block the spread of the Internet. These “losers” hope to slow down or stop its diffusion, and some institutions make this easier to do than others.” (Milner 2006)

Obviously, authoritarian governments are more eager to limit the use of internet and related technologies. For instance, the use of Facebook is not possible in China. By doing so, they also minimize its diffusion. Even though, Milner’s (2006) findings support that democracies are better in adoption than authoritarian regimes, the question remains what explains the differences among democracies. If all cases to be studied would be democracies, then political regime type is not necessary and sufficient condition for explaining different diffusion patterns.

The importance of institutions in comparison with income has been confirmed by scholars studying specific institutions and policies affecting access to telecom services. Access to telephone services is comparable to access to internet because one of the pre-conditions for internet use is existence of basic telecom infrastructure. In the early years most internet users needed a telephone line to use dial-up service to internet. Even in the technologically advanced such as the United States, 3 percent of the adult population still used dial-up service in their homes in 2013 while 30 percent of adult Americans did so in 2004 (Pew Research Center 2013). In 2004, 21 percent of Estonian households with internet access used dial-up connection while 53 percent of European households did the same (Eurostat 2015). Most importantly, the literature on rules governing telecom sector and telecom policies brings in richer understanding of institutions than simple democracy-authoritarianism dichotomy as discussed by Milner (2006) would suggest. Dasgupta et al (2001) carried out an econometric analysis and argue that differences in income among countries cannot be an explanatory variable for understanding internet diffusion. They argue that internet diffusion is linked to availability of main telephone lines and countries with lower levels of main telephone lines also have lower levels of internet diffusion. As was pointed out above, this may be particularly true in 2001 when the study was completed because vast majority of internet users used dial-up connection. Dasgupta and others go in their paper to demonstrate that state competition policies are an important explanatory variable in understanding internet diffusion. Low-income countries with high World Bank ratings for competition policy have a significantly higher number of internet subscriptions per main telephone lines (Dasgupta et al 2001, 15). The importance of competition for explaining the diffusion of technologies in sync with studies on telecom regulation by Heimler (2000) and Taylor (2002). Similarly, Fink et al (2003) researched 86 developing countries and their econometric analysis shows that complete telecom liberalization pays off by increasing teledensity by 8 percent (Fink et al 2003, 99). By teledensity they mean the main telephone lines in per capita terms. Along the same lines, Guillen and Suarez (2005) demonstrate that one important factor contributing to the internet diffusion is privatization and competition in the telecom sector.

Furthermore, as personal computers used to be the main method for connecting to the internet and still are an important devices in this respect, then internet diffusion is linked to the adoption of computers. As John Gage, a co-founder of Sun Microsystems, once said “the network is the computer” (Gapper 2007, 11; Weber 2004, 7). Caselli and Coleman (2001) show that the size of government reduces the adoption of computers while smaller size of government encourages the adoption of computers. They also found that sound property-rights protection encourages the adoption of computers.

These findings emphasizing the role of competition and extent of government intervention can be linked to an underlying theme in trade policy literature, which holds that trade protectionism, i.e. reduction of competition and increase in government intervention, reduces the benefits of technology transfer for small countries (Besley and Case 1993; Dollar 1993, 434). Trade protectionism decreases adoption incentives created by network, market power and learning externalities (Besley and Case 1993, 399). The connection between rules governing international trade and internet diffusion will be explored further in this literature review.

This set of literature discussed above highlighted some key findings of the literature on internet and related information technology diffusion. The first question is whether institutions or national income matter more for explaining the outcome in internet diffusion. The discussion above demonstrated how institutions can possible be a more powerful explanatory variable than income, particularly when comparisons are made on the basis of small sample of countries and various institutions are considered. The second question is what type of institutions are more important than others in understanding how internet diffuses in different countries. This will be explored in the next parts of this chapter.

2.2 Institutional Complexity

The common denominator of the studies discussed above is their reliance on factors that are easily measurable. Variables such as GDP, democracy, size of government and some other "thin" measure of tangible resources and easily identifiable "institutions". The reality, of course, is profoundly "thicker" than any number crunching on the basis of these datasets would reveal. The studies may establish correlations and tell us something that happens on the average in the world but at best the contribution to the understanding of Internet diffusion they provide is extremely limited. Particularly, as they do not incorporate the insights of earlier studies on technology diffusion which emphasize social shaping, specific context and informal factors in understanding technology diffusion. Most importantly, quantitative approaches using a few variables may not result in improving our understanding of how internet actually diffuses on the ground. For instance, if we learn that higher GDP or democracy improves internet diffusion, then it cannot explain differences in internet diffusion outcomes among democratic countries with relatively high GDP. Even the data that is collected on the use of internet carries very different meanings, but in spite of that the thinness of the approach implies that it may still represent one and the same data point in the quantitative analysis. In other words, the quality of Internet connection may vary so significantly in different countries that the use in country carries completely different meaning from the use in other country. For instance, many wifi users may have experienced a situation in various setting where heavy use and high traffic volume slows down access for all users. Obviously, in that kind of situation it is difficult to carry out online bank transactions or make a skype call. At the same time, all users have internet connection and use the internet. In quantitative studies relying on large data sets low quality internet connection and high quality connection would often receive the same ranking or would be represented as a same data point. However, quality of connection would determine what is possible to achieve with the connection and hence, would impact extensity and intensity of diffusion. Therefore, the arguments about institutions and resources have to be much more detailed in explaining the patterns of diffusion than quantitative studies analyzing large number of countries would accommodate. A Ookla speedtest in 2014 found that Hong Kong at 72.49 Mbps has highest average download speeds in the world while the US was 31st at 20.77 Mbps which is slower than in Estonia and Slovenia (Ookla 2014). Low internet speeds mean that it is more difficult to carry out complex transaction online and hence limits the use of internet. Obviously, the Ookla speedtest is not a perfect measure because it is an aggregated country measure, which takes into account rural areas. Internet adoption in some degree is dependent on geography and topography and cost to put in infrastructure lines. Nevertheless, these are the choices that policy-makers have to make either by encouraging private infrastructure investment in remote areas or intervening directly. However, most studies focusing on internet diffusion overlook these important details. This small but important detail has direct connection to the rules of the game, i.e. how sector is regulates and what kind of leverage belongs to service providers. In others, words there are many different rules that influence internet diffusion. These rules are complex.

Therefore, institutional complexity behind adoption cannot be reduced to the variables such as whether country has had their free elections or what is its ranking in some index measuring political freedoms. Particularly, as the collection and demonstration of data in these indices itself is highly questionable. Such reductionism in treatment of institutions ignores the interactions between informal and formal institutions, context specific factors such as physical and topographic barriers, interlinkages with ideas and path dependencies on early decisions. So what is meant by institutional complexity in this dissertation? The working definition refers to the interactions of formal and informal institutions as well as interactions of formal institutions on different levels of government regulations. This implies that broad rules governing macroeconomic environment may conflict with regulations on micro level. There is considerable literature on institutional complexity and one way to define it is "incompatible prescriptions from multiple institutional logics" (Greenwood et al. 2011, 317). Different institutions, their interactions, conflicts and institutional logics (see discussion below) create institutional complexity. Room (2011) offers a good overview of different approaches to institutionalism and incorporates institutionalist perspectives with that of complex adaptive systems as found in what is called "complexity science". The complexity science is developed to understand physical and biological processes where local interactions may lead to complex patterns on a global level through the positive feedback loops in selforganizing processes (Room 2011, 15-49). These scientific perspectives have been applied to a variety of social sciences and there has been expansion of such inquiries in the past decade but it has not generated considerable empirical enquiry yet (Room 2011, 9).

Usually, it can be assumed that greater institutional complexity implies greater constraints on agency. For instance, Pierson defines institutions as constraints rather than enablers by writing that institutions are "the rules of the game in a society or, more formally, the humanly devised *constraints* that shape human interaction" (Pierson 2004, 27). For instance, the convergence of national and international standards for professionals will lead to convergence of institutional logic of different polities (Pierson 2004, 138-139). This implies that the result may be "institutional isomorphism" because different institutional logics are in conflict with each other. Most importantly, institutions and institutional complexity do not have to be constraining. First, good institutions can reduce uncertainty, which encourages entrepreneurial activity. Second, some entrepreneurs and policy entrepreneurs may be well equipped for navigating in institutional complexity and achieving desired outcomes. They may benefit from complexity and it may create absolute or comparative advantages for them. It is possible for what Crouch (2005) calls "institutional entrepreneurs" to weave the international institutions into distinctive domestic patterns.

Institutional logic may stem from laws and regulations imposed by government in the case of formal institutions as well as socially constructed historical patterns of behavior, mental models of agents, habits, assumptions, expectations, values, culture and other rules, which may constrain or enable individuals and groups of individuals in their behavior and define social reality for them. Institutional logic may operate on community level as long as community members share the same beliefs. On a macro level, community may be a nation. Different nationalities may share the same beliefs about themselves and other nations. On a micro level, such abstract community as a nation may consist many different communities, which may follow different institutional logic. These communities may have different understanding of the same issue depending on their beliefs, knowledge and other factors (Smets et al., 2012; Thornton et al. 2012). For instance, nation as a community may be proud of IT developments in their country. They may experience the differences in quality and availability of services when spending time abroad or read about it in the newspapers. Within a nation IT community may also share the view about overall progress but may be more critical of recent developments finding that the government is not investing enough in IT development. Within the IT community an open source community may have a different view finding that government has overinvested in proprietary software solutions and should rely on open source solutions instead.

The notion of institutional complexity considerably broadens the possibilities how institutions may enable or hinder internet diffusions. The institutionalist explanation discussed earlier in this chapter has relied primarily on the approaches found in rational choice institutionalist literature in political science and new institutional economics literature. However, conceptualization of institutions as would benefit from recognition that there are three different accounts of institutionalisms in political science literature and integration of insights from rational choice, sociological and historical institutionalism (Hall and Taylor 1996). New institutionalist approaches in political science and economics have often focused on formal institutions (Hall 1984, 19-20; Streeck and Thelen 2005, 11) Subsequently, the institutionalism, particularly, its rational choice brand, has often been criticized that their minimalist definition of institutions does not capture the substance of activities taken by different actors (Wedeen 2002). Actors actual practices, their work habits, their norms of behavior, mental models, their self-imposed constraints, expectations and many other factors that influence their behavior are assumed away in formalistic approach to institutions.

However, this critique of overly rationalist and instrumentalist approaches does not imply that assumption of rational strategic interaction should be given up and institutionalist explanations for internet diffusion have to rely solely on social and historical context as the key determinant of outcomes. Rather, the conceptualization and operationalization of institutional variables would benefit in recognizing that rational action of actors is embedded in institutional structures and social context (Granovetter 1985). This is not to say that actors cannot make choices and their action is pre-determined but their rational action is more constrained by uncertainty, imperfect information and institutional complexity than the calculative approach to institutions would suggest. The nature of institutions can be significantly broadened by incorporating definitions found in historical and sociological institutionalist literature (Hall and Taylor 1996; Granovetter 1985). These insights are not new for political science as broad range of scholars combine rational choice, historical and sociological institutionalism in their studies. However, these different streams of institutionalism have not found sufficient attention on scholarship on internet diffusion. It is also an opportunity for the author to add historical and sociological perspectives his previous study on Estonia and Slovenia which focused primarily on rational choice and formalistic approach to institutions (Kitsing 2004).

Furthermore, this understanding of institutions is consistent with Douglas North’s relatively recent work (North 2005) where the role of informal institutions and mental models are emphasized in contrast with his earlier more rationalistic interpretation of institutions. North's earlier work on institutions also makes it clear that he is referring to both informal (habits, norms et al) and formal (laws, constitutions et al) institutions (North 1990). Institutions “…are in turn a function of the shared mental models and ideologies of the actors” (Denzau and North 1994, 15). North’s views have a resonance with the discussion above on institutional logic, where it was already pointed out that the operation of institutions may rely on belief systems. These beliefs may be translated into formal institutions at some point or they may be essential for maintaining informal rules of the game. As beliefs and ideas change, it also implies that institutional framework is dynamic over time. Certainly, the change in beliefs takes time and hence, it can be also constraining factor for institutional change. Most importantly, these interactions between ideas and institutions relate very well to the discussion of openness and epistemological nature of technology as important aspects affecting technology diffusion. However, such definitions by aiming to capture a broad range of phenomena that goes under institutions sacrifice precision and concreteness for universality and applicability to broad categories of social phenomena. Hence, the following synthesis of the literature suggest a number of abstract ideas from a vast institutionalist literature on how institutions, agents and technology interacts.

2.3 Trade, Geography and Entrepreneurial Discovery

In addition to more nuanced understanding of institutions, the dissertation seeks to incorporate broader perspectives on technology diffusion into the analysis. This would allow me to develop a more meaningful understanding of internet diffusion. Since the discussion of trade and its potential impact on technology diffusion was briefly mentioned above, the literature on technology and trade can be taken up again. Kitsing (2004) examined the effects of economic openness (defined as openness to trade and capital flows) on internet diffusion. However, international trade, increasingly, is not just about material goods but increasingly about diffusion of ideas. The fact that trade leads to non-material effects - causal relationships - that was already understood by Plato and Aristotle. These Greek philosophers made the case for restricting trade for various non-economic reasons associated with moral and civic dangers stemming from extensive contacts with foreigners that could make it difficult to ensure loyalty of citizens (Irwin 1997, 14-15). Most importantly, this non-material impact of trade is fundamental for technology diffusion (Lall 1993, 125). Technology diffusion depends both on importation of technical equipment and inflow of know-how, this in turn among other things contributes to increase of human capital (Caselli and Coleman 2001). These new adopted ideas mix with local already existing ideas by creating a new symbiosis. The relationship of international trade to the transmission of ideas and to increases in human capital is particularly important in the context of this study where both country cases are small open economies heavily dependent on trade.

It is also important because increasingly global trade is intra-industry trade within global value chains of large multinationals. Apple has made it blatantly clear letting all of its users know that Apple products are made in China but designed in California. As scholars have shown "makers" of Apple in China capture insignificant portion of value-added while most of the value-added in Apple products goes to designers in California (Linden et al 2009). This is so because they are in business of ideas and own the intellectual property. Even more detailed study on global value chain of Nokia revealed similar result where most of value-added is captured by intellectual property owners in Finland while final assembly of Nokia smartphone is activity with low value-added (Ali-Yrkkö et al 2011). For instance, on the basis of the supply chain's geography and the assembly volume, Finnish scholars estimated that service exports from Finland to China in 2007 resulting from the production of Nokia N95 smartphone were approximately €0.8 billion while official data showed that the total service trade across all industries from Finland to China was €0.6 billion in the same year (Ali-Yrkkö et al 2011).

These and other studies on global value chains and international trade have come to a conclusion that available trade statistics reveal little about the economic consequences of the increasing global dispersion of production processes. The globalization often means fragmentation of production across borders within supply chains of single multinational and it has exaggerated the growth of trade. The trade statistics tend to overemphasize the role of final assembly while actually the value-added of final assembly is miniscule. Furthermore, traditional data underrepresent the role of service exports, which is a crucial part of modern production networks. And services are intangibles and connected to epistemological nature of technology. Reliance on „commodity“ statistics does not allow to understand the importance of ideas and intellectual capital involved in trade.

What are the alternatives for improving our understanding of trade and thus interactions with diffusion of technology? As a start trade figures should produced using value added in each country, instead of including the value of intermediate imports. This would give a better picture of trends in globalisation of trade. The joint initiative of Organisation for Economic Cooperation and Development (OECD) and World Trade Organisation (WTO) called Trade in Value-Added (TiVA) addresses this issue by considering the value added by each country in the production of goods and services that are consumed worldwide. The TiVA indicators provide new insights into the commercial relations between nations. However, the data is relatively old, aggregated to level where it is difficult to see specific product categories and is distorted by transfer pricing. One component of value added is profit but because of profit shifting by multinationals and exploitation of transfer pricing schemes - where profits are booked in low tax jurisdiction - the actual value-added may be different from real value-added.

Alternative approach is taken by Hidalgo (2015) to demonstrate how different knowledge and know-how is embedded in different products. Hidalgo and his team have developed a database, which uses trade data to show how networks of knowledge evolve and grow by mapping a “product space” (the database is available at atlas.media.mit.edu). However, while the database might be useful for a broad global study involving multiple countries (The Observatory of Economic Complexity 2015), it is not as useful for conducting detailed case studies on two countries and sectors within countries. First, trade data comes with errors (for instance Russia was shown as more important trade partner for Estonia in 2012 than Sweden and Finland, which contradicts Eurostat and Statistical Office of Estonia.) Second, the entire product category ‘electronics’ was simplified as “telephones” for Estonia for 2012. Estonian electronics firms do not produce telephones or even mobile phones but more sophisticated technology such as Ericsson’s RBS family mobile stations. This RBS technology is important for creating mobile phone networks and allowing mobile phones to communicate with each other but it is certainly not a telephone.

However, Hidalgo’s emphasis on knowledge embedded in trade of different products as well as the literature on global value chains emphasizing the value-added of intellectual property in products is connected to the broader understanding that adoption of ideas is crucial for technology diffusion (Eaton and Kortum 1999, 563; Mokyr 1990; 186-190, Castells 2000, 35-37). In essence, the nature of technology is epistemological which means that diffusion and use of technology takes place within the social frameworks of knowledge. Our previous knowledge and beliefs affect how we use technology. At the same time, technological change affects how we think and our thinking about thinking. It is circular process but technological change does not have uniform impact. We perceive technology differently depending who we are. Braman (2012) see information policy as epistemology policy. She argues that epistemology affects perceptual entity, i.e. how we perceive technology, it affects how material and social world are experienced, translation of experiences into facts and which facts are discussed in social groups and lead to consensually understood truth (Braman 2012, 137). This means that the use of technical equipment differs in different contexts as has been pointed out by many scholars (Mokyr 1990, 186; Fountain 2001, 88-90, 98; Keller 2002, 138; Murmann and Homburg 2001, 203; Zanfei 2000, 527). For instance, it will be discussed in a more detailed manner later in the empirical part of the study greater proportion of Estonians use internet banking than Slovenians. Or we can experience it every day that younger generation tends to be more active users of social media than older generation. Keller argues, for instance, that language could be an important factor in understanding the emergence of clusters in technology diffusion (Keller 2002, 138). If this is true, then simple change of formal institutions (from authoritarian to democratic regime, for example) or increase in GDP does not necessarily translate into increased rate of technology diffusion. Of course, much of the internet-related technology and services are quite new and dynamic, so we don't know which ones will expand, nor do we know if they have a “life-cycle” both as services/products or for age cohorts. For example, will people continue to use social media as intensely as they age?

This literature on fragmentation of global production networks, embeddedness of knowledge in products and social frameworks of knowledge emphasize the importance of context. This context is linked to geography which matters greatly. Different geographic regions have different perceptions, experiences and knowledge about technologies. Technology is diffused among the clusters of countries – even if the technological knowledge has become more global. Porter (1998) has pointed out that location has maintained a key role and global economy essentially consists of clusters of related companies in different locations. The world is not flat. Internet does not diffuse on a basis of some universal model but its diffusion can vary greatly depending on specific knowledge embedded in different regions, the previous experiences, skills and perceptions of population and obviously geographical location of a region or country. This context specificity is often left out in the literature on electronic government and internet technologies as more linear and technologically determinist approaches dominate. There is often implicit or explicit assumption that particular models can be transferred to other countries and all cases are comparable which ultimately assumes away the importance of informal institutions and context-specificity, i.e. knowledge, experiences, perceptions and so on, in the diffusion process of internet and related technologies.

Therefore, the literature on internet diffusion and electronic government would benefit by carefully studying recent trends in the scholarship of innovation systems and management. In the 1990s, the innovation management and innovation systems literature tended to emphasize technocratic, universal one size fits all and top-down policy-orientated approaches in explaining the outcomes in innovation, including diffusion of innovations such as internet. During the past decade, a new set of studies has emerged from a wide range of disciplines, which emphasize the importance of location, entrepreneurial discovery and local context - such as embeddedness of specific knowledge, experiences and perception - in understanding innovation and its diffusion. This perspective emphasizes the importance of small and well educated entrepreneurial communities and local ecosystems of universities, firms and other types of organizations within which experts and entrepreneurs operate as key agents in bringing about changes in innovation and encouraging diffusion of technologies (Saxenian 1994; 2006; Feldman, Francis, and Bercovitz 2005). Similar notions may be conceptualized differently as startup communities (Feld 2012) or creative classes (Florida 2005), but the key to all of them is the process of entrepreneurial discovery in explaining diffusion of technologies such as internet as well as broader outcomes in innovation. These approaches emphasize the role of entrepreneurs and their agency in ecosystems and deemphasize the role of old-fashioned top-down national or regional public policy in shaping diffusion of technologies. This does not imply that institutional frameworks do not matter. Quite the opposite. Top-down public policies attribute too much to the ability of government by changing the formal rules of the game to achieve desired outcomes in technology diffusion. More recent approaches highlighted above actually emphasize the importance of informal institutions in the emergence of ecosystems, which facilitate diffusion of technologies. Smart specialization scholars are skeptical of government's ability to pick a completely a domain in economy and turn it into high-tech success unless these domain is already embedded in real economy and/or it is built of different domains embedded in the current economic structures. As smart specialization literature is essential to these debates, then next part of the chapter will explore in a greater detail.

2.4 Smart Specialization

Shifting to a related line of research, the process of entrepreneurial discovery is central as well to the emerging focus on "smart specialization", which has not only shaped academic deliberations but policy making in the European Union (Foray, 2015; McCann and Ortega-Argiles 2013; 2014; European Commission 2012). This stream of research emerged on the basis of scholarly accounts which studied the productivity differences between European Union (EU) and the Unites States. The key finding was that technology diffusion and use are crucial variables in explaining the "productivity gap" between the United States and Europe. The productivity differences exist and are growing because EU countries have been slower than the US in adopting and using new technologies, particularly ICTs such as internet. The ideas from smart specialization literature will be explored in the empirical part on the basis of different domains in Estonia. However, as the empirical part is descriptive, then the predictive power of these ideas will not be tested.

The approach of smart specialization literature differs from traditional technology and innovation policy literature which emphasize the need to develop high-tech sectors such as ICT and biotechnology. Foray (2015) and McCann and Ortega Argiles (2013; 2014) argue that regions not only have different technological and industrial capabilities but also differ in their evolutionary trajectories. This is essential for understanding internet diffusion because it reveals that diffusion may take different routes in different environments depending on local context and time. There is no one-size fits all model which is ahistorical and aspatial in explaining diffusion of the internet. It has strong links to ideas of new institutionalist in political science such as Pierson (2004) which have been highlighted throughout this chapter.

One of the most well known smart specialization scholars, Foray (2015), emphasizes that regions have to focus on their traditional strengths and competences and find domains where step-by-step innovation process allows develop new skills and knowledge for greater use of technologies, particularly ICTs. When we consider ICT sector, then Helsinki has strengths in online gaming (Angry Birds), London has strengths in financial services (Transferwise) and Stockholm has strengths in online music streaming (Spotify). It would make sense to develop similar companies in these locations in Europe. Alternatively, focus does not have to be ICT sector specific and ICTs can be as universal horizontal technologies applied to different sectors to make them more efficient. For instance, it could be exploitation of ICT in car manufacturing in Bavaria or production of bicycles in Northern Italy. Most importantly, the use of new technologies relies on exploiting them in domains where different countries and regions have already a comparative advantage. It is not a creation of new domains for economic activity in a top down fashion and attempt to transfer some supposedly universal model from one environment to another one without any consideration of differences in their respective ecosystems. Furthermore, the diffusion of knowledge and technology has to take place across different domains, activities and sectors, not only among a few high tech sectors. In this sense, diffusion of internet in financial services, for example, is not about focusing on ICT sector but making financial sector more efficient and customer friendly. This allows new technologies to be diffused and adopted widely across different sectors.

Traditional approach to innovation emphasized the role of research and development (R&D) but disconnect between R&D and entrepreneurial activity is one of the core problems in the EU (European Commission 2012). Instead of high level policy-making and scientific approaches to innovation, Foray stresses the importance of (2015) decentralized knowledge of entrepreneurs for developing new domains which can adopt and adapt ICTs as was discussed above. There are significant information asymmetries between policy-makers and entrepreneurs and policy has to rely on information gained through entrepreneurial process of discovery. According to McCann and Ortega-Argiles (2013) an entrepreneurial process of discovery allows identification of new domains for technological development. The degree of embeddedness and relatedness of domain increases the impact of innovation developments across different activities and sectors. It has to be pointed out that smart specialization literature defines entrepreneurs very broadly: public universities and research institutes can be entrepreneurial and part of the process. It is not impossible that policy makers can be entrepreneurial. Hence, there is some overlap with what Mazzucato (2011) calls "entrepreneurial state" but I am not making the same normative argument about considerable extension of state into different realms of economy. Quite the opposite, entrepreneurial discovery process in the public sector is a fact of life. However, if left uncontrolled it may become easily rent-seeking where the benefits are concentrated and privatized and costs are diffused and socialized. The understanding of entrepreneurial discovery process is also consistent what Room (2011) and Crouch call "institutional entrepreneurs". They are "creative political schemers, looking for chances to change and innovate" (Crouch 2005, 37).

Economic geography literature on the relationships among entrepreneurship, innovation, ICTs and geography can be summarized on basis of six stylized facts (McCann and Ortega 2013, 4). First, entrepreneurship and innovation tend to be more widely spread in more densely populated areas and cities than in regions with lower population density. Second, regions with greater sectorial diversity rather than regions where one or some sectors dominate tend to have higher degrees of innovation and entrepreneurship. Third, innovation and entrepreneurship tends to be lower in regions dominated by small number of large firms. Fourth, regions with internationally connected multinational companies tend to have higher degrees of innovation and entrepreneurship. Fifth, regions with greater market potential tend to have more innovation and entrepreneurship. Sixth, the diffusion of ICTs has increased differences among what is labelled core- and non-core regions. This is because ICTs are complements to knowledge-intensive activities which also require face-to-face interactions but they are substitutes for activities which can be routinized (the last idea is further discussed under social networks and capital). In other words, if greater adoption and adaption of ICTs was one of the main arguments for developing smart specialization concept, then in reality the diffusion of ICTs has increased differences between core and periphery (McCann and Ortega 2013, 4). Hence, public policies aimed at encouraging internet diffusion can be self-defeating if they do not factor in local informal institutions, knowledge, skills and geographical specificity and ensure that positive externalities of diffusion process is internalized by local actors rather than by outsiders.

The role of entrepreneurial discovery in contributing to the diffusion of innovations spatial and local context shares with the Schumpeterian understanding on innovation the emphasis on entrepreneurs. Let's recall the introduction to this chapter and emphasize that entrepreneurs do not operate only in private sector but they can also be found in public and non-governmental sectors. Even though, the emphasis in this research are often on cases in private sector such as financial services, then it must be pointed out that in some countries financial services are provided by government owned entities. For instance, the largest bank in Slovenia is owned by government. Furthermore, financial services and other business services have important social functions. Internet bank saves time and makes transactions more efficient for businesses but also for NGOs, individuals and government agencies. As was discussed in the introduction, the entrepreneurial discovery and entrepreneurs are defined more broadly in this dissertation than in the traditional Schumpeterian approach. Schumpeter's ideas and role of entrepreneurs in technology diffusion will be further discussed in the next part on supply and demand.

2.5 The Interactions of Supply and Demand

In order to understand the role of entrepreneurs in the process of internet diffusion we have to consider supply and demand for internet. At first this approach seems going backwards after discussion of formal and informal institutions, trade and spatial factors. However, the interactions of supply and demand is not just narrow and reductionist "economic" issue. The supply and demand for internet exists in marketplace but it also exists in government as well as in non-governmental sector. Hence, the discussion of information technology and its role in innovation above should be seen in the context of interactions of supply and demand. Most importantly, previously discussed broader perspectives on conceptualization of technology diffusion, where the importance of local context and epistemological nature of technology is revealed, is strengthened further by the asymmetrical relations between demand and supply in the process of technology diffusion. By analyzing the history of different cases of technology diffusion Mokyr argues that supply is more crucial than demand (Mokyr 1990, 152, 297). "The "demand" for technology is a derived demand, i.e., it depends ultimately on the demand for the goods and services that technology helps to produce; there is little or no demand for technology for its own sake," writes Mokyr (Mokyr 1990, 151). Logically, it follows that the internet is not necessary demanded for its own sake, but rather as a means for achieving whatever goals individuals may wish to pursue. In other words, there are many substitutes for the internet. Kitsing (2004; 2008) already pointed out asymmetry between hosts and users of internet. Hosts can be used as supply-side indicator. The term "internet hosts" refers to organizations or firms that have computers directly linked to the worldwide internet network. For instance, an Internet Service Provider (ISP) serves as host, and individuals can connect through the ISP host computer to the internet. However, hosts can have many internet users. Internet users are usually identified by calling up individuals and asking them whether they have used internet. This can be seen as demand side indicator. Both concepts are discussed in greater detail in the methodology section of this dissertation. However, as Kitsing (2004) as well as Kitsing (2008) and Kitsing and Howard (2009) have pointed out hosts and users do not correlate. Countries which have more internet hosts do not necessarily have more internet users and vice-versa.

The asymmetrical relations between supply (internet hosts) and demand (internet users) are very well revealed by looking at the data that Milner (2006) provides in her study of digital divide (although she does not explicitly point it out). Differently from many other scholars who either use hosts or users as their measure of internet diffusion in quantitative studies relying on a large sample, Milner uses both hosts and users. The asymmetry is demonstrated by the fact that hosts and users do not correlate very well as it is clear from tables that regime type has different influence on hosts and users (Milner 2006, 182). Her study was discussed in greater detail in earlier parts of this chapter. Therefore, the role of supply and demand for internet has to be analyzed on the basis of theories on diffusion of innovations. Innovation is not simply a new product or service or a process, but much more than that. It is one of the most important economic and social processes as the key to innovation is application of new product, service, process and/or idea in practice. Without application it would be just invention, not innovation. Well-known supply-side understanding of innovation emphasizing the role of entrepreneurs comes from Schumpeter (1975) who describes innovation as a process of "Industrial mutation (…) 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" (Schumpeter 1975, 83).

According to Schumpeter, the process of creative destruction is the source of innovation and the essential nature of competition. It is much more important than any other form of competition, for example, competition of prices or quality, as usually discussed in the economics. Schumpeter was well-known for his criticism of neoclassical microeconomics which its emphasis on marginal analysis and equilibrium between supply and demand. According to Schumpeter, neoclassical microeconomics was based on comparative static models, which failed to explain the change and emergence of profit. Marginal analysis demonstrated decreasing returns, which led to stationary state where profits disappeared. Schumpeter, however, argued that economy is in constant disequilibrium and analysis must not focus on equilibriums but how economy moves from one equilibrium to next one. Innovation through the process of creative destruction was key to understanding the economic change and emergence of profits.

The key actor in implementing the creative destruction in Schumpeter's theory is the entrepreneur. An entrepreneur is not an ordinary businessman. Actually, Schumpeter emphasizes differences between entrepreneurs and businessmen. Businessmen follow routines. Entrepreneurs break routines. They are true innovators who are always looking for new ways of doing things and new products. An entrepreneur is not a calculative economic man who engages in constant marginal analysis and calculates opportunity cost in every step. Constant calculation of costs and benefits would make it difficult for entrepreneurs to get out of the bed each morning. Rather, entrepreneur is akin to medieval knight whose motivations cannot be understood on the basis of simplistic marginalist analysis. This is not to say that his motives are completely irrational but rather that they are not rational in the narrow sense used in neoclassical economics. Entrepreneurs may be motivated by honor, need to do something, desire to put their ideas into practice and numerous other things that simplistic analysis of rational choice fail to account for. Ideas matter for Schumpeter. In a different essay, Schumpeter (1949) actually argues that ideology is a necessary pre-condition for scientific progress as ideologies generate ideas, which can be tested empirically. Schumpeter's emphasis on the role of entrepreneurs connects his insights on diffusion of innovation with those scholars discussed previously, who emphasize the importance of entrepreneurial discovery and decentralized contextual knowledge of entrepreneurs.

This dissertation relies on even broader definition of entrepreneurial discovery than identified by Schumpeter. One the one hand, it is Schumpeterian approach where entrepreneurs are risk-takers and innovators who find ways to break old routines and establish new ones. Entrepreneurs engage in constant process innovation as well as improve existing products and bring new products to the market place. On the other hand, the entrepreneurial discovery also includes what in smart specialization literature McCann and Ortega-Argiles (2013) call an entrepreneurial process of discovery (discussed in previous part). This process means in addition to Schumpeterian approach involvement of entrepreneurs in policy-making process and consideration of their insight in early stages of policy design, which allows identification of new domains for technological development as well as re-designing public policies through constant feedback mechanism between entrepreneurs and policy-makers. The involvement of entrepreneurs in policy-making concerning ICTs and other technologies is crucial because successful innovation policy has to be aware of developments in real economy. The degree of embeddedness and relatedness of domain increases the impact of innovation developments across different activities and sectors. It has to be pointed out that this dissertation relies smart specialization literature, which defines entrepreneurs very broadly: public universities and research institutes can be entrepreneurial and part of the process. It is not impossible that policy makers can be entrepreneurial. Hence, the entrepreneurial discovery is not only limited to private sector, but can also take place can also take place in public sector as well as in the non-governmental sector.

However, demand side must be considered as well. One of the key criticisms of Schumpeter's theory of innovation is that it does not take into account the demand side and similarly to Mokyr and the smart specialization literature emphasises supply. Schumpeter describes demand as having little importance for the development of innovations. He points out that innovations are not generally generated by the wants of consumers. Consumers do not have the ability to determine what goods are produced. Producers initiate the innovation process and bring about economic change. The consumers are then "taught" by the producers to desire the new products that they offer. As Henry Ford once supposedly said “If I had asked people what they wanted, they would have said faster horses” (Vlaskovits 2011). More recently, Steve Jobs has said that “It’s really hard to design products by focus groups. A lot of times, people don’t know what they want until you show it to them” (Ciotti 2013). Obviously, supply is necessary precondition for the initial introduction of innovation. No consumers asked in the 1950s for the internet. Rather it was result of work in several computer laboratories, which later led to its adoption and commercialization. Similarly, consumers did not demand internet banking in the 1990s. Rather, the supply of this service created demand, which depending on country can obviously vary, as we will see later in the empirical part of the dissertation.

However, supply is not sufficient pre-condition for the diffusion of innovation. To gain a more comprehensive picture on the role of the demand side in the innovation process needs to be considered. Rogers (1995) and his diffusion of innovations is most well-known take on demand side which was first published in 1962. However, the same idea presented more succinctly can be found in F.A. Hayek’s *Constitution of Liberty* published in 1960. Hayek describes the demand side as the determining force in the innovation process.

Due to the associated high cost, innovations are initially used only by a few wealthy consumers, as they benefit more from the innovation than other consumers. Luxuries today are necessities of tomorrow. Their special needs are better satisfied by new products or services, i.e. innovations. The consumption behaviour of these initial consumers serves as a test phase for the innovation. By experimenting with the innovation, the initial group of consumers assesses whether the innovation can in fact serve a wider range of consumers in the society. If these initial consumers consider an innovation useful or important, they will buy it. If the innovation fails to gain their favour, they will reject it by not buying it. Thus, the decision to buy or not to buy an innovation is a vote for or against it. This voting characteristic of the initial consumer's consumption behaviour steers the innovation process of the society in the direction favoured by these initial consumers. Obviously, consumers do not make these decisions in a vacuum but are influenced by choices of other consumers, imperfections of their knowledge, informal and formal institutions and may other factors. Hayekian understanding differs from neoclassical economics because he does not assume that markets are perfect and reach equilibrium but markets are imperfect. Hence, his theory is not necessarily in conflict with Schumpeter’s and other theories emphasizing supply side. Supply matters for bringing new innovations to market place such as internet banking. If the environmental factors, consumer tastes and thousands of other variables are favourable, then the innovation spread. Again, it is important to link back to literature to formal and informal institutions, geography and smart specialization and to emphasize that conditions governing supply and demand differ in different countries and thus rate of internet diffusion differs as well.

To simplify the innovation diffusion literature we can say that essentially there are different types of consumers. The first group are early adopters who may be wealthy or at least willing to spend a high cost on a given product. Cost here does not only refer to direct cost in dollar or euro terms, but also to opportunity cost of using new products. They have special needs and desires than can only be satisfied by the innovation. They are the “test drivers” of the innovation process. Their decision to buy or not to buy steers the innovation process in the direction they favorite way. They willing take risks and in a way they can entrepreneurial in their adoption of products. And there are laggards. They are not willing to spend a premium on a given product and/or they are risk-averse. Only have average needs and desires that are satisfied well enough by the existing products. They will only adopt an innovation once it became a mass product. Between laggards and early adopters are different groups some more and others less cautious in adopting new products.

Hayek (1960) overemphasized agency and income but for Rogers (1995) innovation itself, time, communication channels and social system are main variables in the diffusion process. Rogers’ work was based on summarizing earlier diffusion theories in sociology, some of them dating back to the 19th Century. Hence, the fact that similar ideas were covered by Hayek in 1960 is understandable. Key to successful diffusion was human capital and characteristics of different adopter groups such as innovators, early adopters, early majority, late majority and laggards. He distinguished between diffusion and adoption seeing the latter as an individual phenomena and latter a broader societal phenomena. In order to innovation to diffuse, a critical mass of adopters must emerge to make innovation self-sustainable. For Rogers (1995) perceived advantage is most important factor explaining innovation adoption. This implies studying relative advantage of innovation meaning whether consumers perceive the use of technology to be convenient. For instance, in the case of internet banking relative advantage can be whether internet banking gives consumers better overview of their finances as well as quicker access than offline banking. The perceived advantage also entails complexity and context of user. The lack of technological complexity implies that consumers find it easy to use internet banking, for instance, and it does not require sophisticated ICT skills.

Eriksson et al (2008) studied the adoption of internet banking in Estonia on the basis of Rogers' model. Ironically, they called internet-banking adoption of "Western style" technology forgetting that it was developed and introduced in Estonia in 1996 and is more widely used than in most Western countries. They found that adoption of internet banking is consistent with Rogers' theory and also with other empirical studies carried out in the Western markets. They found that the use of internet banking is strongly influenced by relative advantage and lack of technological complexity in Estonia. They also found that perceived risk (meaning trustworthiness of services and worries about security and data leakages) is an important factor influencing decision when consumers start using the service but its importance disappears once use becomes regular (Eriksson et al 2008, 164-165). Rogers (1995) did not identify perceived risk but it has been found to be important factor by scholars building on his work (Eriksson 2008). Eriksson et al (2008) also argue that their findings in Estonia are consistent with technology acceptance model developed by Davis et al (1989), which relied on the empirical analysis on the USA. The shortcoming of this study is that it does not factor in supply side and broader environment concerning internet banking. It does not answer to the questions on how and why banks started to offer this service and on how and why government started to build its own e-government services on top of internet banking.

Obviously, both supply and demand-side explanations of innovations can be integrated. In some sectors innovation is more supply-driven and other sectors more demand driven. As internet is general purpose technology it can be argued that innovation occurs because of the interactions between the supply and the demand side in a competitive situation. However, the interaction is not simultaneous. First, there must be supply which enables a select number of consumers or businesses have to experience the innovation. They simply may not know what to demand in the first place. Suppliers achieve temporary monopolies by bringing an innovation to the market. Because of the high monopoly price the innovation is at first consumed only by a limited number of consumers. They can pay the monopoly prices because they benefit more from consuming the innovation than the average consumer. For instance, Black et al (2001) found that users of online financial services have higher income and they are heavy users of internet (Eriksson et al 2008). Second, if the innovation proves to be successful, it becomes more widely distributed in the market. This motivates imitators to copy the innovation and to undercut the monopoly prices of the innovator. In effect, the price is further reduced and large parts of the society are able to consume the innovation. This in return motivates the innovators to come up with a new innovation, which again secures them the consumption done by the early adopters and the resulting monopoly profits.

The individual supplier relies on the process of entrepreneurial discovery and decentralized knowledge to experiment with new innovations in the market place. A wide disparity between consumers in the market contributes to the importance of a decentralized knowledge of entrepreneurs in searching and discovering new market segments for their innovation (Foray 2015; McCann and Ortega 2013). The suppliers have to consider the nature of market and think of potential reaction of consumers. For instance, scholars differentiate between radical and incremental innovation. It is a stylized fact that incremental innovations are more likely to diffuse than radical. Introduction of internet banking to consumers who have not used banking before would be radical innovation. Introduction of internet banking to users of banking services would be incremental innovation (Eriksson et al 2008, 157). However, the line between incremental and radical innovation is often blurred in reality. Furthermore, scholars differentiate between voluntary and involuntary innovation. Most private sector innovations are voluntary because transactions in the market place occur on the basis of mutual consent. Hence, internet banking is an example of voluntary innovation (Eriksson et al 2008, 157). Entrepreneurs in private sector cannot force anybody to adopt innovation. However, policy entrepreneurs in public sector can do it. For instance, Estonian government has made it almost impossible to file annual reports of companies by regular mail or in person. It must take place in government's business registry, which does not enable the uploading pdf or word files but requires the data to be filed into pre-existing forms. This is certainly involuntary innovation and it is possible to speak of "forced digitalization" (author's term), which will be explored further. Most innovation adoption models assume that innovation is voluntary, though.

Most importantly, the stylized fact that innovation process is likely to be the more efficient and productive if it is voluntary and incremental points towards assumption that innovation benefits from the utilization of decentralized and tacit knowledge (Hayek 1945). The development of an innovation by a central order, a single business or government or incumbent monopoly internet provider, can only draw from the limited amount of available knowledge. Even if it is highly scientific, it is not sufficient and under some conditions even necessary for introduction of innovation. Both kinds of knowledge, the scientific knowledge and the specific, decentralized knowledge are used to further accelerate the innovation process in society (Foray 2015; McCann and Ortega 2013). That's why smart specialization literature does not only emphasize scientific innovation but also knowledge-based innovation. Innovation does not have to be and is not always science based but it is always knowledge-based. If the innovation process also incorporates the specific, localized and tacit knowledge, it is likely to be more efficient. The specific, localized and tacit knowledge provides an assessment of the new innovation in practice – an assessment made under the specific circumstances under which each individual consumer or groups of consumers exploit it. However, to understand the interactions of supply and demand better and to spell out constraints on both consumers and entrepreneurs, we need to consider the network nature of internet and path-dependencies involved in diffusion process. The next part of this chapter will discuss these themes.

2.6 Network Good and Path-Dependency

The importance of informal and formal institutions, interaction of supply and demand and process of entrepreneurial discovery is reinforced further once the nature of the internet is understood. It is important to understand that the internet is not an independent good. This implies that the value of the internet is not determined solely by the connection at a particular speed. The internet is a network good. This means that the value of the internet depends on the network and on different technologies which are connected to this network. This is the case with internet as well as with many information technology goods (Harknett 2001, 242-246). The network good means that a value of a good for any given person is influenced by consumption choices made by other persons. This notion is grounded in basic microeconomics and study of externalities. In other words, there are externalities to being connected to certain classes of goods. The externalities are particularly important because internet is by nature a decentralized network, i.e. applications are hosted at the edge of the network by absolutely anyone. This means that internet is much less controllable than a smart network. In the case of smart network applications are hosted in the network's core amd usually by operator of the network (Icenberg 1998, 24-31). A typical example of a smart and centralized network is a telephone network. Even though, there are attempts to make internet more similar to smart network by various governments and other entities, in essence it remains a decentralized and stupid network.

Nevertheless, the simple assumptions of neoclassical microeconomics are not sufficient for understanding the network nature of internet. The increasing returns associated with the technology adoption and its subsequent use has led some scholars to see technology diffusion as a path-dependent process (Mokyr 1990, 163; Fountain 2001, 85; David 1985). What is meant by path-dependence? The concept is often used without explicit specification of causal mechanism involved in the process (Campbell 2010, 90). Political science literature emphasizes that actors gain increasing returns through feedback mechanism, which is consistent how they acted in the past. This locks in particular type of behavior. Another approach from sociology is less rationalistic and emphasizes that practices become institutionalized and they are taken as given by different agents involved. In other words, it becomes difficult to change particular models of behavior or traditions. Particularly, when they work or at least there is a perception that they work well. Comparative political economy literature on varieties of capitalism emphasizes institutional complementarity as a result of co-evolution of different institutions. This makes it difficult to change one institutions because it is tightly interconnected with other institutions (Campbell 2010, 90-92). This dissertation will combine these different casual mechanisms of path-dependence in the empirical part. However, it tends to emphasize non-rationalistic chance elements behind the path-dependent processes.

Most importantly, the outcomes for network-goods are often path-dependent and, thus, neoclassical model based on rational expectations is not helpful for analyzing the dynamics of the adoption process for eventual outcomes (Radner and Sundararajan 2005, 3). The path-dependent process can be understood as following:

> "A path-dependent sequence of economic changes is one of which important influences upon the eventual outcome can be exerted by temporally remote events, including happenings dominated by chance elements rather than systematic forces. Stochastic processes like that do not converge automatically to a fixed-point distribution of outcomes, and are called non-ergodic. In such circumstances "historical accidents" can neither be ignored, nor neatly quarantined for the purpose of economic analysis; the dynamic process itself takes on an essentially historical character."
> (David 1985, 332)

Most importantly, the notion of path-dependency violates the basic assumptions of microeconomics such as rationality because agents' choices are severely constrained in choosing particular technology. Idealized rational action in explaining the diffusion of new technologies implicitly assumes that over time and through some degree of trial and error the superior technologies will be chosen and used in increasingly better manner (Fountain 2001, 84). Milner's (2006) discussion of digital divide is a great example of such rationalistic understanding of technology adoption. Very narrow and overly rationalistic conceptualization of institutions is combined with oversimplified characterization of interests where potential losers block the Internet adoption, while winners facilitate it (Milner 2006, 178). Evidently, it implies that we are dealing with forward-looking rational agents who can predict the future risks and engage in cost-benefit analysis in determining whether they will be losers or winners as a result of technology adoption.

However, perfect rational calculation as articulated by neoclassical economics and rational choice literature in political science is not an option for agents facing constant change and a high degree of uncertainty, which is the case in the technology adoption. Most importantly, uncertainty and risk are fundamentally different (Keynes 1936; Knight 1921). Uncertainty implies that the role of rational calculation and bargaining based on consideration of risk is significantly reduced (March and Olsen 1998). If technology adoption would not be messy and path-dependent process and would lead to fixed point of distribution of outcomes, then "known unknowns" can play vital role and risks can be assessed and considered in the calculations of agents.

Nevertheless, non-ergodic process of technology adoption implies that accidental outcomes cannot be cancelled out. Particularly, as this process is rapidly changing and highly imperfect where chance may matter more than systematic forces, which implies that "unknown unknowns" dominate. The best we can do in light of uncertainty and constant change, we should see the rationality of agents in the adoption as highly "bounded" or "adaptive" (see Simon 1955 for the discussion of "bounded rationality" and Mueller 1986 for "adaptive rationality"). Furthermore, since the rational calculation does not provide a formula for action for agents faced with uncertainty, the agent will follow "the logic of appropriateness" instead of "the logic of consequences" that rationalist calculation would require (March and Olsen 1998). The role of mental models and ideologies of agents becomes essential in influencing the institutional change (Denzau and North 1994). And these changes in institutions can either encourage or discourage the ways technology is diffused. It is important to emphasize that these changes take place in specific time-frame. Pierson (2004) emphasizes the importance of temporal nature of institutional change which is often not captured by rationalistic approaches to path-dependency. He writes:

> "There will be other choice points, but the entrenchments of certain institutional arrangements obstruct an easy reversal of the initial choice. Perhaps the better metaphor is a tree, rather than a path. From the same trunk, there are many different branches and smaller branches. Although it is possible to turn around or to clamber from one to the other— and essential if the chosen branch dies— the branch on which a climber begins is the one she tends to follow." (Pierson 2004, 20)

Pierson (2004) connects temporal nature of institutional change also to the spatial nature of path-dependency, which is also emphasized by the smart specialization literature. Pierson argues that "If there is one single area of economics in which path dependence is unmistakable, it is in economic geography — the location of production in space" (Pierson 2004, 25).

Since new technology maybe represent more unknown unknowns than known unknowns by increasing uncertainty, bad decisions can be made (Fountain, 2001, 85). In other words, perceived losers and winners may get their cost-benefit analysis wrong. This assumption of rationality in individual behavior or in market as a whole implies that the actors are capable of understanding and learning of how technology adoption works and consequently encourage and/or discourage the process depending on their interests and how institutions may constrain these interests. The notion of “critical juncture” for the path-dependent process where all following actions are severely limited by some decision carried out long time ago is conceptually probably the best way how to think about the constraints on rational action. The examples of critical juncture can range from the adoption of QWERTY keyboard for typewriters to granting excessive privileges to telecom monopolies in countries such as Armenia and Latvia. The former locked in a particular type of keyboard that we use today. The latter increased the cost for spreading of internet connectivity. Path-dependence is not the same as inevitability. As Pierson emphasizes there are real alternatives available when choices are made. However, previous choices will affect outcomes and sequence of events (Pierson 2004, 20). Path-dependence does not rely on causal independence through time but it allows narrowing down the set of choices and show how decisions are linked through time (Pierson 2004, 52).

The path-dependency and imperfect bounded rationality challenges the assumption that actors will learn “right” lessons, which is basis for rational actor models (Fountain 2001, 85). Such assumption is not justified because actors may also learn the “wrong” lessons (Fountain 2001, 85). As Pierson emphasizes the outcomes are result of human action but do not result from human design (Pierson 2004, 102). Nye (1999) uses the term “path-insistence” to capture ideological and political insistence on specific policies regardless of rational criteria. His work concerns attitudes of Americans and Europeans towards energy issues but its certainly fits well with the importance of path-dependence in understanding technology diffusion. Manuel Castells (2000) gives example how Soviet Ministry of Electronics in copying American chips rounded the space of US chip leads from 1/10 inch to 0.25 millimeters instead of proper equivalent of 0.254 millimeters. As a result the Soviet chips looked like American but these chips did not fit into a Western socket. The Soviet semiconductor assembly equipment that was built as a result of this copying efforts was in the end not able to make chips that could be exported because the inherent desire to simplify of what seemed to the Soviet government officials as an unimportant aspect of chip design. As this mistake was covered quite late, then one bad decision contributed to the widening of technological gap between the West and the USSR (Castells 2000, 32). However rational the Soviet leaders might have been in promoting adoption of Western technology, they failed to learn what makes it work, which, in turn, had devastating consequences on the Soviet economy. Paul Roemer, an expert in the Soviet economy, echoes this view by arguing that the technological innovation so crucial for so-called intensive growth was insufficient in the Soviet Union (Roemer 1994, 44). The growth of the economies became more dependent on the adoption of new information technologies by the 1980s and, as a result, “the Soviet-type economies failed dismally” (Roemer 1994, 44). Innovation did not occur because there were no incentives to innovate without competition and no other mechanisms for innovation are available (Roemer 1994, 46).

To conclude, this synthesis highlighted network nature of internet where outcomes may be highly asymmetric and choices path-dependent rather than perfectly rational. This discussion brought out that agents in making critical decisions in the technology diffusion process are characterized by imperfect rationality and their decisions may be accidental but with long term consequences. Chance elements and critical historical events remotely connected to the outcome may matter more than rational calculation and choices. This again neatly fits into the previous discussion of entrepreneurial discovery process where learning through trial and error has emphasizes the asymmetry and non-linearity in the technology diffusion process.

2.7 Entrepreneurial Discovery and Social Networks

It is not just decentralized nature of Internet as a network which creates certain pre-conditions for its diffusion. Social capital and social networks of entrepreneurs, consumers and other agents affect its diffusion as well. These networks of social relations can be understood as institutions. Particularly, seeing networks of social relations as institutions, this project argues that studies on digital divide and internet diffusion would benefit by incorporating insights of social network theories into their models. That's why the title of the dissertation refers only to institutions and not to social capital and networks because it is assumed that the term institutions incorporates social capital and networks.

Interactions of formal and informal institutions are fundamental for understanding the emergence of particular type of network institutions in different localities. Ultimately, the institutional governance structure can be seen as network (Lazer 2005; Castells 2009). Lazer (2009) sees international system as a network. Castells argues that in the network societies power lies within networks and distinguishes among four types of power: networking power, network power, networked power and network-making power (Castells 2009, 42-47, 418-420). The network-making power is the ultimate form of power (Castells 2009, 47). This insight can be linked to the role of knowledge in these networks and specific social capital that they rely on.

The connection between information technologies and knowledge is usually made in the context of debates concerning information society and knowledge society (Servaes and Carpentier 2006). This synthesis shares the view that technology transformative role is dependent on knowledge embodied in people and on social, economic and political context of society (Servaes and Carpentier 2006, 5-6). However, the following parts take a more concrete approach by trying to highlight how knowledge, networks and social capital are vital factors in explaining the diffusion of technology.

The significance of ideas, epistemological nature of technology and informal institutions that this synthesis highlighted above can be linked to the importance of social capital and social networks. After all, networks connecting computers are ultimately social networks as they link individuals, groups, organizations, ideas (Wellman 2001). The internet should not be studied in isolation as merely technological network but as a social institution that is a part of every-day life (Wellman 2001). Wellman (2001) argues that the use of internet increases peoples social capital (Wellman 2001, 2032-2033). However, communities with higher levels of social capital may be more eager to adopt and use the internet in the first place. Indeed, scholars have found that establishing identity, trust, and group cohesion through social and cultural structures is essential for creating and sustaining productive virtual work groups (DeSanctis et al 2001; Kiesler and Cummings 2002; Neus 2001). More specifically, researchers have demonstrated that facilitating face-to-face meetings once in a while among the members of virtual teams is an important element in building social capital and purely virtual communities may result in low-trust environment (Maznevski and Choduba 2000; Nardi et al 2002; Ostrom and Ahn 2001, 33). In addition, virtual communities will increase social capital when they develop around physically based communities (Blanchard and Horan, 1998). If face-to-face meetings would not be important, then activities are not knowledge-intensive and information technology can be used as substitute for activities as smart specialization experts McCann and Ortega (2013a) pointed out. Activities that require internet as a complement require face-to-face meetings (McCann and Ortega 2013a, 4). This in turn builds social capital. For instance, venture capitalists are still clustered primarily in specific locations such as Silicon Valley which makes face-to-face meetings easier.

Nevertheless, the concept of social capital must be clarified in order to understand how it might or might not impact the internet diffusion. Traditional approach in the social sciences has seen social capital as an important aspect in understanding the well-being and vibrancy of a community (Putnam 1993, 2007; Costa .and Kahn 2004; Jacobs 1993; Schweik et al 2012). The concept of social capital is defined as trust among community members and is measured by mapping out the strength of ties among community members in considering their attendance in public meetings, participation in elections and group activities. Putnam writes that social capital "…refers to features of social organization, such as trust, norms, and networks that can improve efficiency of society by facilitating coordinated actions" (Putnam 1993, 167). Trust is based on expectation that agents will act in a particular way in a given situation. If this is not the case, then social sanctions will follow. Particularly, in voluntary and cooperative arrangements with low levels of formal institutionalization social capital can be seen as a substitute for formal institutions and their enforcements. In other words, social capital reduces transaction costs in situations where formal institutions cannot achieve this goal (Putnam 1993, 172; Pretty 2003, 1913; Schweik et al 2012, 69).

The literature on trust has identified that in commons settings, trust between participants is often created when participants engage in "reciprocal cooperation" situations (Axelrod, 1984; Putnam 1993, 172-173; Schweik et al 2012, 70). Reciprocity of transactions creates social capital. However, these reciprocal transactions does not have to be understood as market transactions because they are about social intangibles, not about money and material goods (Portes and Sensebrenner 1998, 130; Schweik et al 2012, 70). The key implication of the reciprocity in the context of social capital is that reciprocity does not have to be "balanced" or "specific" (Putnam 1993, 172). Reciprocity can be generalized or diffused (Putnam 1993, 172). And the generalized reicprocity can become embedded in the entire social network, which allows solving dilemmas of collective action (Putnam 1993, 172).

We should not understand the social norms that govern behavior in terms of narrow self-interest but their motivations can be nonconsequantialist (Knight and Ensminger 1998, 105). Individuals may follow social norms because it is appropriate thing to do in a given context. If participants in any undertaking have expectation that their trust won't be exploited, then cooperation is more likely to endure. Networks of interpersonal communication and exchange can be horizontal (agents are equivalent) or vertical (unequal agents and asymmetric relations) (Putnam 1993, 173). More horizontal networks should contribute to more successful outcomes – in this case technology diffusion. More hierarchical networks should be less successful (Putnam 1993). Saxenian (1994) found that horizontal social networks explain the success of Silicon Valley.

Usually social scientists have operationalized social capital by exploring at civic participation in Italy, phenomena of rotating credit agencies, voting turnout, attendance at public meetings membership in voluntary organization, tendency to get involved in group activities such as bowling and by various other measures that usually relate to physical attributes and geographic attributes of communities (Putnam 1993; 2007; Costa and Kahn 2003; Schweik et al 2012, 69). However, scholars studying high-tech clusters emphasize the trust does not have to come necessarily from having personal and family connection, living in the same neighborhood and/or having particular physical characteristics but it emerges as a result of reputation for performance in professional peer groups (Patton and Kenney 2003, 13). This approach is based on Coleman (1988) for whom social capital was defined by its function. Social capital consists a certain social structure and it accommodates actions of agents within the structure. Social capital is productive as are other forms of capital but it resides in the structure of relations, not within entities and human beings (Coleman, 1988). For example, on the basis of traditional understanding that emphasizes community life and civic engagement Silicon Valley seems to have very low levels of social capital as it is a world of strangers who primarily focus on their work. However, scholars have pointed out that the region has very high levels of social capital and its important factor in understanding its success (Patton and Kenney 2003, 4, 12; Fountain 1997; Saxenian 1994). This is so because “community is defined by the professional peer groups and not by physical neighborhood where one sleeps” (Patton and Kenney 2003, 4).

All of this literature highlighted above with emphasis on trust and reciprocal interactions, which obviously take time, implies that social capital leading to a more extensive and intensive use of internet is more likely than the use of internet leading to a creation of higher levels of social capital. One way how social capital can matter in the diffusion of technology is that scholars have found social capital to be an important factor in knowledge creation which facilitates technology diffusion. Ghosal and Nahapiet (1998) have found that social capital makes possible knowledge creation. They argue that more dense social capital creates “organizational advantage”. There have been a numerous studies showing importance of social capital for technology firms and military (Honig et al, 2006), in understanding business interactions in Silicon Valley(Castilla 2003), in call centers (Castilla 2005) as well as more general studies showing how social networks interact with markets and organizations (White 2002; Wasserman et al 1994; Eccles and Nohria 1992).

The literature on social capital and networks has a straightforward link to the international relations’ concept of “epistemic communities” (Haas 1992). Haas defines epistemic community as “a network of professionals with recognized expertise and competence in a particular domain and authoritative claim to policy-relevant knowledge within that domain or issue-area” (Haas 1992, 3). Members of an epistemic community may have different backgrounds and represent different disciplines but they share normative and principled beliefs, which helps to establish trust among the members of community. The density of social capital and affiliated social networks is thus affiliated with the emergence of epistemic communities, which may more or less connected to the international networks of experts. Even though the research question here is not an issue of international policy coordination, such communities may have direct links to IT groups and experts in different locations of the world and by including both experts from private and public sector form a network that transcends traditional relations of market and hierarchical organization. The explicit knowledge can be shared in these communities globally. However, the actual implementation on the ground depends on local and national institutions and tacit knowledge of local epistemic community. The existence of such epistemic community may be important for understanding why the internet has diffused in a particular location and not in other locations. Their authoritative claims to knowledge may have lead governments to follow their advice in reforming formal institutions – if the conditions are right. Essentially, as this implies, that study of the role of social networks of experts has to take into account mental models and ideologies of agents and whether they are shared widely or not this knowledge within their epistemic community. In the context of this project social capital, social networks and epistemic communities are seen broadly as institutions because they structure action of agents (more specifically it will be discussed under methodology section below). As these networks of knowledge-based experts with authoritative knowledge transcend traditional hierarchy of organizations and challenge the assumption of frictionless transactions in the market. If market would be frictionless and non-market hierarchies would set the course, then the role of social capital, networks and epistemic communities would be marginal at best.

In sum, the value of this literature allows exploring the importance of social capital and social networks in understanding the technology diffusion. Social capital creates trust and disseminates knowledge which have positive impact on the increased internet use. The existence of social networks among experts can accommodate the process of entrepreneurial discovery and affect diffusion process as well. This can happen through formal process as the involvement in policy-making or through more informal mechanisms.

2.8 From Tacit Knowledge to Tacit Web

The discussion of diffusion on innovations and epistemic communities and social capital already introduced distinction between explicit and tacit knowledge (see Hayek 1945 for discussion of tacit and dispersed knowledge). Following Hayek (1945), it is argued that most useful knowledge in society is dispersed and localized. Ultimate outcomes depend on local implementation and understanding of issues (Room 2011, 58). Particularly considering the institutional complexity that is potentially linked to the outcomes in the internet diffusion, it is easy to see how international and regional policy measures can lead to a diverse set of domestic outcomes. This is especially so because the internet is decentralized and unintelligent network, which leads to a proposition that its diffusion can be explained by the extent of tacit and dispersed knowledge found within the local entrepreneurial networks. By nature tacit knowledge is difficult to code which means that it cannot be shared and managed as explicit knowledge (Haldin-Herrgard 2000). Perception, language, time and distance create barriers for sharing tacit knowledge (Haldin-Herrgard 2000). Hence, such tacit and decentralized knowledge is best utilized through process of entrepreneurial discovery with emphasis on experiments and trial and error. For instance, in Estonian language and policy debates e-government is understood much more narrowly than in English – primarily meaning only the use of information technologies by the executive branch or in some cases even the cabinet. Obviously, this is not merely a linguistic difference but leads to a different emphasis on implementation, and thus, to the diffusion of technology within government.

Most importantly, the vital role of tacit and decentralized knowledge and entrepreneurial discovery implies that the existence of similar formal institutions may lead to different outcomes. If tacit knowledge matters for the spread of information technology, than any attempt at offering explanation and/or policy lessons must consider this possibility. Indeed, Castells and Himanen (2002) argue that there is no single model that countries can adopt and each country should follow its own path to "informational economy". This fits well with the smart specialization literature highlighted above which emphasizes different evolutionary trajectories (McCann and Ortega 2013; Foray 2015) Even in the European Union where the degree of harmonization of regulation related to information technologies is greater than in any other region in the world and all kind of EU-wide initiatives to encourage the use of information technologies have been launched, research on the European information society has pointed out that there is "no single road to the Information Society" because "different national authorities in Europe react differently to the plans of Brussels" (Servaes 2003, 27).

Even more radical interpretation is given by Drahos and Braithwaite (2003) suggest that we have entered into the area of "information feudalism". Of course, their approach is limited as they discuss intellectual property rights of information economy. In addition their understanding of medieval feudalism is narrow primarily focusing on relations between lords and serfs. They suggest that "the majority, the peasant serfs who had to work the land, had to live with the arbitrariness that absolute power brings" (Drahis with Braithwaite 2003, 3). "The redistribution of property rights in the case of information feudalism involves a transfer of knowledge assets from the intellectual commons into private hands" (Drahis with Braithwaite (2003, 3). Indeed, information economy is governed by medieval system but it is much more complex than the simple dichotomy between serfs and lords. In fact, medieval systems as the current information economy is really a non-system as there are multiple sources of authority with overlapping powers. This is not necessarily negative development. Zielonka (2006) has argued that new member states from Central Eastern Europe have faced much fuzzier constraints on implementing supposedly harmonized EU imposed regulations than the traditional uni-dimensional literature suggests.

More specifically, Tenbuecken (2006) demonstrates that the EU harmonized telecom regulation has produced quite different regulatory policies in different EU member states in Central and Eastern Europe which had much less flexibility in adopting the EU Telecom *Acquis* than their Western European counterparts. The general terms “liberalization”, “regulation”, “de-regulation”, “re-regulation”, and “independent regulator” imply distinct policies in different contexts (Tenbuecken 2006, 156-167, 200-239). These findings correspond well to the argument by Vogel (1996) that globalization of telecom markets does not lead to the convergence of international regulatory regimes but to different reactions in domestic regulatory regimes. Since one of the key findings in “formal” institutionalist literature was that telecom regulation is an important causal factor in explaining outcomes in the internet diffusion, then in order to avoid conceptual stretching regulation has to be studied carefully in different domestic contexts. Furthermore, it has to be understood in the context of institutional complexity and conflicting institutional logics which was highlighted earlier in this chapter. Policy heterogeneity highlighted by Vogel (1996) and Tenbuecken (2006) is closely linked with institutional complexity because institutional complexity reduces certainty and increases ambiguity. Room (2011) shows how policy diversity and heterogeneity emerges by connecting complexity science and institutionalist analysis. Knoepfel et al (2011) argue that if implementation of public policy falls under several ministries, or several departments within one ministry, then policy context is heterogeneous. If policy is implemented by one unit at the same ministry, then it is homogeneous. Nevertheless, it is difficult to imagine completely homogeneous policy context, particularly when we discuss interactions of EU and national institutions. Hence, it is a question of degree of heterogeneity and homogeneity. Relatively homogeneous policy by design may still result heterogeneous results. This may stem from unintended consequences, interactions of government regulations with informal rules as discussed under institutional complexity. It is similar to competitive heterogeneity affiliated by scholars such as Harold Demzets (1973) and Michael Porter (1980) in strategic management and industrial economics, which examines why industries do not converge on one single model of operations. In international economics policy heterogeneity is used to highlight regulatory differences between countries (Kox and Lejour 2005). However, there might be also regulatory differences within countries or among the group of countries such as EU as discussed Vogel (1996) and Tenbuecken (2006). It is a fact of life that regulations may conflict with each other and may be implemented differently by policymakers because of different institutional logics and path-dependencies.

To reiterate, the technical aspects and easily transferable knowledge play only small part in explaining the intensity and extensity of Internet diffusion because the epistemological nature of technology. Most importantly, the existence of tacit and dispersed knowledge interconnected with the density of social networks and entrepreneurial discovery. Entrepreneurial discovery in the broadest sense involving both public and private sector agents contribute to a broader *zeitgeist* concerning internet in given society. In this sense, the internet is really tacit as its diffusion and its use depends more tacit elements such as highly localized and dispersed knowledge, social capital and networks and informal rules of the game rather than on explicit knowledge and tangible factors. Thus, tacit web refers both to the nature of Internet as well as characteristics of entrepreneurial, social and institutional networks which impact its diffusion.

2.9 Summary

This discussion of technology diffusion and related literature, makes two suggestions. First, the research on digital divide and Internet diffusion would benefit by recognizing epistemological and network nature of the technology. Scholars can develop more nuanced arguments by incorporating insights from the broader accounts on diffusion of number of different technologies instead of relying solely on the literature on Internet diffusion. This is particularly valuable approach as the literature of Internet diffusion is new in the broader context of technology diffusion literature.

Second, scholarly explanations of Internet diffusion outcomes would benefit by moving beyond formal categories such as GDP and formal institutions. A more detailed approach to explanatory variables would give richer and more nuanced view of Internet diffusion. The discussion above focused on many different approaches found in social science literature to technology diffusion by highlighting how broadened concept of institutions, process of entrepreneurial discovery, social networks as well as path-dependence and tacit knowledge should be incorporated into the analysis. It particularly brought out the importance of intangible elements such as social capital and networks and tacit knowledge as important elements advancing understanding of the diffusion processes.

On the basis of this synthesis of literature, the chapter suggests to consider institutional complexity and entrepreneurial discovery in order to understand the different outcomes in internet diffusion rates. The interactions between formal institutions and informal institutions as well as path-dependence must be considered in understanding different outcomes in the internet diffusion. Differences in formal institutions may not explain the outcomes in the Internet diffusion. Informal institutions which include habits, norms of behavior, social capital, networks and many other factors which have been discussed in length above have may offer better explanatory variables. Internet diffusion has to be studied as a path-dependent process where the development of particular diffusion process can be traced back to a critical juncture. In the internet diffusion process both supply and demand matter even though their interaction may be asymmetric in different periods of diffusion process, i.e. in the beginning it may be more supply driven and in the mature phase more demand driven. Social capital and networks facilitate the process of entrepreneurial discovery which utilizes of localized and dispersed specific tacit knowledge. This process can be more fundamental for extensity and intensity of Internet diffusion than relying on top-down social engineering and explicit scientific knowledge. In the end, both scientific and tacit knowledge may matter but under certain conditions tacit knowledge is both necessary and sufficient for technology diffusion in a given country because the diffusion of technology does not require a domestic science base. Nevertheless, the domestic science can contribute further to the diffusion under certain circumstances. The next part aims to take the core ideas into more concrete level by outlining research methods. It starts by the overview of the conceptualization and the measurement. This is followed by discussion of the rationale for case selection.

CHAPTER 3

METHODOLOGICAL ISSUES AND RESEARCH METHODS

This chapter will offer an overview of key methodological issues concerning the conceptualization and measurement of internet diffusion and will conclude by discussing the research methods applied in the dissertation. The research strategy is based on descriptive and comparative approaches comparing cases. Essentially, it combines explanatory, descriptive and multiple-case study methods. First, comparison of cases focuses on variance between internet diffusion processes in two countries with an aim to offer a "thick description". Second, it will describe different initiatives and processes within one country. Essentially, it uses different units of analysis in different chapters. Chapter Four will be a macro-level comparative study of two nation-states. Chapters Five and Six undertake a deeper, analysis of the initiatives and processes taking place within one country, Estonia, and explore how these processes are linked with macro level processes in Chapter Four.

This approach will provide more detailed and nuanced insights into the internet diffusion process that cannot be captured by survey research and quanitative approaches. Quantitative approaches often claim to establish a causality between different variables in explaining the diffusion. This dissertation will not make any causal claims but limits itself to the explanation and description of rules and processes that have facilitated internet diffusion. It also insists that previous studies have not been able to establish actual causality because of the lack of sufficient counterfactuals and overdetermination as well as weak conceptualization and operationalization of concepts such as internet diffusion. Hence, the explanatory and descriptive nature of the dissertation is purposefully self-imposed by suggesting that scholars studying internet diffusion pretend to claim causality on the basis of reductionist approaches, which ignore non-linearity and complexity of diffusion process. This disserstation aims to celebrate complexity and particularities of internet diffusion processes. It emphasizes details that are often overlooked by reductionist approaches. In order to understand the shorthcomings of more quantitative studies, and the benefits of this "thick description," I will start by discussing the concept formation and measurement of variables often used in the internet diffusion research.

3.1 A New Index Measure of Internet Diffusion and its Limitations

As it was already pointed out in the Chapter Two of this dissertation, the internet diffusion cannot be defined differently by differents scholars. No uniform definition of internet diffusion can be found the literature. In this dissertation, the terms internet diffusion, penetration, adoption, connecitivity, access, use and digital divide are used interexchangably to describe the same phenomena. One way to define diffusion is the following "diffusion of an innovation is a macro process concerned with the spread of the innovation from its source to the public" (Dholakia et al 2004). The internet adoption can be defined as "… a micro process that focuses on the stages through which an individual passes when deciding to accept or reject the innovation" (Dholakia et al 2004). In practice, it is not possible to distinguish between adoption and diffusion. These processes are mutually interdependent. Micro and macro processes interact. Often macro outcomes are simply aggregates of multiple micro processes. Adoption of internet by groups of individuals such as students or businesses in manufacturing sector, for instance, increases diffusion of internet on per capita basis on macro level. Indeed, the same authors after offering definitions write about "adoption and diffusion patterns of internet" without clearly drawing the line between the two (Dholakia et al 2004). Thus adoption, use, penetration and diffusion of internet describe the same phenomena in many scholarly accounts (Kitsing 2008; Kitsing and Howard 2009).

Internet diffusion is usually understood as referring to how widely the internet is used in society. The concept is operationalized by measuring in in relative terms, not in absolute terms. Different indicators are standardized and scholars consider per capita internet diffusion rates or use per 100 inhabitants or some other measure in relation to population. Such approach is important because it establishes equivalance. This means that specific context is taken into account (Adcock and Collier 2001, 536). As it was emphasized in Chapter Two of this dissertation local context is crucial for understanding diffusion. Standardizing by population is important because it avoids effects that are the results of population size (Adcock and Collier 2001, 536; Jacob 1984, 30). As it has been also highlighted in the literature review, usually scholars have employed two standard ways of measuring internet diffusion. First, scholars measure the number of internet hosts per 100 inhabitants (Kiiski and Pohjola 2001; Inglehart and Welzel 2005, 279-280). Second, other scholars prefer measuring the number of Internet users per 100 inhabitants (Beilock and Dimitrova 2003).

As Kitsing (2008) and Kitsing and Howard (2009) have pointed out, "internet hosts" are organizations or firms that have computers directly linked to the worldwide internet network. An Internet Service Provider (ISP) is a host. This means that individuals can connect through the ISP host computer to the internet. The International Telecommunications Union (ITU) measures internet hosts by two-digit country code, e.g.; France: .fr, United Kingdom: .uk., et al. or three digit-code referring to a specific classification of organization, e.g., .org, .com, .edu et al (ITU 2006). This way of measuring internet diffusion can be a reliable method of measurement. Errors in collecting the data are minimal as well as from a technical standpoint, data is easily assesible (Jacob 1984, 34). Most importantly, it is not necessary to conduct surveys in order to identify hosts. However, problems do arise with content validity (Adcock and Collier 2001, 538-539, Kitsing 2008; Kitsing and Howard 2009). This method of measurement of internet hosts does not necessarily inform use if a counted host is physically located in a certain country. As ITU points out, the indicators are based on “approximation” (ITU 2006). This limitation is particularly relevant of hosts providing services under internet names ending with .com or .org. Therefore, using the number of internet hosts per 100 inhabitants is not a meaningful operationalization of the concept of Internet diffusion (Kitsing 2008; Kitsing and Howard 2009). The indicator is not valid because the link between per capita internet hosts as operationalized variable and the concept of internet diffusion defined as a percentage of internet users in society may not exist. Convergent validity is missing because internet users and internet hosts do not correlate. discriminant validity is also not present. This is so because he measurement does not differentiate between different types of hosts, e.g., internet hosts based in domestic economy and those based outside (Kitsing 2008; Kitsing and Howard 2009).

The second method of operationalization of internet diffusion focuses on users. Again, it was highlighted in the Chapter Two that some scholars rely on these measures. But how do we identify users? Usually, it is done on the basis of survey research. Number of users per 100 inhabitants is usually recorded by contacting people by telephone. Surveys ask whether they used the internet during a specific period which can be one year or six months or some other time frame. It depends on survey as some surveys tend to identify heavy users in addition to regular users. As the operationalization of internet diffusion, surveys offer an better alternative to measuring hosts. Discriminant validity is present. The surveys differentiate between internet users and non-users in given country. It is a more direct measure of use while the internet hosts-based approach measured users indirectly. Measuring hosts is based on assumption that supply equals demand. However, as it was higlighted in the Chapter Two relations between supply and demand are asymmetrical and nonlinear. However, the measurement of internet users is inferior in terms of reliability. Internet users are not trustatable in terms of validity either. Convergent validity which refers to correlations with host is missing. As Kitsing (2004; 2008) as well as Kitsing and Howard (2009) have demonstrated by comparing indicators it is obvious that there is no correlation between users and hosts as well as between subscribers and users and formfo subscribers and hosts.

ITU also has pointed out that surveys are differently conducted in different countries (International Telecommunications Union 2006). For instance, different age groups are included in various countries. These survey design issues create systematic errors or biases for any cross-country analysis on the basis of ITU data. This again undermines measurement validity. Most importantly, both approaches to measuring the internet diffusion have serious limitations in term of validity and reliability. Furthermore, these two approaches do not reflect well the nature of the internet as a network good as it was discussed in the Chapter Two.

3.1.1 Index-based Approaches

Again, one solution is to rely on more comprehensive datasets and not just on hosts or users. This means the creation of an index which has been used to measure complex social phenomena such as institutional performance, for instance (Putnam 1993, 75). Some scholars promoted index-type of approach for the analytical framework of the Global Diffusion of the Internet Project already in 1998 (Press et al. 1998). Barzilai-Nahon (2006) has proposed index-based approach, where she treats internet as an independent good. Her approach is integrated index similar to approach by Press and others (1998) and the World Economic Forum (Kitsing and Howard 2009).

Based on these previous insights, Kitsing (2008) and Kitsing and Howard (2009) have proposed "the index of effective internet diffusion" which captures intangible elements of technology. The effective internet diffusion does not capture only the quantity of Internet use but also quality of its use while approaches using hosts and users as indicators capture only “formal internet diffusion”. This index relies on conceptualizing internet as a network good and highlighting network nature of its diffusion. The index categorizes variables into three dimensions of Internet diffusion: network nature, sophistication of use and social distribution. The table 3.1 offers idealized vision of the index and summarizes the key elements of the index. It is emphasized by the authors that the concrete application of the index depends on data availaibility in the countries to be studied (Kitsing and Howard 2009).

Table 3.1: The Three Dimensions of the Index of Effective Internet Diffusion.

Dimension	**Techniques for measurement**	**Some potential indicators**
Network nature (Geographical dispersion, Sectoral absorption, Connectivity infrastructure, Organizational infrastructure).	Quantitative, qualitative, network analysis	Asymmetrical or symmetrical distribution between cities and rural areas, quality and quantity of connections to hubs, intensity (what for) and extensity of use (percentage) in different sectors: commerce, education, percentage of internet users, broadband users, wireless diffusion, number of internet hosts, number of internet providers, degree of independence of telecom regulator and market openness et al.
Sophistication of use	Quantitative and qualitative	The purposes of internet use, availability of services and content, nature of discourses about the internet et al.
Social distribution	Quantitative and qualitative, network analysis	Percentage of males, females, young, old, different ethnic groups in using the internet, differences in use of these groups, connections between the different groups, Gini coefficients for technology distribution

Source: Kitsing and Howard (2009).

As it was discussed in the literature section of this dissertation, there are many substitutes and complements to the internet. The index of effective internet use aims to demonstrate the actual use and diffusion of the internet in society more closely than would be achievable by looking at hosts or users. This dissertation will use insights from the index of effective internet diffusion in the Chapter Four. However, it must be pointed out that the index-based approaches have also serious shortcomings. First, they are still reductionist. Obviously, it is not as reductionist as using one or two variables. Nevertheless, index uses a limited number of variables, then significant portion of complexity is assumed away. Second, indexes are arbitrary. Authors decide which variables to use and which concrete values to assign to these variables. Several variables may correlate, which again may increase the arbitrariness. Third, construction of new index would offer a static snapshot in time and not dynamic evolution of variables over time. Of course, index could be constructed retrospectively covering many years but considering the scope and length of this dissertation, such exercise on its own would not leave time for anything else.

Third, indexes may use unreliable data. It is not just data is collected differently in different countries and may be manipulated. Even the concepts may not have unified meaning. For instance, data on broadband use is often not comparable because there is no universal definition of broadband. The ITU Standardization Sector's Recommendation I.113 defined broadband as a transmission capacity that was faster than primary rate ISDN, which is 1.5 megabits per second (Mbit/s) or 2 Mbit/s depending on country. In 2001, members of Organisation for Economic Cooperation and Development (OECD) countries adopted a definition of broadband which is less than 256 kilobits per second (kbit/s). The ITU also began collecting data using this baseline definition. However, the European Commission's Communication Committee established a different definition in 2002 at 144 kbit/s. Most importantly, such definitions have become irrelevant as advertised broadband offers below 2 Mbit/s are rare.

An even more complex issue is the cost of internet access because of complexity of tariffs and bundles offered by different operators depending on the device, time of use and many other factors. Even comparisons within country are difficult, not to mention between countries. The OECD commissioned a working group on broadband metrics in 2010, which after several years and meetings in Paris, London and Washington DC still struggled with finding a new common simple definition of broadband because of quickly evolving technology, particularly in wireless form. In the end, the OECD working party recommended to continue using the old definition of broadband. The working group also went through complex topics such as broadband speed tiers, next generation access, availability metrics, investment metrics, performance metrics, competition metrics, prices and many other factors (OECD 2012) The sheer complexity of these issues highlights the challenges of generating comparable conceptualizations and data that can be used comparatively. The OECD efforts involved the best experts from member countries and the secretariat.

The empirical discussion in Chapter Three mimics the index-based approach and internet diffusion in Estonia and Slovenia is measured across 11 variables which link back to the ideas developed in the index. Obviously, there are trade-offs involved. Including more than 11 variables would increase complexity to research design and would make interpretation of data extremely challenging. At the same time, it is certainly improvement in comparison with studies where only one or two variables are used in operationalization of internet diffusion.

3.2 Research methods

Following the insights from the discussion on methodological issues, 11 different variables are selected for measuring and comparing internet diffusion in Chapter Four in comparison of Estonia and Slovenia.

Table 3.2: The Three Dimensions of the Index of Effective Internet Diffusion and Measures Used for Comparing Estonia and Slovenia.

Dimension	**Measures**	**Data source**
Network nature (Geographical dispersion, Sectoral absorption, Connectivity infrastructure, Organizational infrastructure).	a) internet use per 100 inhabitants, b) households with access to internet at home, h) broadband penetration rate, i) mobile broadband coverage	Eurostat, United Nations
Sophistication of use	c) households with access to broadband, d) enterprises with access fixed broadband, and j) download and upload speeds.	Eurostat, Ookla.
Social distribution	e) regular internet use by females and males, f) households with access to internet in rural and urban areas, g) households with access to internet on the basis of income quartiles, k) individuals with low formal education and senior citizens regularly using internet.	Eurostat

Source: Author on the basis of concept from Kitsing and Howard (2009).

As the table 3.2 shows the internet diffusion is measured and compared on the basis of following ten indicators: a) internet use per 100 inhabitants, b) households with access to internet at home, c) households with access to broadband, d) enterprises with access fixed broadband, e) regular internet use by females and males, f) households with access to internet in rural and urban areas, g) households with access to internet on the basis of income quartiles, h) broadband penetration rate, i) mobile broadband coverage, j) download and upload speeds and k) individuals with low formal education and senior citizens regularly using internet. Measures a), b), i) and h) correspond to network nature of internet. Measures c), d) and j) correspond to sophistication of use in the index. Measures e) f) and g) and k) correspond to ideas of social distribution in the index.Furthemore, these 11 indicators offer a good mix of both demand side and supply side indicators and three variables out of ten capture diffusion among different demographic and socio-economic groups. As was emphasized in the discussion above, there is always a degree of arbitrariness involved in the selection variables. However, it is clear that this approach is more comprehensive than relying on one and two variables and captures well the intensity and extensity of internet diffusion. To understand factors that may create preconditions for the internet diffusion, the research uses variables such as per capita gross domestic product at purchasing power parity (per capita GDP at PPP) to demonstrate the variance in national wealth as well as the gini coefficient as a measure of income inequality.

The literature review suggested that institutions may be crucial in understanding different technology diffusion patterns. Hence, a background concept of institutions is used according to the definition offered by North: "Institutions are the rules of the game in society or, more fundamentally, are humanly devised constraints that shape human interaction" (North 1990, 3). North is explicit in stating that institutions are not the same as organizations. Institutions are more fundamental – rules of the game –- that interact with organizations. The Northian emphasis on incentives points out that institutions are enablers, not only constrainers. In other words, institutions may both create and remove incentives to engage in any type of undertaking. Obviously, the operationalization of institutions relies also on the discussion on institutions developed in the literature review and insights from political science scholars such as Pierson (2004).

I will operationalize the background concept of institutions in the context of insights considered in the literature review. First, institutions will be divided into formal and informal categories, with my focus centering on the formal rules, but the informal rules and social networks will be considered as well whenever the data allow me to do so. Second, the dynamics of institutional change will be considered in the analysis. This analysis will not be static– it attempts to incorporate a description of how the change in institutions from 1991 to present may have affected the spread of technology. It does not make any deterministic and probable linkages between institutions and technology diffusion. Rather on the basis of careful case study analysis it tries to demonstrate how institutions have contributed in the form of critical junctures for the spread of internet.

On the basis of the literature review, the following analyses will examine changes in general formal institutions governing economy, international trade, foreign direct investment, privatization, competition policy, regulation of telecom companies and various government initiatives encouraging the use of the internet and targeted at the ICT sector. Furthermore, I will consider in my analysis specific institutional changes affecting the internet and information technology and informal rules of the game and how these rules interacted with formal rules. In general, formal institutions can be measured by examination of legislation, reports by government and international organizations and through semi-structured interviews. Formal institutions can be analyzed further by in-depth analysis of EU Regular Reports, which provide detailed overviews of overall and telecom institutional frameworks for different years.

The impact of formal rules on the incentives of key actors cannot be explored without incorporation of informal rules. Credible commitment and rule enforcement depend on the interactions of the two – particularly in rapidly changing economies. But the interactions of formal and informal institutions is challenging to measure. It heavily relies on semi-structured interviews, surveys and indirect secondary data which may or may not support particular interpretation. Hence, the discussion of informal insitutions is significantly more subjective and subject to biases than the changes in formal institutions. However, informal instutions have to be factored in because the impact of informal institutions can be either added or substracted from the perceived effect of formal institutions. Depending on the particular country and situation informal institutions may increase the credibility of commitments and contract enforcability or may reduce it. In this analysis, I am particularly interested to see whether there are any fundamental discrepancies between formal and informal institutions, which undermine the projected effect of some or many formal institutions. It is important to see whether formal rules of the game created a credible commitment or not. Or opposite may be true that informal institutions may contribute to the internet diffusion despite the weakness of formal institutions and a lack of credible commitment mechanism in the formal institutions.

I have highlighted the perspectives on formal and informal institutions in the Chapter Two. The following is my own synthesis on how I will try to operationalize these perspectives in the empirical part. To further research on informal institutions, the empirical discussion will bring in percpectives on the roles of entrepreneurial discovery processes, social networks and social capital by combining them with more formal institutionalist perspectives whenever data allows me to do that. This analytical approach is based on the premise that the entrepreneurial discovery process is based either explicity or implicitly on the rules of the game. The dominance of particular type of rule of the game is influenced by the network effect of internet and network effect embedded in the entrepreneurial discovery process. In some countries institutions that emerge encourage the diffusion of Internet through the entrepreneurial process of discovery. In other countries they do not.   In other words, formal institutions may facilitate the emergence and operation of localized networks which are fundamental for the diffusion of internet. Hence, the thesis aims to map out the role of tacit and often overlooked insitutional aspects which may encourage the spread of internet. Nevertheless, informal institutions and the interactions between formal and informal institutions and mental models of key actors are difficult to measure. Opinion surveys such as the data from the Eurobarometer are clearly not sufficient as the thesis is interested in specific professional networks in specific contexts. On the basis of primary and secondary sources and in-depth elite interviewing in, the research aims to explore the role of specific entrepreneurial discovery processes.

3.2.1 Case Selection

The study is disciplined configurative as it will use established theories to explain cases (George and Bennett 2005, 75). Concerning the trade-offs involved between particularist and generalist approaches, it leans towards the particularist approach and rejects the generalist definition where the case study is "an intensive study of a single unit for the purposes of understanding a larger class of (similar) units" (Gerring 2004, 343). Population of the study is equal to the sample. The research is not generalist and does not aim to demonstrate that a particular set of independent variables creates necessary and sufficient conditions for higher outcomes in internet diffusion rates in particular population (see for instance, George and Bennett, 2005, 26; Gerring 2001, 132 for the discussion of research methods). The research does not aim to establish causality and answer to "if …then" questions. Even the best designed quantitative studies never establish deterministic causality. At best, they show statistically significant correlations, which allows authors to entertain the possibility of causal relationship between different variables. Often authors may overinterpret their result and speak in deterministic language about causality. This does not certainly mean that correlations will equal causality. In this context, it is not possible to see how case study, comparative or not, can ever show causal relationships. Self-selection biases, overdetermination, measurement validity and other factors make it impossible. The research cannot aim to establish a probalistic causality or deterministic causality between the independent variables and the dependent variables (Gerring 2004, 342). By outlining the necessary conditions for internet diffusion in a particular institutional context, the lack of counterfactuals and overdetermination does not allow to establish causality.

My strategy is closest to *congruence tests*, but I argue that lack of counterfactuals and overdetermination is still making it difficult to use the congruence tests for establishing strong casual relationship. The use of these tests moves the research strategy away from a ceteris paribus approach because of over-determination effects. In other words, the over-determination implies that are too many variables that can explain the outcome in the dependent variable. More specifically, small number of cases and presence of many variables limit the ability to focus on the effects of changes in particular variables while keeping everything else constant. Nevertheless, George and Bennett (2005) argue that it is possible to conduct congruence tests, which emphasize “similarity in the relative strength and duration of hypothesized causes and observed effects” (George and Bennett, 2005, 183). The congruence method “does not mean that causes must resemble their effects or be on the same scale…” (George and Bennett, 2005, 183). They argue that scholars can take into account theoretical reasons why our hypothesized causes affect variables in a particular way and on these grounds we can analyze whether independent and dependent variables are congruent (George and Bennett, 2005, 183). Hence, by starting with theories and on the basis of these theories one can make predictions regarding what kind of relationships we expect to see between dependent and independent variables. If one finds out on the basis of the interviews, for example, that the predicted relationship exists, then one can entertain the possibility that there is a causal relationship. According to George and Bennett (2005) the congruence method is the second best option in the situations where we cannot carry out natural experiments or where it would be unrealistic to assume ceteris paribus because there are more variables that change than one. Nevertheless, my approach takes more minimalist interpretation of congruence tests and social science research methods in general concerning causality. It stems from the understanding that even in the well designed causal research these challenges are almost never properly tackled because models are abstraction of reality and assumed sigficant portion of reality away. Hence, I will limit myself to description and explanation.

The study aims to explain and describe conditions which allow understanding the diffusion of internet in a particular context. Thus, the findings cannot be generalized for a larger population than sample. It cannot be generalized for instance even for the transition economies of Central and Eastern Europe even if I study one of the countries, not to mention for all transition countries or the entire world. However, the studies should be illuminative for researchers with the aim to help in theory building and if possible in comparing a large sample of countries. Nevertheless, this study chooses a particularist approach in full understanding of trade-offs involved between particularist and generalist approaches to the research design. It combines different case study methods as was pointed out in the beginning. Units of analysis vary from chapter to chapter. In Chapter Four, the sample consists of units that are defined as diffusion processes in countries; the level of analysis is on aggregate, macro- or country level.

The research strategy emphasizes the extensiveness and intensiveness of the case-study method based on case comparibility (Gerring 2004, 347-348; Collier 1993, 111). This description allows to improve our understanding of internet diffusion and processes which may constrain and enable the diffusion. The dissertation combines both macro and micro level processes. First, I start with macro level approach by combining two countries. Chapter Four examines diffusion proecesses in Estonia and Slovenia as a primary case and uses sometimes other Central and Eastern European (CEE) countries as a secondary cases to highlight the importance of variance between two cases and with other CEE countries and understand factors affecting internet diffusion in Estonia and Slovenia. For illustrative purposes, it also makes comparison with a larger set of countries in the Central and Eastern European as well as with other countries in the world. The purpose of comparison differs throughout different sections. If the purpose is to compare a country with aspirational examples, then it should be done so. If the purpose is to compare a country with most similar ones in terms of GDP, institutions, membership in the EU and some other factors, then it should be done so.

After macro level approach, I will move to more micro level and describe diffusion process, institutional and policy variables within one country on the basis of several cases. Chapters Five and Six compare different initiatives and processes within Estonia. This allows me to examine better the social, economic and political context in one country and offer even thicker description than in Chapter Four. Chapter Five can be described as focusing on positive cases. Since study of positive cases may lead to false positives – meaning that wrong lessons can be learned on online studying success stories – the Chapter Six offers negative cases. This allows understanding heteregeneous nature of outcomes and through the method of elimination avoid fallacies associated with false positives. Combination of different case study designs and mix of different levels of analysis makes the research quite complex. However, it makes it more realistic by allowing to capture more complex phenomena. The aim of clean research design often excludes important research questions because reality is fuzzy. Hence, often methods determine the questions that scholars ask. However, the purpose of the research drives the methodology in this dissertation, not other way around as it often happens in social science research.

The diffusion processes in Estonia and Slovenia make good comparisons. They have a variation in the per capita internet penetration rate by both users and other measures. At the same time, there is also variance in national wealth and institutions but external environment is rougly similar because both countries became independent in the early 1990s and joined the European Union in 2004 (Overview of both countries is available in Appendix B). Hence the EU membership implies fairly similar institutional setting as EU member countries have unified their legislation in broad economic, regulatory and sector-specific governance in telecom sector. Hence, degree of comparability is very high, many ambiguities can be avoided and a variance between different variables can be established by nature of the units. It allows not to focus too much breadth and representability but on the depth and comparability (Gerring 2004, 347-348). If I were to consider the breadth and representation extremely important, it would make sense to have a large sample size and to apply statistical methods but as I have indicated above I doubt that it would be able to establish causality. Furthermore, institutional complexity implies that many variables are involved. At the same time, the number of units is very small. Therefore, it would make sense to increase the number of units and look at the units where are also many explanatory variables are similar or the same, in order to diminish the number of variables involved (Collier 1993, 111-113). However, institutional complexity implies that variance across Estonia and Slovenia is already significant despite the factors I have mentioned above.

Incorporation of larger countries, such as Poland and Russia, may add relevance and offer an opportunity to compare “least-likely” cases and introduce a “crucial” case (George and Bennett 2005, 80). However, these units will reduce comparability with smaller countries. For instance, there are differences regarding the external environment. In this sense, such large countries would introduce new variables (Collier 1993, 112-113) without necessarily contributing to the comparability.

3.2.2 Semi-structured Interviews

The main benefit of interviewing for my study stems from the possibility to collect information that is not available in other sources such as Eurostat surveys and secondary literature. The in-depth interviews will allow capturing the impact of internet diffusion and institutional developments better than more formalized quantitative methods. Artificial intelligence researcher Parsaye (1988) has pointed out that elite interviewing is one of the three methods that allows capturing tacit knowledge from experts (other two being learning by being told and learning by observation which cannot be used in the context of this research). In comparison of quantitative and qualititative research methods in information collection Gerardo Munck pointed out benefits of in-depth interviews where "… informants not only answer but often offer own more nuanced responses and unprompted insights" (Munck 2004, 116). In this sense, survey interviewing would not reveal these insights and I am not interested in the views of general population why the Internet is as diffused in their country. I am interested in much more specific information and therefore the elite interviewing is appropriate approach (Dexter 1970).

The use of semi-structured interviews varies in this dissertation. In the case of Slovenia I use interviews in order to gain background information because I am less familiar with Slovenia than Estonia. I do not speak the language and I do not follow local news in Slovenia. In Estonia I used interviews to gain information which was not otherwise available. Hence, I rely heavily on interviews in Chapter Six but I combine interview insights with secondary data in Chapter Five. My three different research questions determine the way I use semi-structured interviews in three different chapters. In Chapter Four I compare internet diffusion in Estonia and Slovenia where huge amount of data is available. Hence, it did not make sense to rely heavily on semi-structured interviews but use it in combination with secondary data.

In the years of 2003 to 2013 I interviewed 34 people in Estonia and Slovenia. They included top level officials of government agencies (telecom regulators, telecommunication ministry et al), top executives of ICT companies who provide internet and internet- related services, investors in telecom and ICT companies, content providers, bankers, politicians who have been responsible for telecom regulations and oversight and experts who have a deep knowledge of telecommunications and internet related regulatory issues in given country (university professors, analysts at leading banks et al). As my analysis is not static but dynamic an important criteria for selecting experts was their experience and knowledge of dynamic changes that took place between 1990 and 2013. I compiled a database of population by publicly available information (Aberbach and Rockman 2002, 673) and by informal conversation with people with a deep knowledge of the issues. Because of tight conditionality outlined above and the small size of countries, my assumption was that the size of group of people I can interview would be quite small. Hence, I did not try to establish a representative sample of population and will not use probability sampling. In other words, population and sample would be identical. Certainly, this process introduces self-selection bias to the research as the individuals to be interviewed will be self-selected (not everybody will grant me the interview). In Slovenia I interviewed seven experts in January 2003 and six experts in June 2012 which gave me a dynamic overview of changes, especially as some experts overlapped in both years. In Estonia I interviewed 21 experts in the time period 2008-2013 (the full list is given in Appendix C). Since I have deeper knowledge of Estonia, I was able to pre-select most candidates for interviews but to some extent I relied on snowballing, i.e. recommendations by other experts. I also used to some extent snowballing in Slovenia.

General questions were prepared for interviews, but actual questions varied depending on the context. In Slovenia the questions were more general because I tried to understand the context. In Estonia I used interviews to gain information about specific situations and issues and therefore questions were often very detailed and targeted at specific person to be interviews. For instance, I would inquire about a specific meeting that took place. Specific location selected by a company for business activities. Information of use of ID card for specific online service and so on.

All interviews were made in person. Interviews were recorded and all interviewees agreed to talk on the record which is used for research purposes but not made publicly available. Interviews were coded because small sample size makes it relevant as the coding provides at least some degree of anonymity. This may help to reduce significant biases as experts may give less constrained responses because they do not want to jeopardize ongoing official and/or social relationships. Methodologically, I did not create specific section that discusses only the results of interviews because the point of interviews was to gain specific insights rather than to offer some generalization on how many experts thinks this or that. Hence, insights from interviews are incorporated into the narrative in the following section and not discussed separately.

3.2.3 Working Groups

In addition to semi-structured interviews the research has benefited tremendously from a numerous working groups organized by international and domestic organizations. Since January 2011 the author has worked as head of economic analysis at the Estonian Ministry of Economic Affairs and Communications and represented Estonian government at the OECD working parties as well as OECD high level ministerial meetings on internet economy. The author participated on regular basis on the OECD Working Parties on Internet Economy and Information Society Indicators in Paris, France. Direct benefit from the OECD was participation on OECD workshops on broadband metrics held in Washington, DC, London and Paris in 2010-2012. This allowed gaining expert knowledge on the broadband measurement issues and hearing a variety of perspectives on causal factors. In addition, the author has benefited tremendously by participating in the workshops and seminars organized by the State Information Systems Department of the Estonian Ministry of Economic Affairs and Communications which allowed to gain new insights into the factors affecting the use and diffusion of information technologies in Estonia.

3.3 Conclusion

This chapter discussed the research methodology by highlighting conceptualization, use of variables and the measurement issues and rationale for case-selection and rationale for elite interviewing. It offered a critique of quantitative approaches relying on one or two measures of internet diffusion and limited number of variables of internet diffusion. It argued that the use of small number of variables cannot demonstrate the complexity of diffusion process. Hence, it discussed the idea of index of “effective internet diffusion” and showed how this concept can be operationalized on the basis of 11 different indicators measuring network nature, sophistication of use and social distribution of internet. It pointed out research strategy which in Chapter Four compares internet diffusion in Estonia and Slovenia and in Chapters Five and Six discusses seven cases within Estonia. The empirical part of the study is based on both secondary and primary data. Chapter Six relies more heavily on primary data while Chapters Four and Five combine secondary data with insights from semi-structured interviews. The rationale for interviews varied. In Chapter Four interviews were used as a exploratory tool to gain more background information. In Chapters Five and Six they were used to gain additional information because data in other forms were not available. Ultimately, research questions drive methodological choices in this research design and not other way around.

CHAPTER 4
INTERNET DIFFUSION IN A COMPARATIVE PERSPECTIVE

4.1 Introduction

This chapter offers descriptive analysis of internet diffusion in Estonia and Slovenia during the last 20 years. It starts by comparing Estonia and Slovenia on a number of indicators on internet diffusion outlined in the research methods part of this paper. To give more context, it also compares Estonia and Slovenia on these indicators with other countries, particularly those in the Central and Eastern Europe, which joined the European Union in 2004 and 2007. After an introduction to the case countries, the CEE and more general comparisons, the chapter proceeds by offering a more detailed comparison of take-up of internet diffusion in Estonia and Slovenia based on descriptive statistics and semi-structured interviews.

4.2 Internet Diffusion in Estonia and Slovenia

I start by considering the traditional measure of internet diffusion by counting the number of internet users per 100 inhabitants. In order to place Estonia and Slovenia in the broad international context, I will demonstrate how internet use in these countries compares with the averages of internet users in the world, European Union (EU), Europe and Central Asia. The comparison with the world average in showing the position of these two countries in the world. Since both countries are members of the EU, then the comparison with the EU average helps to see how number of internet users in Estonia and Slovenia fare in the EU context. Comparison with Europe and Central Asia helps to compare with the average in the region that does include only developed countries but also less developed countries.

Figure 4.1 compares the percentage of users with the world, the EU and Europe and Central Asia's (all income levels) averages. It is clear the growth of internet users has been constantly highest in Estonia reaching almost 80 percent in 2012. At the same time, Slovenia lags behind both Estonia and EU average reaching 70 percent in 2012. If the spread of internet is often taken for granted, the data in Figure 4.1 is telling that only around one third of world population were counted as internet users in 2012 and in Europe and Central Asian average was slightly less than two thirds.

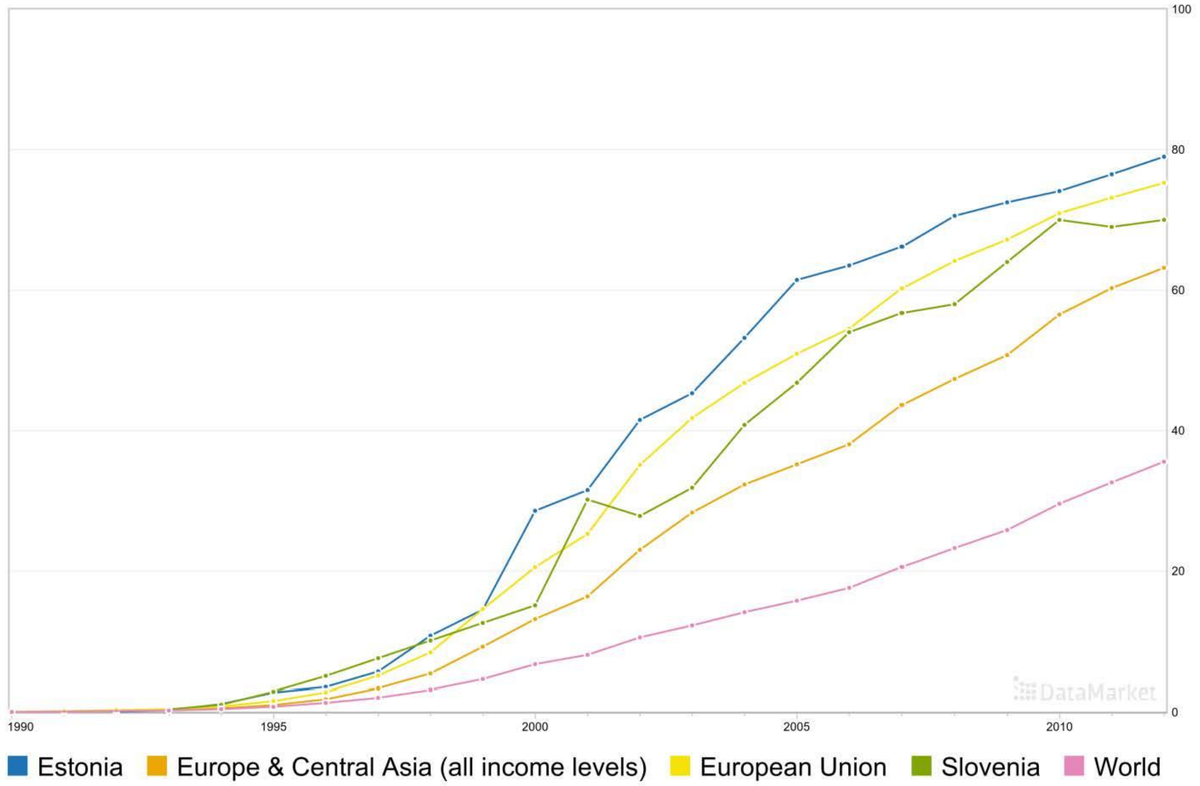

Figure 4.1: Internet users per 100 people in Estonia, Slovenia, the European Union, Europe and Central Asia and the World in 1990-2012 on the basis of data from United Nations (2014).[4]

The comparison with the world is merely illustrative. However, the internet diffusion has to been seen in the specific institutional context. Hence, it is more fruitful to compare Estonia and Slovenia with other countries in the Central and Eastern Europe as shown in

[4] Here and below I am using datamarket.com, data aggregator and software tool, to generate figures from a multiple sources. Datamarket.com is available only for registered users and it has collected a variety of data from multiple sources. In this figure the data comes from United Nations (2014) which, in turn, is provided by the World Bank. Sources are available in biography. More detailed data of the figure 1 is available in the Appendix D.

Figure 4.2. The membership of the EU indicates that their institutional context is more similar than with those countries outside of the EU.

4.2.1 Demand-Side Indicators

Figure 4.2 indicates that the growth of internet use has been constantly greatest over the years in Estonia. Only the Slovak Republic has caught up with Estonia over the years and both countries have about 80 percent of population using the internet in 2012. Slovenia is broadly placed with the Czech Republic, Hungary, Latvia, Lithuania and Poland where the percentage of internet users varied between 65-75 percent in 2012 and where the growth of users has been slower than in Estonia over the years. Bulgaria and Romania are clearly lagging behind as the growth of users has been slower reaching 50-55 percent in 2012.

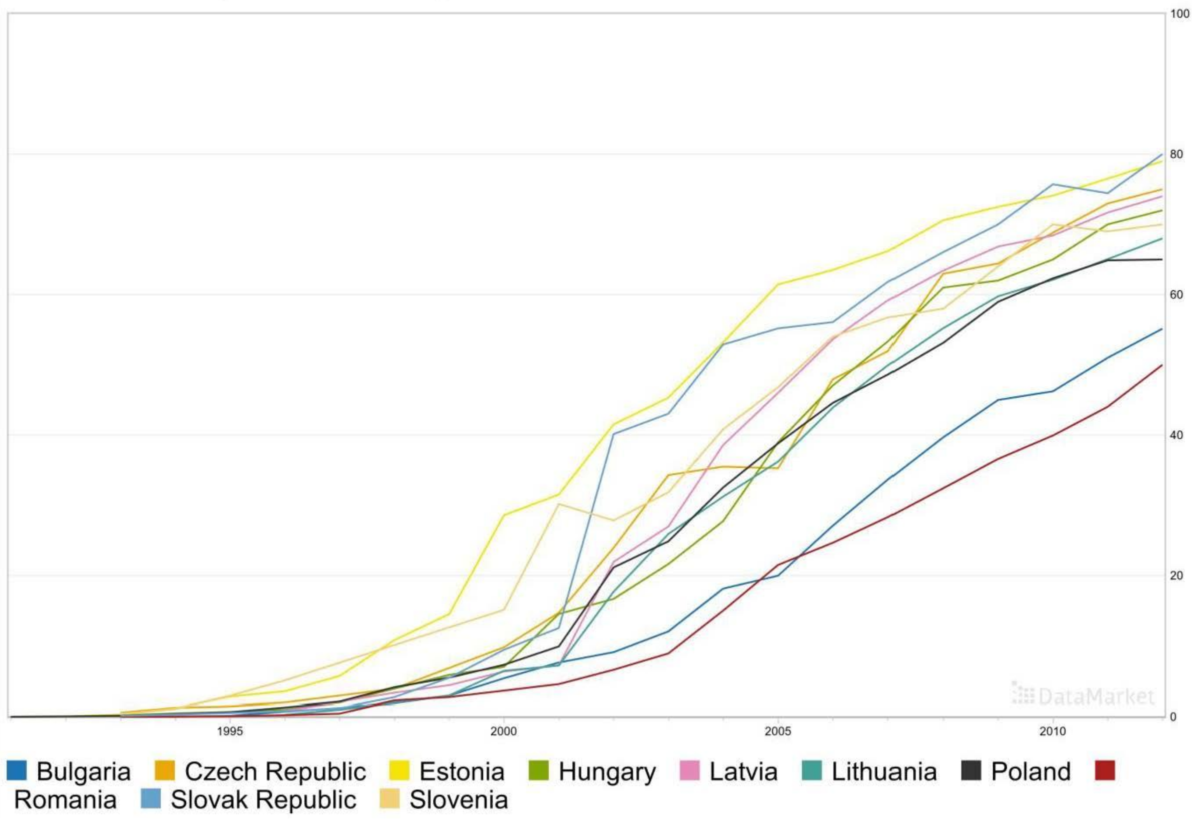

Figure 4.2: Internet users per 100 people in selected Central and Eastern European countries in 1990-2012 on the basis of data from United Nations (2014).[5]

[5] More detailed data is given in Appendix D.

However, when we look at data on households with internet access at home (in Figure 4.3, below), then the difference between Estonia and Slovenia is significantly smaller as 80 percent of Estonian households had internet access at home in 2013 while the percentage was 76 in Slovenia. Certainly, the data indicates that Slovenia has been quickest in adopting internet at home in the early years as already in 2004 about half of households had internet access (Figure 4.3).

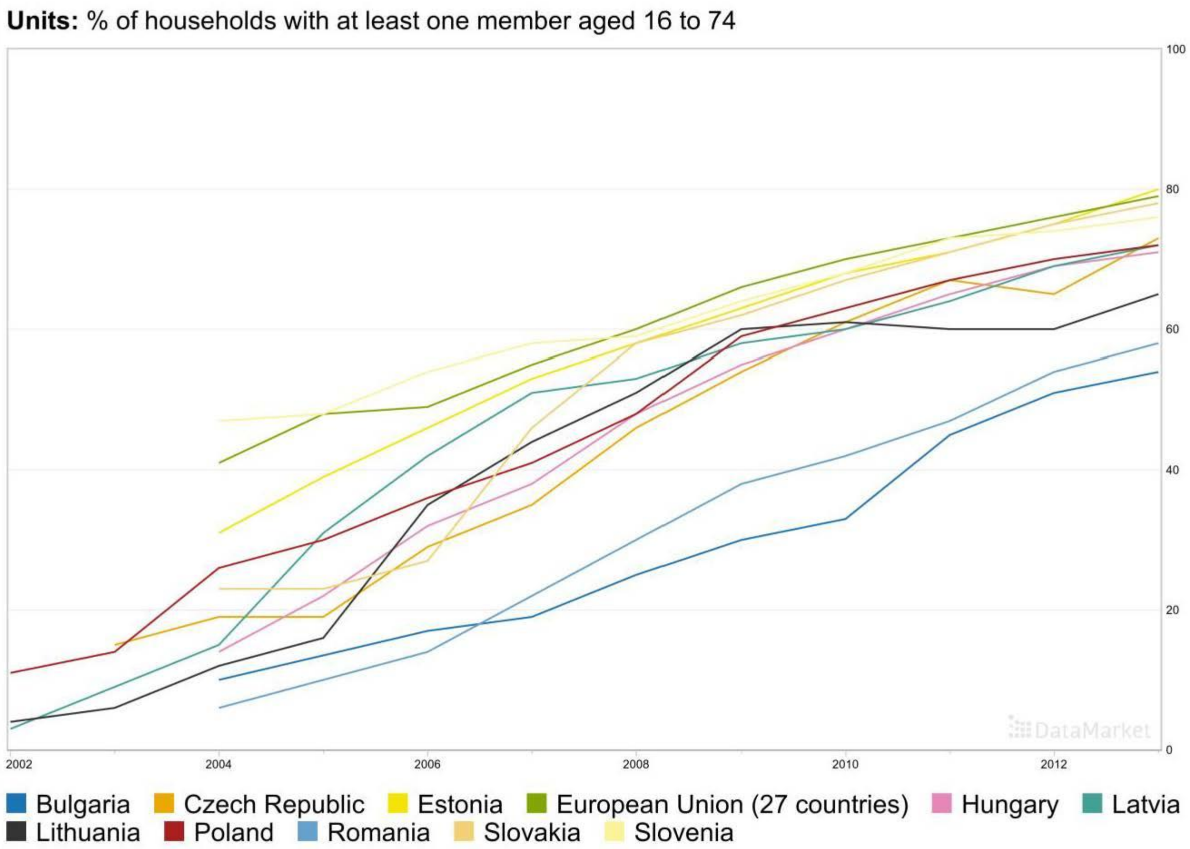

Figure 4.3: Households with internet access at home in the European Union and the selected CEE countries 2002-2013 on the basis of data from Eurostat (2014) .[6]

At the same year, less than a third of Estonian households had internet access. Estonia by this measure was more similar to the average of the CEE countries and below the EU

[6] More detailed data is available in Appendix D.

average in 2004. In 2013 Estonia is on the same level with the EU average and above the CEE average (Figure 4.3). Only in the Slovak Republic has the growth of internet access at home been more remarkable than in Estonia over these years. The households with internet access have been growing four-fold between 2004 and 2013 in the Slovak Republic. Similarly to the data on internet users, the data in Figure 4.3 shows that Bulgaria and Romania lag behind with the percentage of households with internet access varying between 55 and 58 percent.

However, it is not important to measure only connectivity at home but it is also crucial to measure its quality as I emphasized in the Chapter Three. One way to do so is to look at the households with broadband connection, which would indicate whether households can access the internet at certain minimum speeds. This is also important variable in demonstrating sophistication of use. Users of more sophisticated internet services require certain minimum speeds to secure quality of connections. Figure 4.4 shows clearly it is obvious that most countries have reached close to 100 percent broadband access in their households. This certainly stems from the fact that the EU uses very minimalist definition of broadband, which in fast-changing technological landscape has lost substantive meaning. Eurostat defines the broadband connection at home in the following way: "The availability of broadband is measured by the percentage of households that are connectable to an exchange that has been converted to support xDSL[7]-technology, to a cable network upgraded for internet traffic, or to other broadband technologies. It includes fixed and mobile connections (Eurostat 2014a)." The Eurostat definition of broadband means minimum download speed at 144 kilobits per second (kbps) while the OECD's and ITU definition is 256 kbps. In essence, almost all internet connections meet the standard of broadband in the European Union.

[7] xDSL refers to all types of digital subscriber lines. It includes ADSL, HDSL, SDSL and VDSL. DSL technologies are known as last-mile technologies because they are used to provide a connection between telephone switching station and a home or office. However, they are not used between different telephone switching stations.

Nevertheless, the data in Figure 4.4 shows dynamics of this minimalist broadband access over the ten years, which is even more crucial to consider. In 2004, two-thirds of Estonian households had already broadband access while only one third of the EU households and of most CEE households had broadband access then. In Slovenia only one-fifth of households had broadband access in 2004. In other words, Estonian households have had significantly longer experience with faster and better quality internet than Slovenian households.

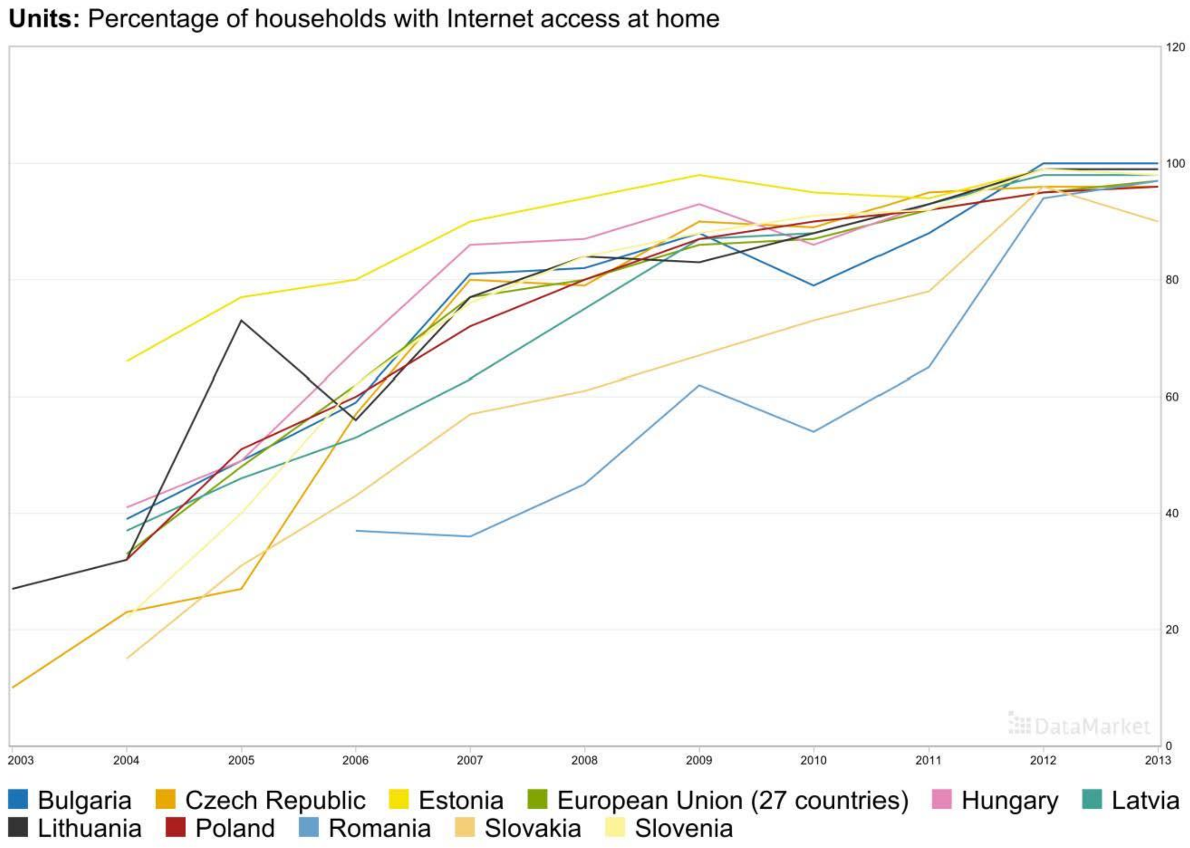

Figure 4.4: Households with broadband access in the European Union and selected CEE countries in 2003-2013 as a percentage of households with internet access at home on the basis of data from Eurostat (2014).[8]

What about enterprises with broadband access? This is not just for understanding the quality of internet among enterprises but also the quality of internet people can access in

[8] More detailed data is available in Appendix D.

general because many people use internet at work. Entreprises with broadband assess also signals sophistication of internet use as low quality inernet connection would make difficult to use some services.   Figure 4.5 indicates that in the most Central and Eastern European (CEE) countries around 90 percent of enterprises have access to fixed broadband with is consistent with the EU average. Exceptions are usual suspects Bulgaria and Romania but also Poland where the access is significantly lower. There is no significant difference between Estonia and Slovenia as both have one of the highest outcome in 2012 and the highest in 2004, where already two-thirds of enterprises in Estonia and Slovenia had access to fixed broadband while in other countries less than half did. It is also important to keep in mind that this data is collected by Eurostat only about companie which employ at least 10 persons.

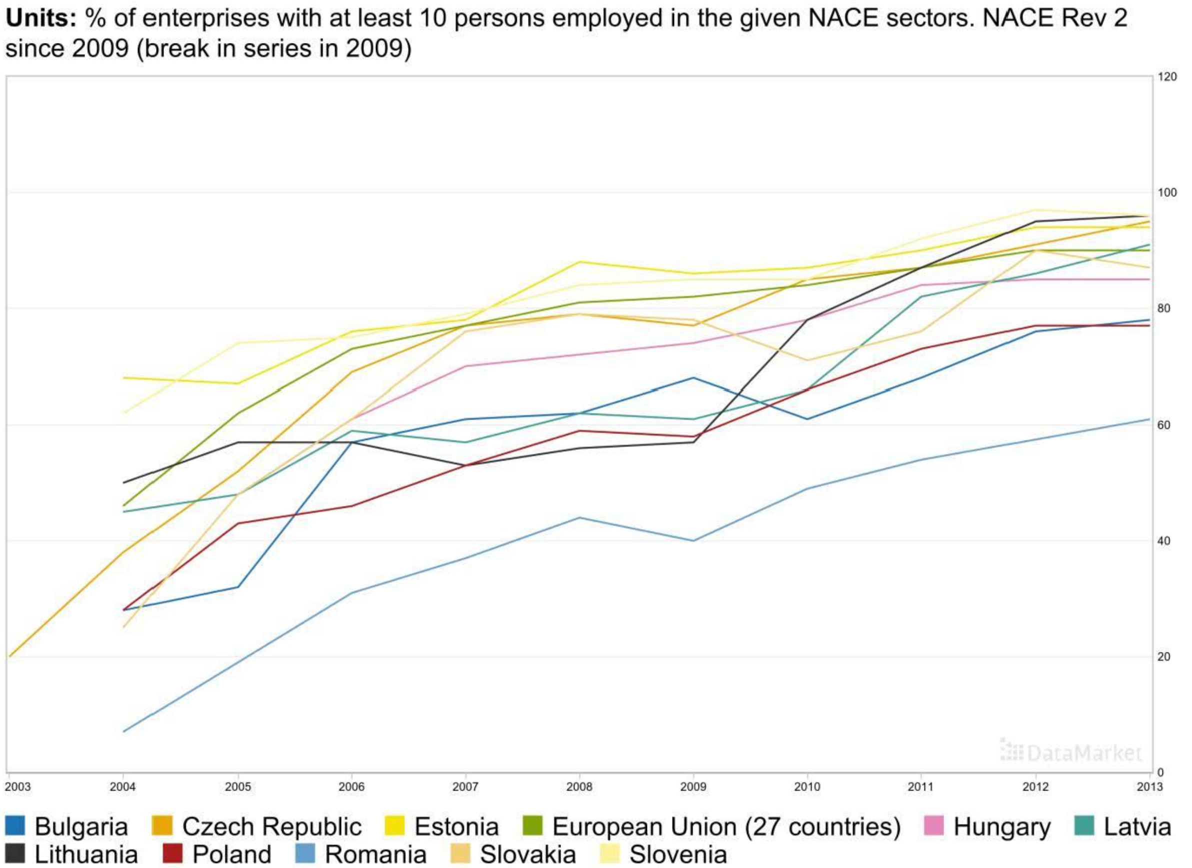

Figure 4.5: Enterprises with broadband access in the European Union and selected CEE countries in 2003-2013 on the basis of data from Eurostat (2014). [9]

[9] More detailed data is available in Appendix D.

It is also crucial to look at internet diffusion among different population segments. First I will look at regular internet use among men and women in Slovenia and Estonia. The regular internet use is a measure which tells us how often people actually use internet even if they may have a good access at work and home and they may report to the statistical office that they use internet. The Eurostat defines regular use in the following way: “Regular use: at least once a week (i.e. every day or almost every day or at least once a week but not every day) on average within the last 3 months before the survey. Use includes all locations and methods of access and any purpose (private or work/business related).”(Eurostat 2015).

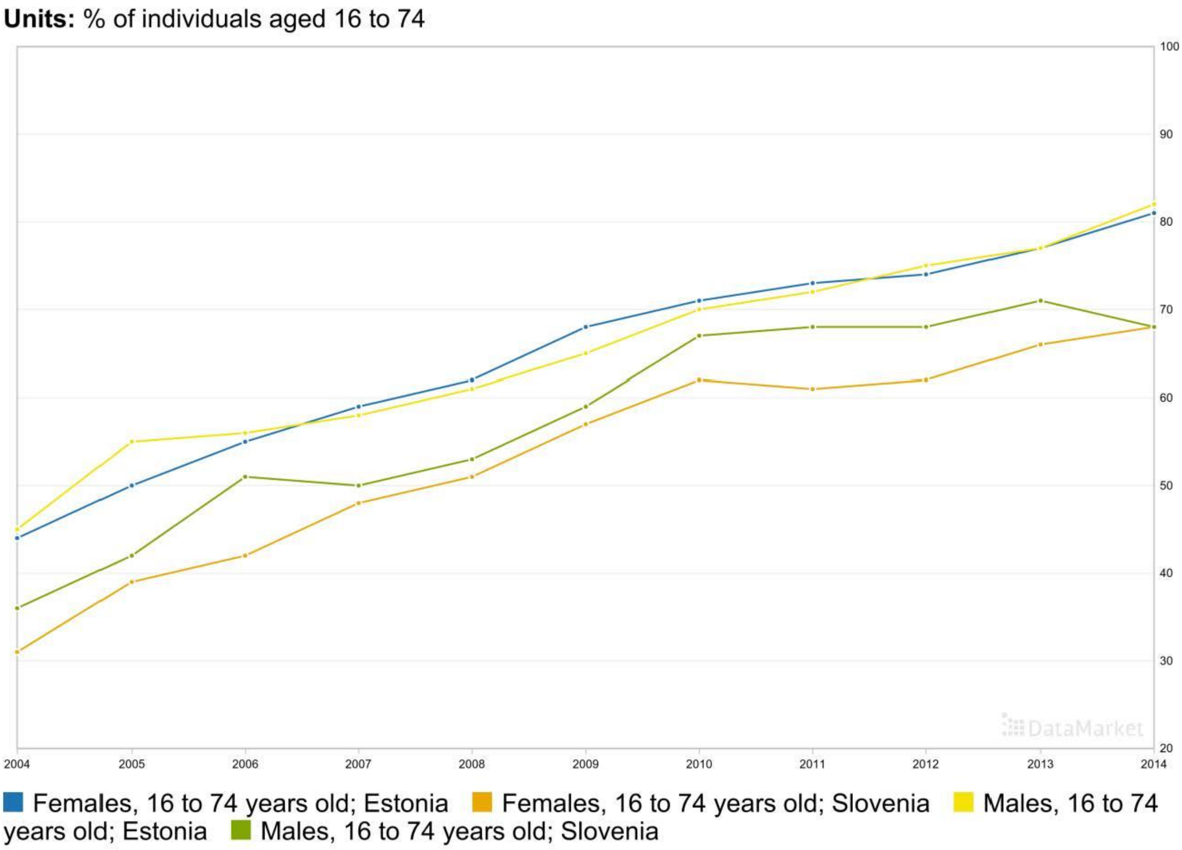

Figure 4.6: Regular use of internet in Estonia and Slovenia by males and females in 2004-2014 on the basis of data from Eurostat (2015)[10]

[10] More detailed data is in Appendix D.

The Figure 4.6 demonstrates clearly that regular use in Estonia is exceeds 80 percent among females and males in 2014. At the same time in Slovenia, the use is below 70 percent and on similar level among males and females. Regular internet use among Estonian females and males has been always higher from 2004 to 2014 than among Slovenian females and males. Quite interestingly, use among males used to be higher in Slovenia from 2004 to 2013 than among females. However, it reached the same level in 2014 but not because of increase in the internet use among Slovenian females but because decline among Slovenian males. This may represent some kind of statistical discrepancy stemming from particular characteristics from one year. If the long term trend is considered, then it is clear that regular internet use among both females and males has been equal in Estonia and it is higher than in Slovenia. Slovenians use internet less regularly and the males are more regular users than females.

Well educated and young people are regular internet users in almost every country. There are no significant differences between well educated and young regular users in Estonia and Slovenia. However, the diffusion process also depends whether laggards start using internet on a regular basis, which implies that suppliers of internet services also offer services that are accessible for differnet population segments. Figure 4.7 looks first at individuals between 25 to 54 years old but with low formal education. It also compares regular internet use among 55-74 years old with low formal education as well as internet use among 65 to 74 years old It turns out that people with low formal education and senior citizens are more avid internet users in Estonia than in Slovenia. This also explains the difference between regular use among Estonian females and males in comparison with Slovenian males and females. In Estonia, people in the bottom of education pyramid and in the top of education pyramid are more regular uses of internet than in Slovenia. In 2006, 30 percent of Estonians aged 25 to 54 years with low formal education used internet while only 11 percent of same population segment did so. By 2014, the internet use among the same group in Estonia had grown to 81 percent while reached 39 percent in Slovenia. The use among individuals aged 55 to 74 was in Estonia 21 percent while in Slovenia it was 10 percent. Here, the same pattern has persisted since 2009 (when the data is available for comparison). In Estonia, 41 percent of 65-74 years old used internet regularly in 2014 while in Slovenia only 21 percent did so in the same year. In 2007 the internet use was 11 percent among the same group in Estonia and 6 percent in Slovenia.

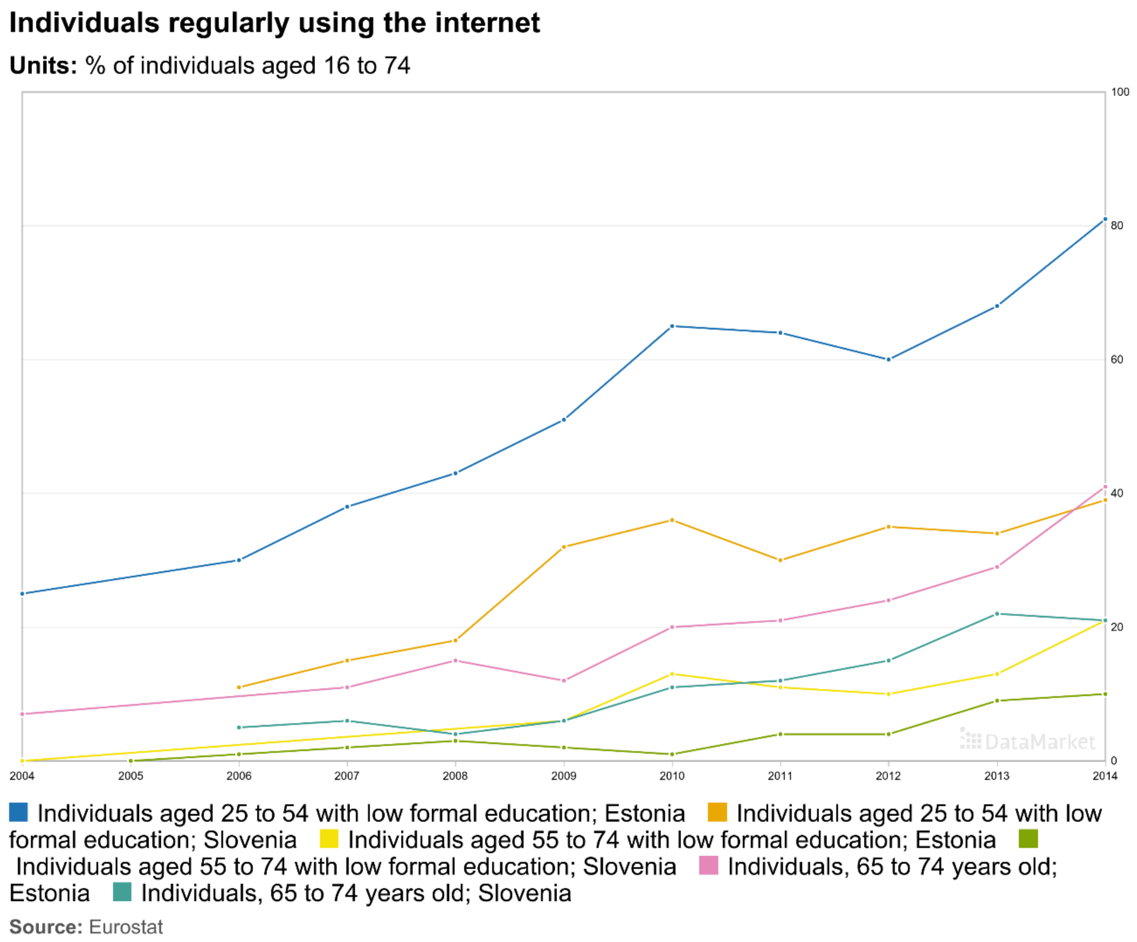

Figure 4.7: Regular use of internet in Estonia and Slovenia among users with low formal education and 65 to 74 years old in 2004-2014 on the basis of data from Eurostat (2015).[11]

[11] More detailed data is in Appendix D.

One additional way to measure distributional factors in the diffusion is is to consider urban and rural populations in the access to internet. The figure 4.8 indicates urban and rural households with internet access at home. It is obvious that there are not differences between Estonia and Slovenia as well as the EU average in 2012.

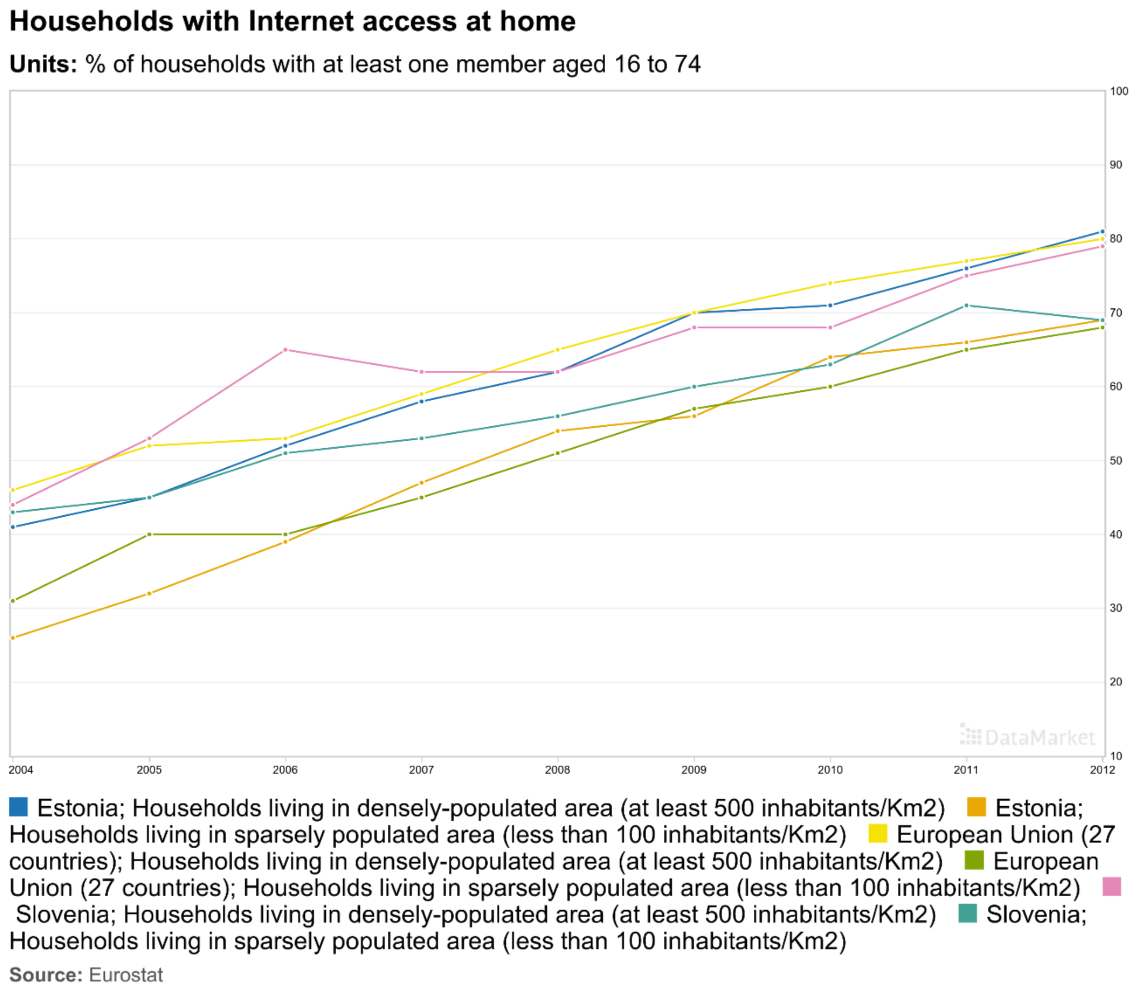

Figure 4.8: Households with internet access at home in rural and urban areas in Estonia, Slovenia and the European Union 2004-2013 on the basis of data from Eurostat (2014).[12]

Roughly 80 percent of urban populations have internet access at home while 70 percent of rural households have access. At the same time the dynamic picture is more telling. In Estonia, the growth of internet access in rural areas has been greater because the starting point was much lower - only 25 percent of Estonian rural households had internet access at

[12] More detailed data is available in Appendix 9.

home in 2004 while over 40 percent of households had internet access in the cities. There was no divide among city-rural lines in Slovenia at the same year. In other words, the gap between rural and urban households has been getting smaller in Estonia while it has been growing bigger in Slovenia between 2004 and 2013.

This is again remarkable in the context of population density. Estonia is significantly sparsely populated than Slovenia. In 2012 Estonia had 30.5 inhabitants per square kilometer while Slovenia had 102.2 inhabitants per square kilometer. It must be also noted that Slovenia is mountaineous while Estonia is flat. The former makes it more difficult to provide internet connectivity in remote areas, while the latter makes it easier. However, there are other factors that balance the topographical factors. As was pointed out Slovenia's population density is three times bigger than Estonia's population density. Also, Slovenian government owns a majority stake in the incumbent telecom company which makes it possible to direct investments to the areas which are underserved by telecom service providers.

The distribution of households with internet access by income allows to understand how the internet is diffused among different social and economic groups within country and between countries (Figure 4.9). This data is quite telling both on static and dynamic comparison. First, Estonia has much greater share of households with income in the first quartile than Slovenia, respectively 56 percent and 41 percent in 2012. At the same time both countries had same level of internet use with 24-25 percent in this income group in 2008. In other words, Estonia has more than doubled the internet use among poorest households in 6 years while the progress has been much more modest in Slovenia. The richest households in the fourth quartile have higher access at home in Slovenia (99 percent) than in Estonia (89 percent). There has not been much dynamic change in this income group in the last six years (Figure 4.9).

Estonia had higher share of households with internet access in both second and third quartile than Slovenia in 2013 as well as 2008. In the third quartile differences ranges between 5-10 percent depending on the year and Slovenia has narrowed the gap. However, in the second quartile Estonia had already 61 percent of households vs Slovenia's 39 percent in 2008 and respective shares have increased to 84 and 74 percent in 2013. Slovenia has narrowed the gap, but Estonia still has 10 percent more households with internet access in 2013.

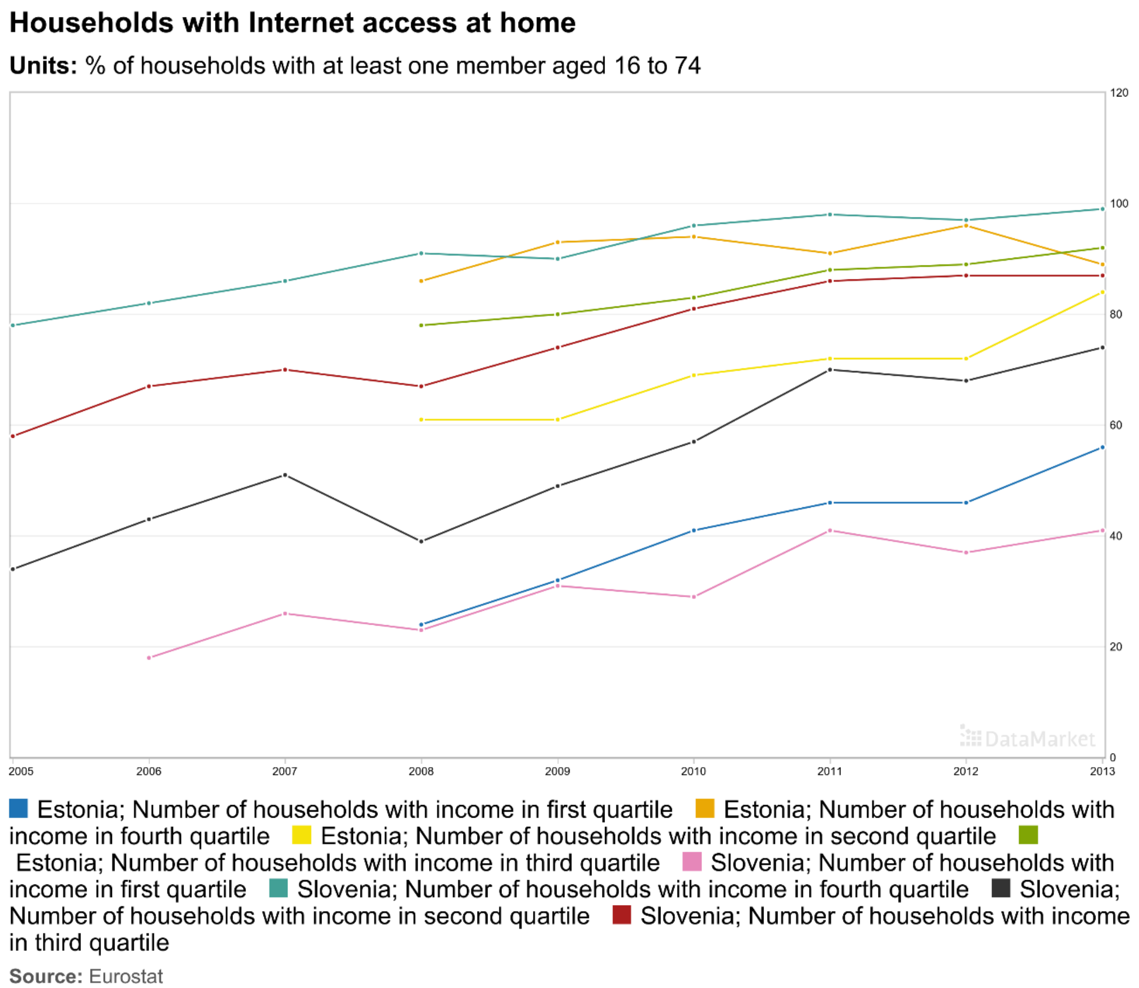

Figure 4.9: The distribution of households with internet access at home by income levels in Estonia and Slovenia on the basis of data from Eurostat (2014).[13]

[13] More detailed data is available in the Appendix D.

The bottom line is that internet access is and has been more evenly distributed among Estonian households with different income levels than Slovenia's households. Estonia has also managed to increase the share of households with internet access among the poorest households while in Slovenia the growth has been much more modest.

4.2.2 Supply-Side Indicators

The previous indicators have been primarily demand driven. Obviously, they are also affected by supply, i.e. if there is no supply of internet in rural areas, then it cannot be demanded. However, final decision is ultimately with those who demand internet. Now it is crucial to include two indicators of supply, which also highlight not just quantity but also quality of internet connectivity.

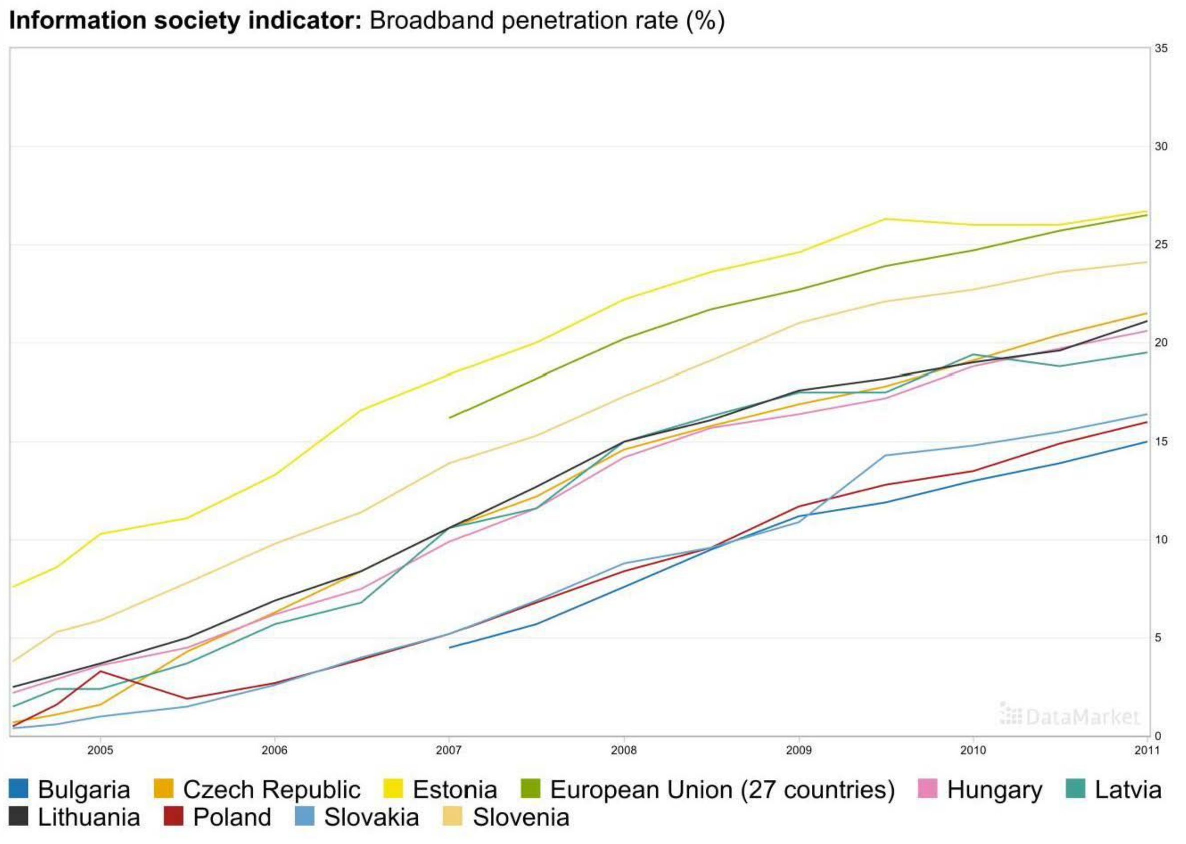

Figure 4.10: Broadband penetration rate in the European Union and selected CEE countries in 2005-2011 on the basis of Eurostat (2014). [14]

[14] The data is available for years 2005 to 2011 and not after that. More detailed information is provided in Appendix D.

First one is broadband penetration rate, which is expressed in percentages and it is calculated as the number of broadband access lines divided to population, multiplied by 100 (Figure 4.10). Obviously, more broadband access lines improve the quality of internet connection. By this measure, Estonia has been ahead of the EU average as well as any other country in the years from 2004 to 2011 (Figure 4.10). Even though, Estonia's penetration rate 27 percent is only slightly higher than Slovenia's 24 percent in 2011. However, Estonia's broadband penetration rate was 8 percent in 2004 while Slovenia's was four percent which was the second highest in the CEE countries. This indicates that Estonia was able to supply better quality internet connectivity earlier and people were able to use it for a longer time period than in Slovenia.

As users have started increasingly to exploit internet on their mobile devices, it is crucial to look at mobile broadband coverage as a supply-side factor (Figure 4.11). Even though 74 percent of Slovenia's population had access to mobile broadband and 62 percent did in Estonia in 2008, Estonia passed Slovenia already in 2009 and in 2010 mobile broadband was available for 90 percent of Estonian population which is same as the EU average but more than Slovenia's 80 percent.

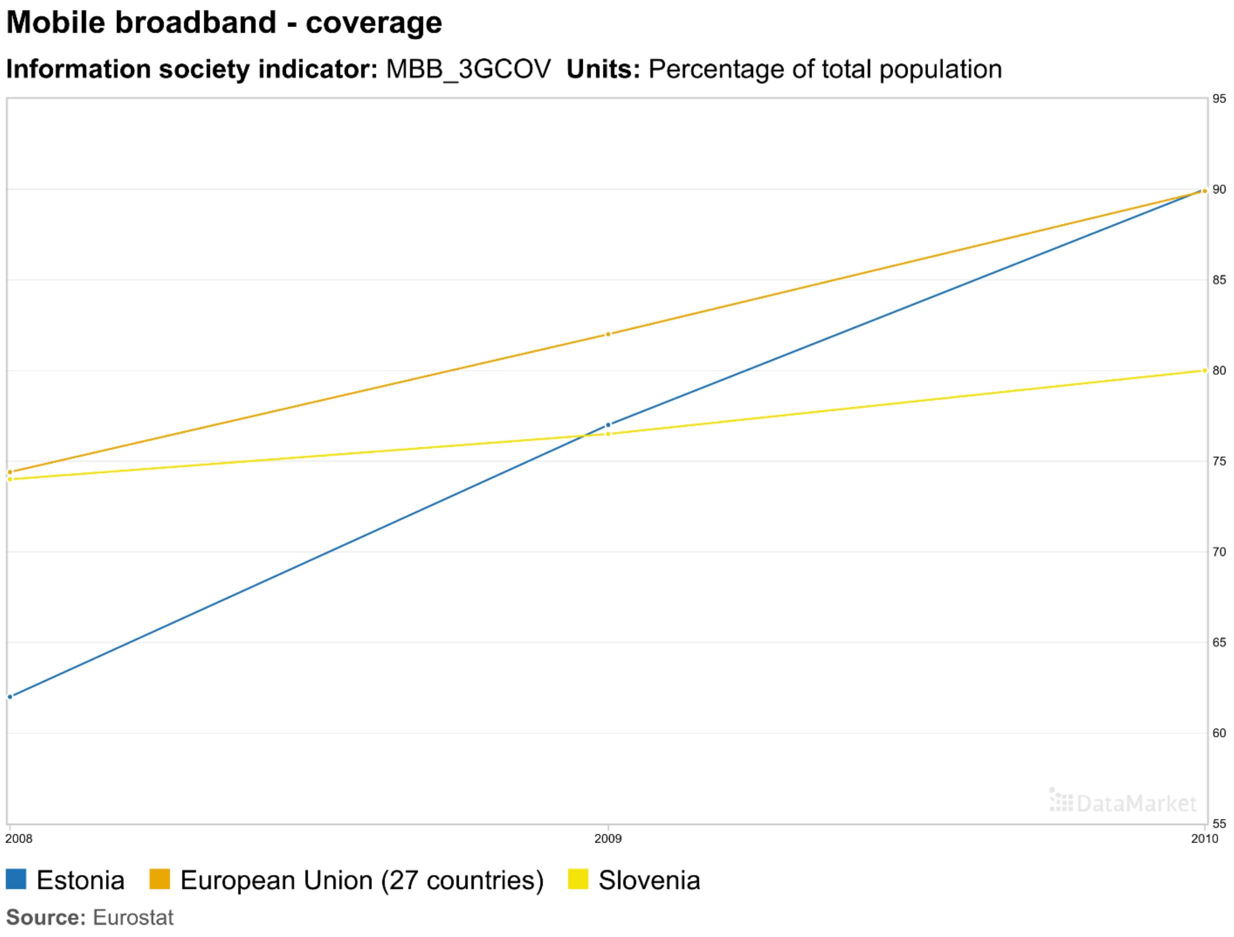

Figure 4.11: Mobile broadband coverage in Estonia, EU and Slovenia in 2008-2010 on the basis of data from Eurostat (2014).[15]

Since the Eurostat did not collect data after 2010 on 3G mobile broadband coverage as a percentage of population and started to collect data only on advanced 3G mobile broadband coverage as a percentage of households, then the Figure 4.12 complements Figure 4.11 with years from 2011 to 2013. Figure 4.12 shows the comparison between Estonia and Slovenia and benchmarks it against the EU average. The data shows that Estonia was relative laggard in 2011 with 87 percent of households covered against Slovenia's 97 but by 2013 both

[15] More detailed data is available in Appendix D.
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countries had reached almost 100 percent coverage in households.

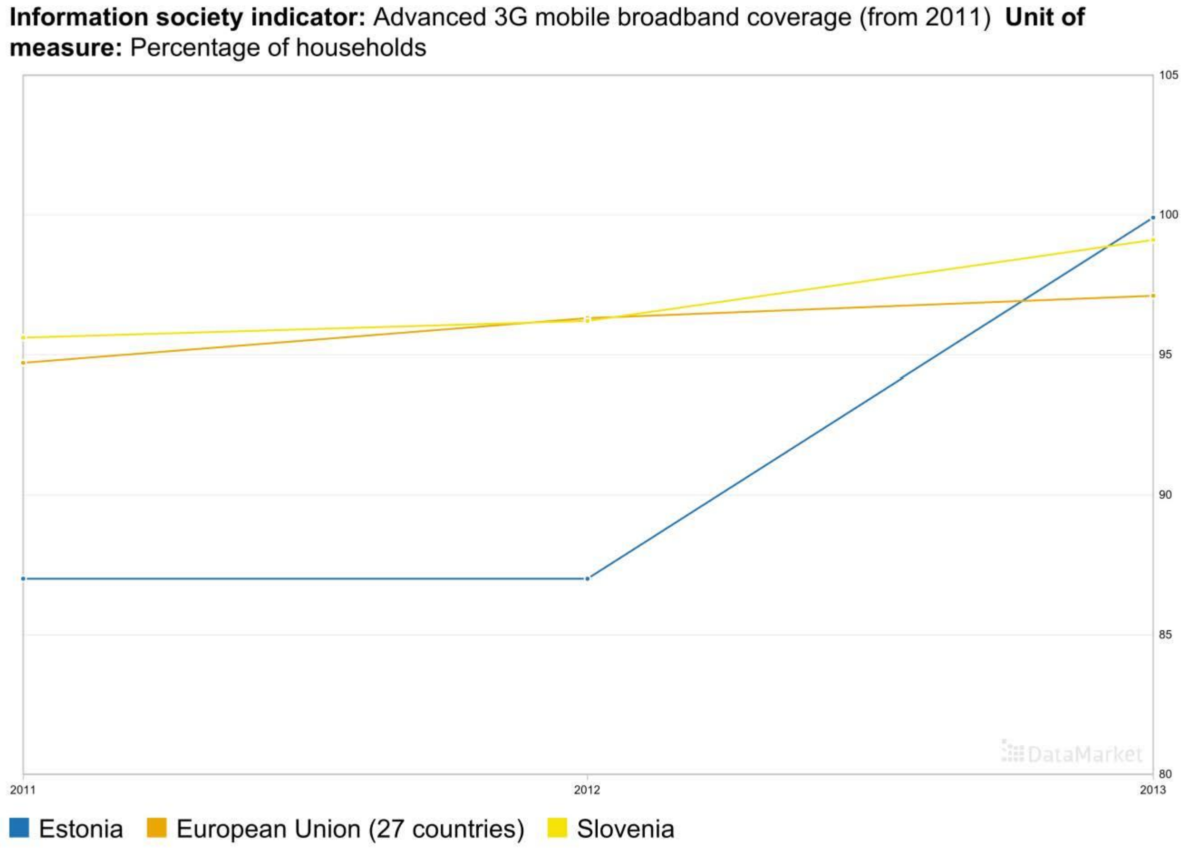

Figure 4.12: Advanced (3G) mobile broadband coverage in Estonia, EU and Slovenia in 2011-2013 on the basis of data from Eurostat (2014).[16]

This Estonia's superiority in delivering higher quality internet connectivity is further bolstered by comparing download and upload speeds in Estonia and Slovenia. As Figure 13 indicates, the Estonian download speeds have been higher on most years between 2008 and 2014. The upload speeds have been roughly the same in the same time period but in 2013 the Estonian upload speed is about two times faster than Slovenia's upload speed. To sum up. the internet diffusion was measured and compared in Estonia and Slovenia on the basis of eleven indicators which are summarized in the Table 3 below. Figure 4.1 and Figure 4.2 are presented as one indicator as they both measure internet users per 100 inhabitant. Figure 4.1

[16] More detailed data is available in Appendix D.
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was used to provide more context to understand where Estonia and Slovenia are based in a global comparison. Figures 4.11 and 4.12 are also presented as one indicator in the Table 4.1. They both measure mobile broadband coverage and as this technology is changing rapidly, the Eurostat has started to collect different data differently for more recent years

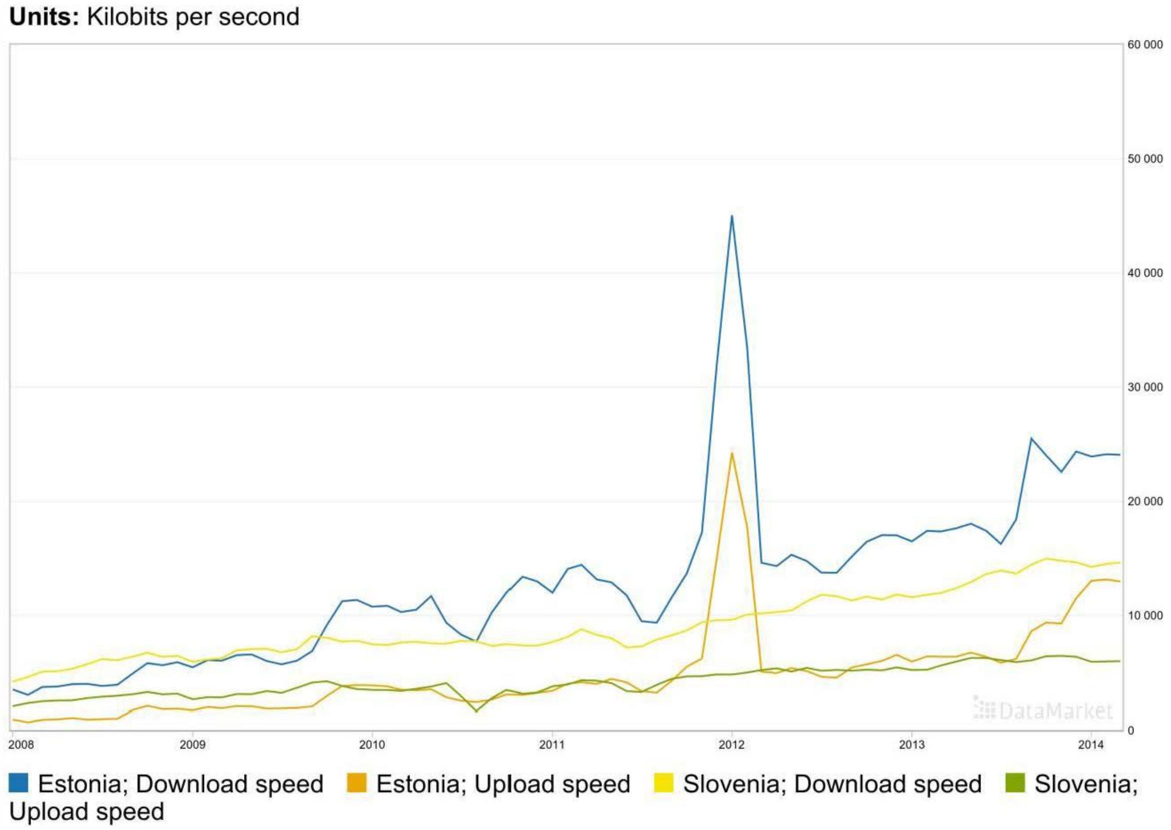

Figure 4.13: Download and upload speeds in Estonia and Slovenia 2008-2014 on the basis of data from Ookla (2014). [17]

Table 4.1 presents results in the form of all years when data is available and a snapshot of last year with available data. In the 'Over All Years' column of Table 3, Estonia performs better in 7 out of the 11 variables listed. In the 'Last Available Year' column, I list the country who scored better for that year for each indicator. In this column, Estonia outperforms Solvenia in 10 out of 11 variables. Slovenia only outperforms Estonia in the 'enterprises with broadband access' category. However, since Estonia was able to catch up

[17] More detailed data is provided in Appendix D.

with Slovenia over time and has better outcome in 10 variables out of 11 in the end, then it can be concluded that dynamic performance measure in terms of growth rate of Estonia has also been considerably better than Slovenia's. Only in category enterprises with fixed broadband access Slovenia is better in dynamic (over all years) and static (last available year) performance.

Table 4.1: Comparison of internet diffusion in Estonia and Slovenia on the basis of static and dynamic variables.

Indicator	**Over all years**	**Last available year**
Figure 1 and 2: Internet users per 100 inhabitants	Estonia	Estonia
Figure 3: Households with internet access at home	Slovenia	Estonia
Figure 4: Households with broadband access	Estonia	Estonia
Figure 5: Enterprises with fixed broadband access	Slovenia	Slovenia
Figure 6: Females and males regularly using internet	Estonia	Estonia
Figure 7: Individuals with low formal education and senior citizens regularly using internet	Estonia	Estonia
Figure 8: Households with internet access in areas with low and high population density	Slovenia	Estonia
Figure 9: Households with internet access by income	Estonia	Estonia
Figure 10: Broadband penetration rate	Estonia	Estonia
Figure 11 and 12: Mobile broadband coverage	Slovenia	Estonia
Figure 13: Download and upload speeds	Estonia	Estonia

Source: Author

However, it must be noted that variance between Estonia and Slovenia on following indicators; households with access to internet at home, households with access to broadband, enterprises with access fixed broadband and households with access to internet in rural and urban areas is relatively small. Neverthelesss, these eleven indicators suggest that Estonia has been able to diffuse better quality internet than Slovenia by giving its users more time to experience with it. In addition, Estonia has been able to diffuse internet more among different demographic and socio-economic groups and has a less constraints on the supply side than Slovenia. Particularly remarkable is higher regular use of internet among older people, people with low levels of education and income in comparison with Slovenia. In other words, there are significant differences between Estonia and Slovenia by measuring both extensity and intensity of internet diffusion. The next part of this section offers a description of some crucial factors in understanding these differences.

4.3 Internet Diffusion and National Wealth

The literature review in Chapter Two outlined a hypothesis which several studies have failed to reject that internet diffusion is correlated with nation's wealth. This correlation seems to suggest a certain causality that wealthier countries have higher degree of internet diffusion than less wealthier countries. This may be so dependening on the sample and specific conceptualization of internet diffusion. However, this is not clearly the case with Estonia and Slovenia. Both countries have similar or higher levels of internet diffusion depending on the variable used than the average of countries of the European Union and the OECD, but they have and have had considerably lower per capita gross domestic product (GDP) at purchasing power parity (PPP) than the OECD and EU average, as indicated in Figure 4.14. Furthermore, Estonia used to be two times poorer in 1993 than Slovenia and was still about one fifth poorer than Slovenia in 2012. Figure 4.14 shows that GDP at PPP in the 2005 constant international dollars for Estonia, Slovenia, OECD members and EU average.

Furthermore, if the comparison is made with all the CEE countries that joined the EU in 2004 and 2007, then it is obvious that Estonia had one of the lowest per capita GDP at PPP in this group in 1993. It has one of the highest in 2012 but its is still significantly lower than that of Slovenia and the Czech Republic. Countries with relatively similar levels of per capita GDP such as Estonia, Lithuania, Poland and Hungary have quite different outcomes in internet diffusion.

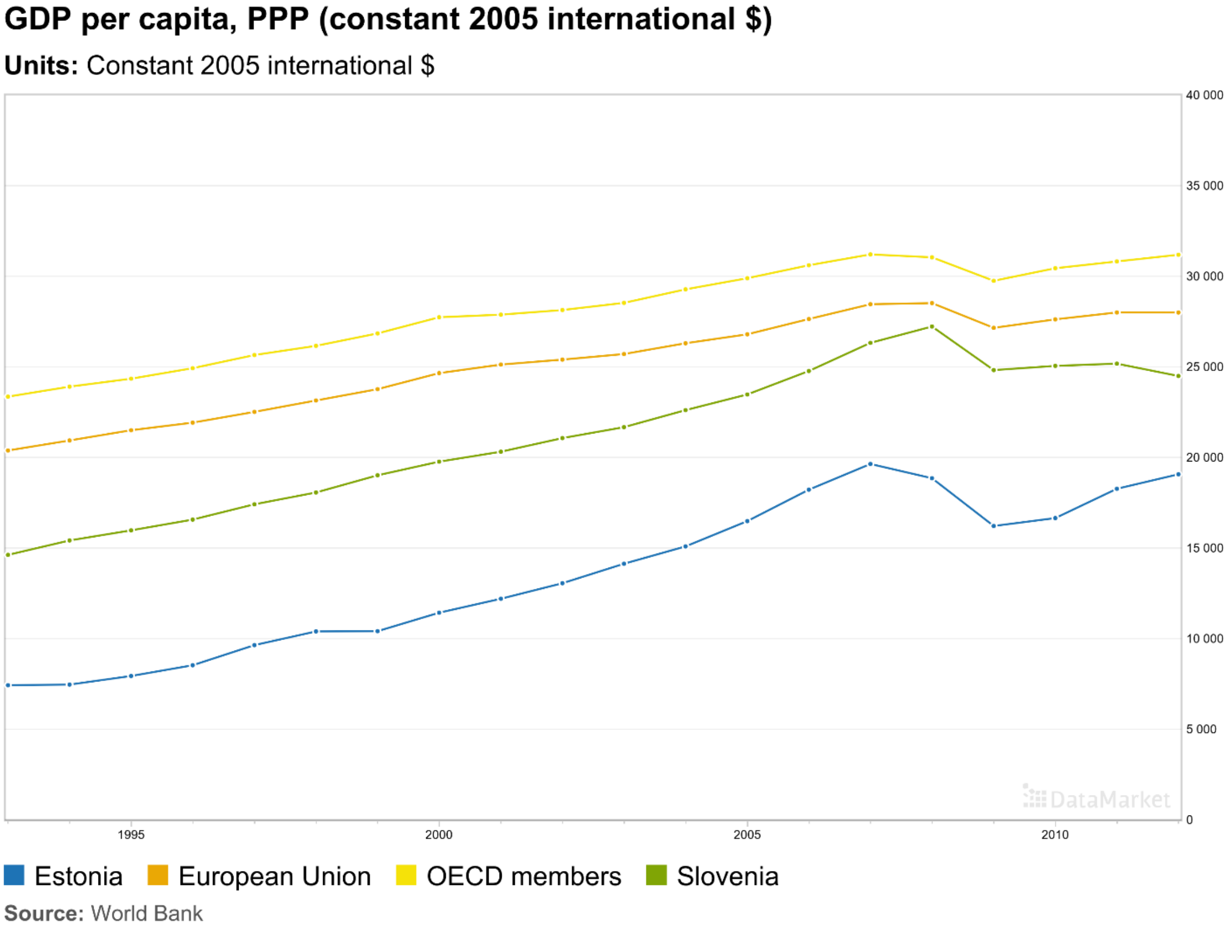

Figure 4.14: Gross Domestic Product per capita at Purchasing Power Parity in Estonia, Slovenia, EU and OECD 1993-2012 on the basis of data from World Bank (2013).[18]

Most importantly, despite of being significantly poorer Estonia actually has either achieved the better outcome on the basis of eight internet diffusion indicators than Slovenia. Estonia's outcome in internet diffusion is particularly remarkable in comparison with Slovenia across different socio-economic groups despite of differences in the per capita GDP. In other words, an average Estonian is considerably poorer than an average Slovenian but the average Estonian is more avid internet user than the average Slovenian. One plausible

[18] More detailed data is in Appendix D.

explanation could be that Estonia has greater degree of income equality than Slovenia and the distribution of internet access among different households just reflects it. Quite puzzlingly, the opposite is true. Estonia is significantly more unequal than Slovenia and than the average of European Union as well as members states that joined in the EU in 2004 and 2007.

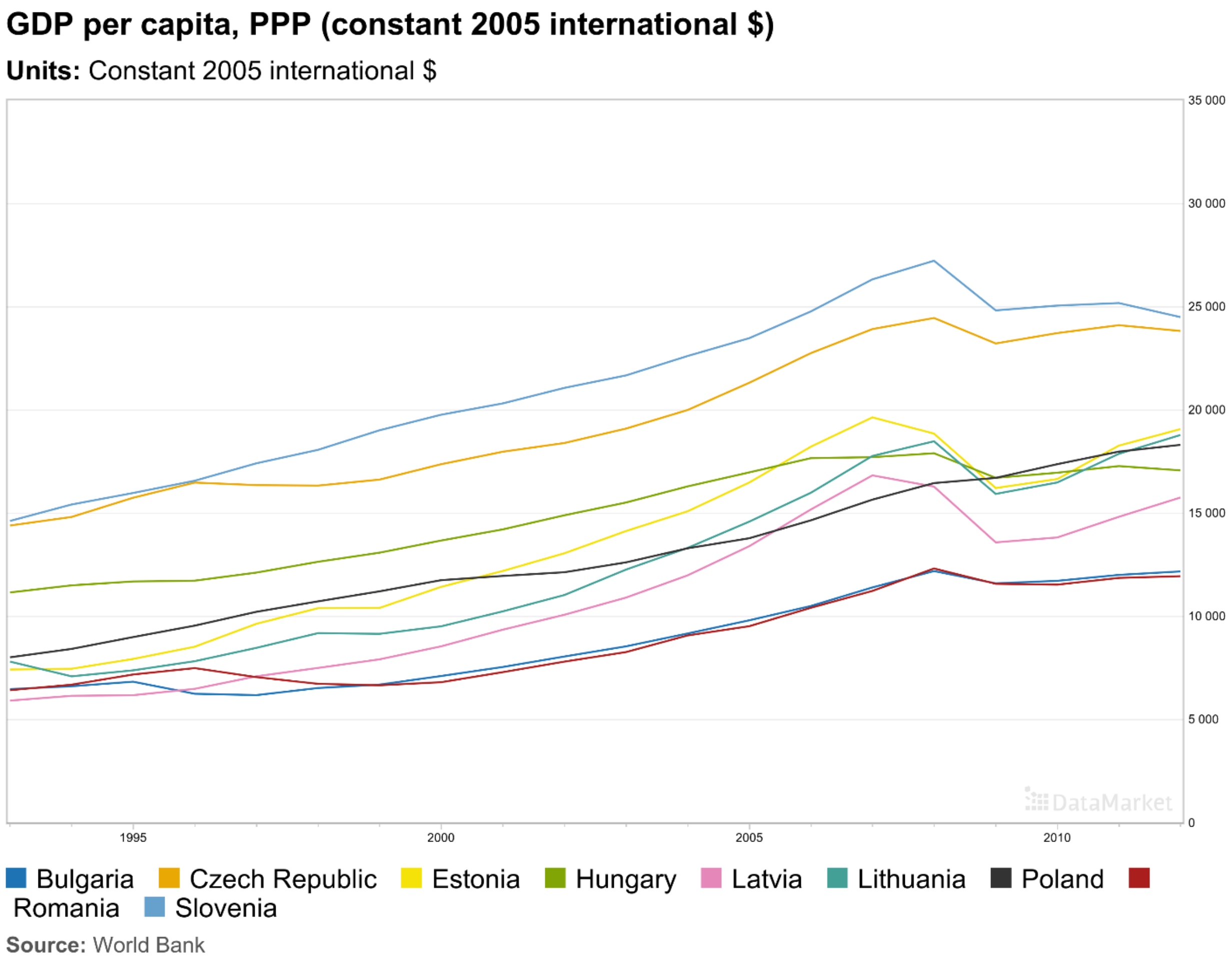

Figure 4.15: Gross Domestic Product per capita at Purchasing Power Parity in Estonia, Slovenia and selected CEE countries in 1993-2012 on the basis of World Bank (2013).[19]

Estonia's gini coefficient has been decreasing from the peak of 0.37 in 2004 to 0.33 in 2013 but Slovenia's gini has stayed at stable 0.24 percent during the same time period (Figure 4.16). In other words, the use of internet has increased among poorest socio-economic groups in Estonia despite of the fact that their income is smaller in both absolute and relative terms

[19] More detailed data is in Appendix D.

than similar groups in Slovenia.

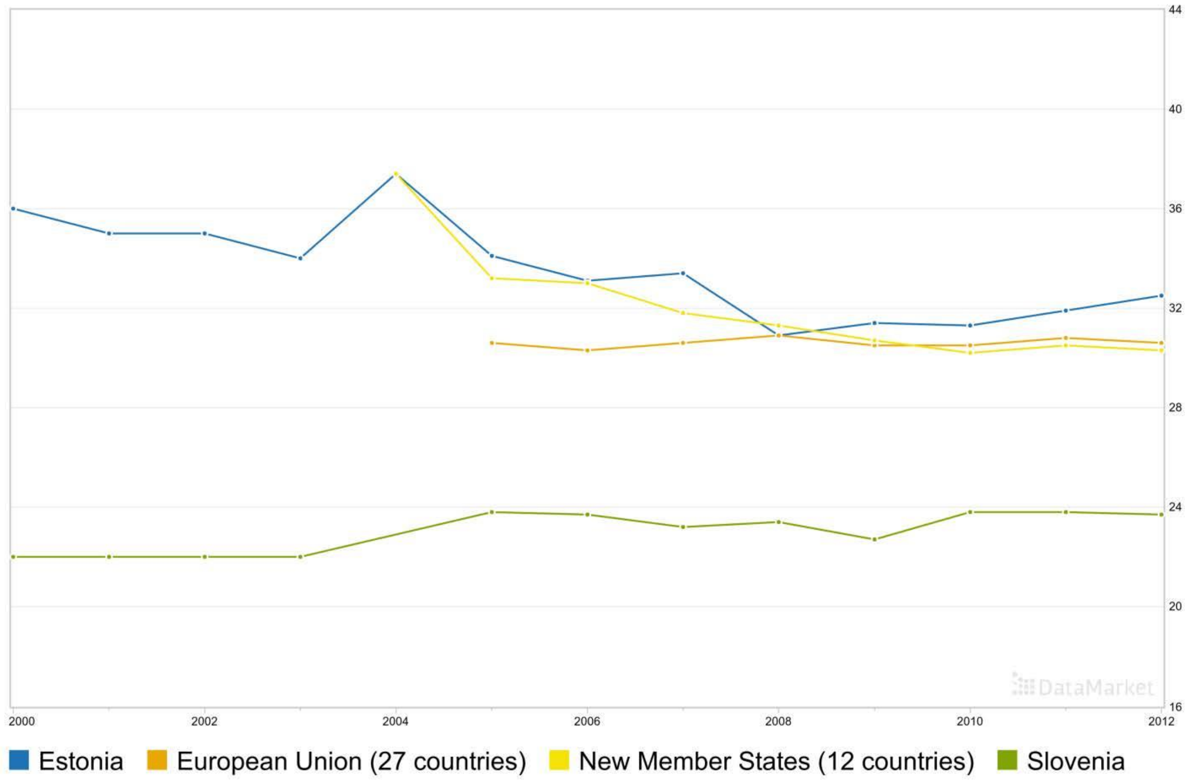

Figure 4.16: Gini coefficient of equivalised disposable income in Estonia, Slovenia, European Union and new member states of the European Union in 2000-2012 on the basis of data from Eurostat (2013). [20]

Thus per capita GDP cannot be a variable that would explain why Estonian internet users have enjoyed better quality internet connectivity for a longer time period and why internet use is more evenly spread among Estonian internet users with different income levels than Slovenian users. Most importantly, the the national wealth hypothesis would suggest that Slovenians should not only have higher and better quality internet connectivity than Estonia but also the diffusion of internet should be more equal among users with different income levels. Particularly so as Slovenia's gini coefficient suggest that income equality is much greater than in Estonia. As we saw above, the opposite is true. Internet diffusion in Estonia is much more egataliarian than in Slovenia. Most importantly, socio-economic groups with lower income in Estonia use internet more than in Slovenia.

[20] More detailed data is in Appendix D.

4.4 Institutional changes in Estonia and Slovenia

One factor that emerged in the literature review (Chapter Two) as an explanation for understanding differences in the internet diffusion were institutions defined as formal and informal rules of the game. Hence, institutional factors have to be considered in understanding the differences between Estonia and Slovenia. This section offers an overview of formal institutions and their changes. Obviously, some insights from the literature review do not offer much explanatory power. It is evident without much deliberation that political regime type whether democracy or dictatorhip cannot explain differences between Estonia and Slovenia, since both countries have been democracies since the early 1990s. Both countries joined the European Union in 2004 and have adopted same detailed EU rulebook which covers significant part of their domestic formal institutions. Therefore the consideration of formal institutions has to be unpacked further.. Even though the EU is considered the most legalized international organization in the world, and its role in shaping the domestic rules goes beyond of what the international relations scholars usually expect of international organizations, the implementation of its formal rules in different member countries still varies significantly.

The literature review discussed the work by Dasgupta et al (2001), Fink et al (2003) and Guillen and Suarez (2005), and reveals that the institutions that may matter most for the availability of high quality internet connectivity are the rules governing the telecom sector. The OECD has been collecting data on the restrictiveness of telecom sector regulation, i.e how open the sector has been to competition. One of the key findings by Dasgupta et al (2001), Fink et al (2003) and Guillen and Suarez (2005) was that telecom sector liberalization and increased competition benefits the availability of telecom services. The data in Table 4.2 shows clearly that Estonia has one of the least restrictive regulatory regimes among the OECD countries while Slovenia has the most restrictive regulatory regime right after the

Luxembourg. Estonia scored 1 out of 6 point scale in 2008 and had almost reduced by half its ranking on restrictivness index in 2013 (Lower the number less restrictive, i.e. more competitive, is the telecom sector). At the same time, Slovenia scored 2 out of 6 in 2013 and the reduction in the ranking had been minimal in comparison with 2008. The OECD and EU average score has been 1 out of 6 in both years. In other words, not only had Estonia low degree of restriveness in 2008 it also managed to reduce it significantly while Slovenia's ranking stay constantly high indicating high degree of restrictiveness.

Table 4.2: Restrictivness of telecom sector regulations and regulatory protection of incumbents in Estonia and Slovenia in comparison with the OECD average 2008 and 2013.

Indicator/Unit	**Estonia**	**Slovenia**	**OECD average**
Restrictiveness of telecom sector regulations in 2008 (From 0 to 6)	1[21]	2.2	1
Restrictiveness of telecom sector regulations in 2013 (From 0 to 6)	0.5	2	1
Regulatory protection of incumbents in 2008 (From 0 to 3)	1	1.4	1.25
Regulatory protection of incumbents in 2008 (From 0 to 3)	0.75	1.4	1.25

Source: Author on the basis of data from the OECD (2014)

Similarly, Slovenia has higher protection of incumbent companies in the marketplace, including telecom companies (Table 4.2). The level of protection was 1 out of 3 in Estonia in 2008 and it was decreased to 0.75 in 2013. The lower number means that government regulations protect less incumbents and encourage competition. At the same time the Slovenia's protection of incumbent companies has stayed over 1 in both years and is slightly

[21] Numbers in this table are approximations.

higher than the EU average but slightly lower than the OECD average which is heavily inlfuenced by extreme outliers such as Mexico and Israel.

The telecom sector regulations and protections influence internet diffusion because in restrictive markets where incumbents are protected entry of new services and new competitors is difficult, if not impossible. Lack of competition allows incumbents to charge higher prices for internet diffusion which reduces demand. It makes it also difficult to offer new services because incumbent may discriminate against new entrants. At the same time, the incumbent companies may lack incentives to provide new services because they do not face competitive pressures. In other words, restrictive regulatory regime and protection of incumbent companies in the marketplace does not allow the process of entrepreneurial discovery to take place. The importance of entrpereneurial discovery and reduction of institutional barriers on supply-side was emphasized in sections 2.4 and 2.5 in Chapter Two.

Obviously, such comparisons on the basis of OECD data are just a snapshot in 2008 and 2013 and do not offer sufficient levels of detail to understand the differences. Hence, the next part of this chapter describes formal institutions and their changes in Estonia and Slovenia in a greater detail. It starts with the discussion on Estonia which is followed by overview on Slovenia. The ideas concerning formal institutions and their impact on internet diffusion were first developed in my Master of Arts in Law and Diplomacy thesis at the Fletcher School at Tufts University (Kitsing 2004). The following sections build on the thesis.

4.4.1 General Background of Institutional Changes in Estonia

Before we take a detailed look at the telecom sector regulation it is important to consider broader institutional context and its evolution in Estonia. It may seem obvious to informed reader but it is crucial to keep in mind that Estonia was once one of the republics in the Union of Soviet Socialist Republics (USSR) in the years 1940-1991. If we place the use of internet per 100 inhabitants in the context of all former USSR member states, then the number of internet users in Estonia is highly remarkable as Figure 19 demonstrates. Certainly, it must be kept in mind that in many ways Estonia was one of the most developed members of the USSR but nevertheless, the progress is quite stunning in comparison. With some former members of USSR there is eight time difference in internet users per 100 people. Even more wealthy parts of former USSR such as Russian Federation have only half of its population online in 2012. The dynamic picture also shows clearly that Estonia was quick to adopt internet use in the second half of the 1990 while even its close neighbors Latvia and Lithuania with similar level of economic development lagged behind.

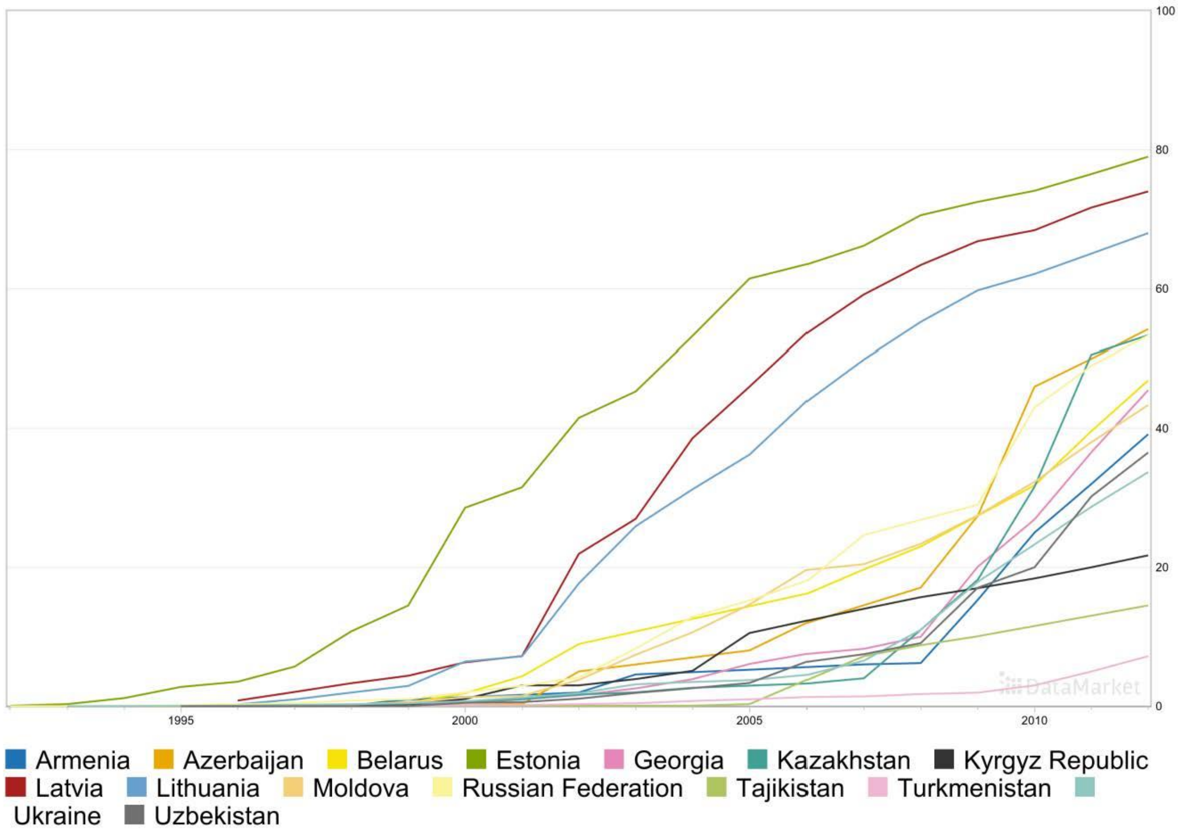

Figure 4.17: Internet users per 100 people in the former republics of the USSR on the basis of United Nations (2014).[22]

[22] Detailed data is available in Appendix D.

In order to understand Estonia's quick adoption of internet, it is crucial to understand the general institutional changes as well as specific changes concerning telecom and ICT sectors that took place in the country. Formal institutional changes in Estonia were rapid and radical in the 1990s (Laar 1996; Freytag 2003; Sorg and Vensel 1999). Significant highlights include corporate and personal income tax reform, which introduced a flat tax rate of 26 percent in the early 1990s (Feldmann and Sally 2001, 7; Freytag 2003, 11). As of 1999, reinvested corporate profits are not subject to income tax. The currency board system was boldly introduced in 1992 – against the advice of the IMF (Iwaskiw 1996, 41; Sally and Feldmann 2001, 6). Government spending as a percentage of GDP was reduced to less than 40 percent, and has remained at that level (Freytag 2003, 11). State subsidies were eliminated (Feldmann and Sally 2001, 7). Large-scale privatization started in 1992, and most enterprises were sold by 1995. Since 1993, it has been constitutionally stipulated that the general central government budget must be balanced (Freytag 2003, 9). Import quotas (a main form of trade protection until 1993) and significant tariffs were completely abolished in 1993. By 1997 Estonia had switched to completely unilateral free trade with zero percent tariffs on all imports (Feldmann and Sally 2001). Previous restricitions put on foreigners wanting to buy domestic firms and real estate were also lifted. These institutional changes combined to create one of the most favorable foreign investment climates in Central and Eastern Europe.

The basic ingredients for the implementation of the rule of law were set out in the early 1990s. The bankruptcy law took effect in 1992 and the system of courts was improved to exercise and enforce contractual rights (Laar 1996, 98). Certainly, the institutional changes implemented by Estonia in the 1990s could not immediately introduce institutions as complex and sophisticated as those in Western Europe. Nevertheless, the Competition Act of 1998 was already in line with EU legislation, except in the area of merger control. The Estonian Competition Law became fully compatible with the EU legislation in 2001 (Freytag 2003, 13). Nonetheless, the quite simple economic system in Estonia and a lack of sophisticated institutions managed to create sufficient conditions for outstanding economic performance in the 1990s.

Once the economic recovery took off, it was also able to bear the high costs of institutional convergence with the laws of the European Union; Estonia joined the EU in 2004. Prior to the obligation of complying with the EU's conditionality, the radical changes in the rules of the game were actually effective and sustained despite political fragility. The most important reforms were the result of bottom-up policy initiatives – not imposed in a top-down fashion by international organizations (Feldmann and Sally 2001). There was little disagreement about the substantial nature of the reforms among the major political parties (Tallo 1995). The party views differed mainly in their assessment of the recent past and regarding issues of nationality (Tallo 1995). These converging attitudes and beliefs of politicians made it easier to carry out the changes in the formal institutions.

4.4.2 Institutional Changes in the Estonian Telecom Sector

Having looked at general changes in the institutional framework, it is now fitting to give attention to the changes in the rules of the game governing telecommunications and information technology. In 1992, the Estonian government signed a concession agreement with *Telia* and *Sonera* of Sweden and Finland, respectively (now TeliaSonera). Both companies acquired half of 49 percent of shares in the incumbent telephone company. A monopoly on fixed-line telephone calls was bestowed on the incumbent, *Eesti Telekom*, until the end of 2000 (WTO 1999, 11-12). In 1997 the company, which had by then been restructured into *Eesti Telekom*, offered 24 percent of the government's 51-percent stake through initial public offering (IPO) to domestic and international investors. The government remained a holder of a 27-percent stake in the telecom company until 2010 when the Estonian government exited from the company.

An independent regulator of the telecom sector was set up in 1998. Nevertheless, the EU still raised concerns in 2002 over potential conflicts of interests stemming from the fact that the telecom regulator is under the administrative authority of the Ministry of Economy and Communications (Commission of the European Communities 2002, 90). The Ministry of Economy and Communications did not represent state interests as a shareholder in *Eesti Telekom* (the incumbent company regulated by the independent telecom regulator) and the ownership rights were transferred to the Ministry of Finance in 2000. This created an additional layer for avoiding the potential conflict of interests. Nonetheless, both ministries represent the same government in the end. Obviously, the conflict of interest or potential conflict of interest was finally resolved with the government exit from the incumbent in 2010. However, the regulator of the market – the Competition Authority – still remains as an agency of the Ministry of Economic Affairs and Communications and its independence has not increased over time.

The provision of leased lines and alternative infrastructure use was partially liberalized before the end of 2000. Estonia had a free market for data transmissions, Internet service providers (ISPs) and backbone service providers before the end of the monopoly on voice services (ESIS 1999). The key commitment concerning the EU was to lift all limitations on market access and national treatment by January 1, 2003, thereby ending the monopoly on fixed-line telephony services. However, Estonia adopted its new Telecommunications Act in February 2000, which lifted the limits on market access and national treatment in the telecommunications market by January 1, 2001 (Commission of the European Communities 2002, 89-90).

Obviously, the development of telecom sector also depends on the general development of information and communication techologies sector. This is not just about infrastructure but variety of products and services that are necessary for infrastructure as well as the use of infrastructure. It can be clearly said that a key institution in development of ICT sector in Estonia has been market since the early 1990s and in the telecom sector, the market has driven developments since early 2000. The Estonian ICT market and telecom market appears to work relatively well with several competitors in all sectors and decreasing prices for end customers. There is effective competition in more segments of the industry than in almost all other EU member states. As the section on internet diffusion highlighted, high quality internet services are widely available for all segments of society. Mobile phone penetration is significant with approximately 135%. Mobile payments are widespread in Estonia, primarily due to effective co-operation between stakeholders. For instance, mobile parking (paying for parking with your mobile phone) was introduced in Estonia already in 2003 and, by 2012, 85 percent of those parking in capital city of Tallinn used this method. In addition, m-payments are a popular method of payment for covering the costs for certain types of services, e.g. for playing and paying for lotto, buying electronic bus tickets.

There have not been any significant competition concerns in ICT and/or telecom markets since Estonia joined the EU in 2004. As competition in the ICT market and telecom market has been effective, no special measures have been taken to encourage innovation through means of competition policy. Interviews reveal that vigorous competition, market forces and competitive pressure necessitate companies to stay innovative in order to stay competitive (Interviews 16 and 19). Supervision on competition in the market is exercised by the Estonian Competition Authority under the Competition Act and the Electronic Communications Act. The World Economic Forum has given Estonia a relatively high rank of

25 in its network readiness index in 2009, where important component indirectly and directly is competition (World Economic Forum 2010).

All of this is not to suggest that there are no improvements to be made. If Estonia is compared with its wealthier Nordic neighbors (Figure 4.18), where over 90 percent of population use internet, then obviously there is still potential progress to be made in increasing the use of internet among its population.

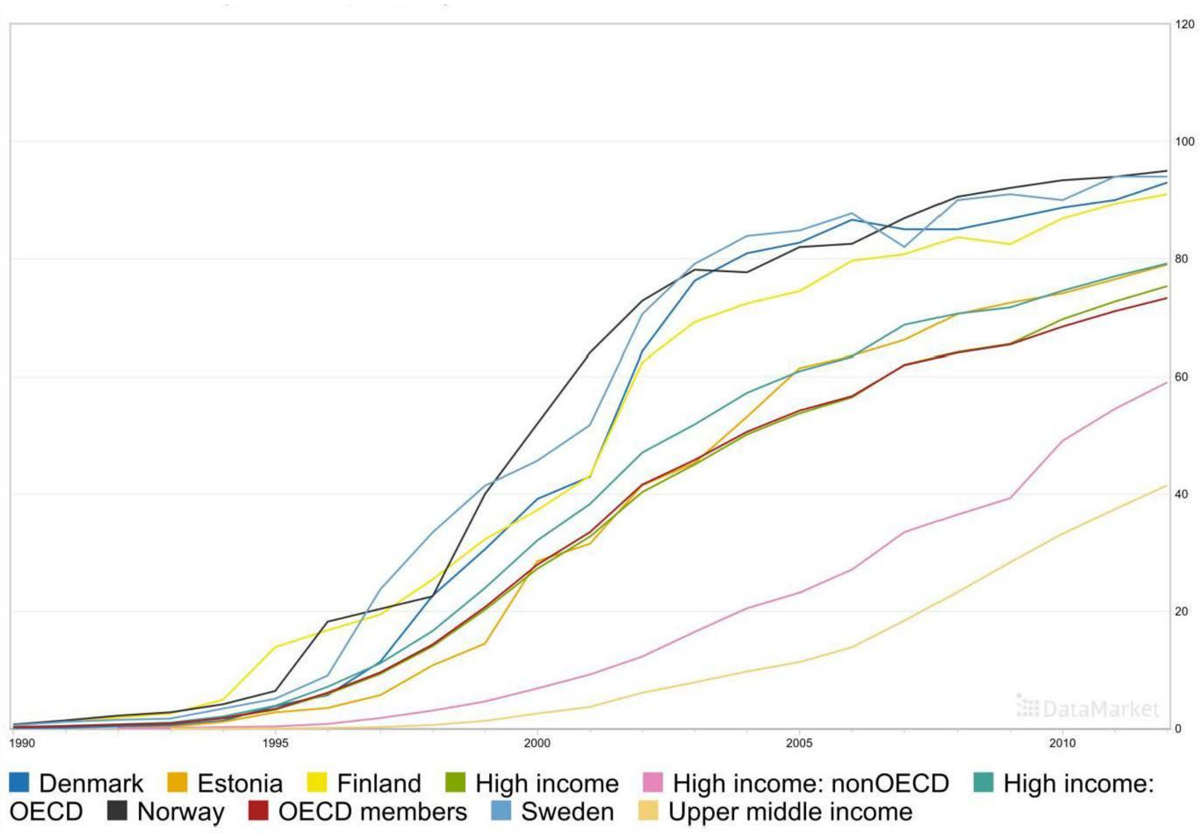

Figure 4.18: Internet users in Estonia, Nordic countries, high income OECD members, high income countries, high income non-OECD and upper middle income countries on the basis of data from United Nations (2014).[23]

Of course, the Nordic countries are exceptional in comparison with OECD and high income OECD countries, which on average have same level of internet use as Estonia. Estonia has 2-3 times lower per capita GDP (depending how it is measured) than the poorest

[23] Detailed data is available in Appendix D.

Nordic country and significantly different instutional development. However, Estonian policy-makers often compare the performance of Estonia with its Nordic neighbours, particularly with Finland. This comparison is more aspirational rather than analytical but it does give a different perspective and aspirational comparisons matter because they feed back into policy-makers mind-set and their framing of policy-issues

Even though Estonia has a higher percentage of internet users than the average of EU 27 member countries, the question of digital divide is still relevant particularly in the aspirational context of Nordic neighbors and the Estonian government rhetoric that access to internet is a basic human right. Despite the human right status of internet access, the extensity and intensity of internet use differs among different social groups and regions. The competition in offering broadband services in bigger cities is tough and the communications operators have replaced the connections using the out-dated technologies with the fibreoptic networks. The basic networks of almost all the major communications operators in cities are based on the fibre-optic connections. The fibre-optic networks in cities are expanded gradually and in the coming years all the residential houses and office buildings will be equipped with next-generation broadband. Although the investments made by the communications operators in next-generation broadband are significant, the high concentration of customers makes it profitable (Interviews 16 and 19).

There is virtually no competition in rural areas because the market is small and unconcentrated. Due to this, broadband is much less available and its quality remarkably lower than in cities and at the same time the fees are much higher. The construction of next-generation broadband networks in rural areas is, for the communications operators, economically not profitable and therefore the investments for business purposes in these areas are not very likely to be made. Hence, Estonia has reached a phase where internet connections in rural areas are less available and their quality much lower than in cities but in spite of that the communications operators develop next-generation broadband only in bigger cities. The Internet services is offered in rural areas, however, only through the out-dated technologies, and due to the lack of investments, these connections will become useless in some years time as they do not enable the new information society services to be used. If this trend continues, the digital divide between cities and rural areas will widen even further and ever more people and businesses will be living and operating in cities with proper ICT infrastructure (Interviews 16 and 19).

The government and telecom companies aim to tackle the gap between rural and urban areas with the broadband project EstWin, which aims at ensuring internet connection with speed up to 100Mbps for all by 2015, also contributes to the improvement of information technology diffusion throughout the country (Interviews 16 and 19). EstWin was launched by the Ministry of Economic Affairs and Communications and some member companies of Estonian Information Technology and Communications association (EMT, Elion, Elisa, Ericsson, Eltel, Levira, Tele 2, Televõrgu AS), which set up the Estonian Broadband Development Foundation for this purpose in 2009. The EU Commission approved state aid status for the project in 2010. EstWin aims to build a network of fibre optical cables in Estonia by 2015 where 98 % of households, organizations and companies have to be within 1.5 km radius of the backbone network connection (Interviews 16 and 19). National Government is involved in investing in backbone network while providing connection for so-called last mile is the responsibility of telecom operators. Estwin will build a network with a length of 6000 km and with 1400 network connection points. The government finished 1200 km of the backbone network by the end of 2011. The cost of the project is 100 million euros – most of which is financed through EU structural funds. However, according to the industry estimates, Estonia needs to invest at about 300 million euros to cover the country fully with broadband connections (Estonian Association of Information Technology and

Communications 2009). Nevertheless, this is more recent initiative which has further encouraged internet diffusion with inflow of the EU funds. Most importantly, Estonian internet users and household access to broadband was already greater than most other countries in the CEE in 2004 when they joined the EU. Hence, institutional changes in the 1990s and early 2000s were crucial for the take-off of internet diffusion.

The key benefit of institutional changes in the Estonian telecom sector was relatively low internet access costs in the early years of internet diffusion and this trend has continued. In order to understand the importance of institutional changes in this sector, a brief comparison with Latvia, Slovenia and Slovakia can be made. Latvia is especially relevant for Estonia as the general institutional changes in Latvia were not so different from Estonia but the variance in institutional changes governing telecom sector was significant. It is obvious that rent-seeking by the incumbent undermined the effectiveness of generally liberal formal rules in Latvia. Latvia had the highest internet access costs in Europe in 2001. Slovakia's costs were high at peak times in comparison with Estonia and Slovenia. Estonia's dial-up internet costs were lower in absolute terms than in Slovenia but higher when adjusted for purchasing power parity because as I have pointed out Estonia was then and still is significantly poorer country than Slovenia.

Table 4.3 Dial-up internet access cost per hour in 2001 (approximation in euros)

	Estonia	Latvia	Slovakia	Slovenia
Peak	1,3	4,2	1.8	1,5
Peak at PPS[24]	2,9	8,8	5,0	2,1
Off peak at PPS	2,2	3,5	1,9	1,9

Source: Author on the basis of data from EU (2002).

[24] PPS refers to Purchasing Power Standard. According to eEurope+2003 Report (2002), "Purchasing Power Parities are obtained as a weighted average of relative price ratios regarding a homogeneous basket of goods and services expressed as a unit that is independent of national currencies".

Liberalization of their telecom sectors in Latvia, Slovakia and Slovenia was a result of EU pressure rather than domestic interests. Even though Latvia and Slovakia both established a market liberal formal rule-set governing their economies, the timing of the institutional changes and interactions between informal and formal institutions channeled the actions of agents in different directions than in Estonia. The Latvian government signed a concession agreement with the incumbent telecom company in 1994, which made changes in the rules extremely difficult before the agreement expired in 2013. Also, in Latvia the monopoly over services was more excessive than in Estonia. In addition to fixed lines, leased lines and alternative infrastructure were also under the monopoly provisions in Latvia. Once Latvia liberalized the telecom sector in the beginning of 2003, per capita Internet diffusion increased significantly. In Slovakia the monopoly power of the incumbent was strengthened by informal rules that encouraged corruption as well as protection of domestic industries in the early years of internet diffusion. The informal rules of the game kept potential challenges to the incumbent's monopoly power at bay - even though the formal institutions governing the economy were fairly liberal. In other words, prohibitive costs resulting from excessive monopoly did not create incentives for the creation of innovative services that would have attracted users. As there were not many users, the potential positive network externalities and increasing returns were limited. The users preferred substitutes to the internet. Consequently, strong interest groups backing the liberalization did not emerge (Kitsing 2008; E-User 2005; Interviews 16 and 19).

The comparison of internet access prices is easier in the early years of internet diffusion. However, it is much more difficult once extensity and intensity of internet use has spread all across the society because of high variety of bundled and unbundled services that different companies in different markets offer. The OECD working group on broadband metrics spent years in discussing how to compare the broadband access prices and what data to use. The difference in data and data collection method make this extremely difficult task and the results may be very different from reality. Most importantly, the comparison of nominal prices and/or adjusted for purchasing power parity is based on the assumption that users of internet have constant objectively measured preferences. But they do not. The users assign different relatively values to the internet use in different context. In some countries and/or some settings users are willing to pay more for a similar service than in other settings and other countries. Thus the preferences of the users and constantly changing and value of internet use depends on the context. Hence, what really matters is not the actual absolute cost of internet access but perceived relative cost of internet access, which is heavily context-dependent. Instead of trying to measure actual costs in different countries and offer some comparison, it is more fruitful to rely on survey data which indicates how important the costs are for the users. In order to understand the internet diffusion, it is crucial not only to focus on users but also non-users.

Figure 4.19 compares different households with internet connectivity in Estonia and different households without broadband connecivity because the internet access costs are too high. In 2005, 36 percent of household without internet connectivity at home reported that they cannot access internet because access costs are too high. In 2013, the percentage of such households had fallen to 11. Among the households with dependent children only 4 percent reported in 2011 that access costs are too high and that’s why they are without internet connectivity at home. In 2005 32 percent of such households thought so. Among the households without children the respective percentages were 21 in 2011 and 38 in 2005.

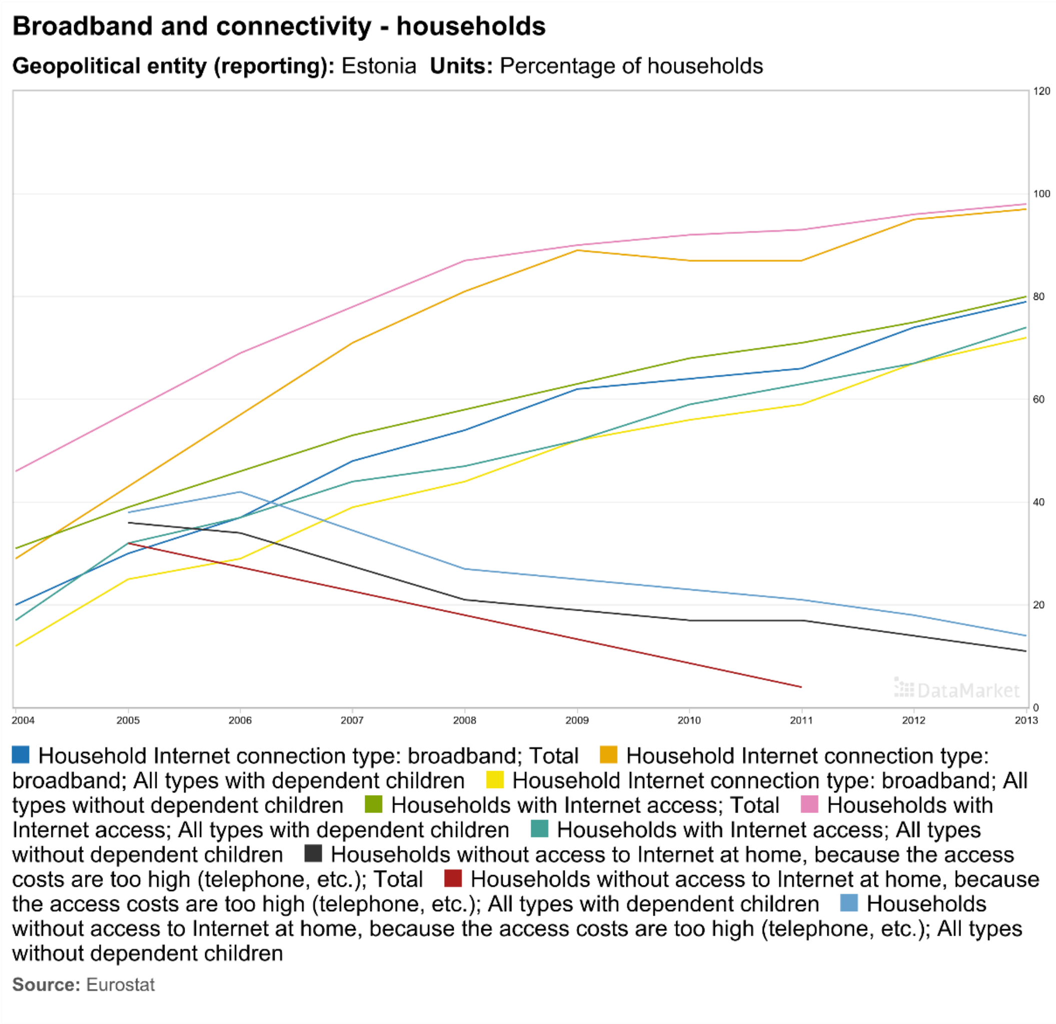

Figure 4.19: Different households with broadband connectivity and without broadband connectivity because high access costs in Estonia in 2004-2013 on the basis of data from Eurostat (2014).[25]

As I have pointed out, the internet is network good and access costs are only one aspect of decision to get internet connectivity at home. The equipment costs have to be factored in as well. The similar trends persists also among households without internet connectivity because equipment costs are too high. The following figure 4.20 indicates that In 2005, 39 percent of households without internet connectivity said that equipment costs are too high. By 2013, the percentage had been reduced to 14. Among households with children

[25] Detailed data is available in Appendix D.

the percentage was 33 in 2005 and 3 in 2012 while among households without children the respective percentages were 41 in 2005 and 21 in 2012.

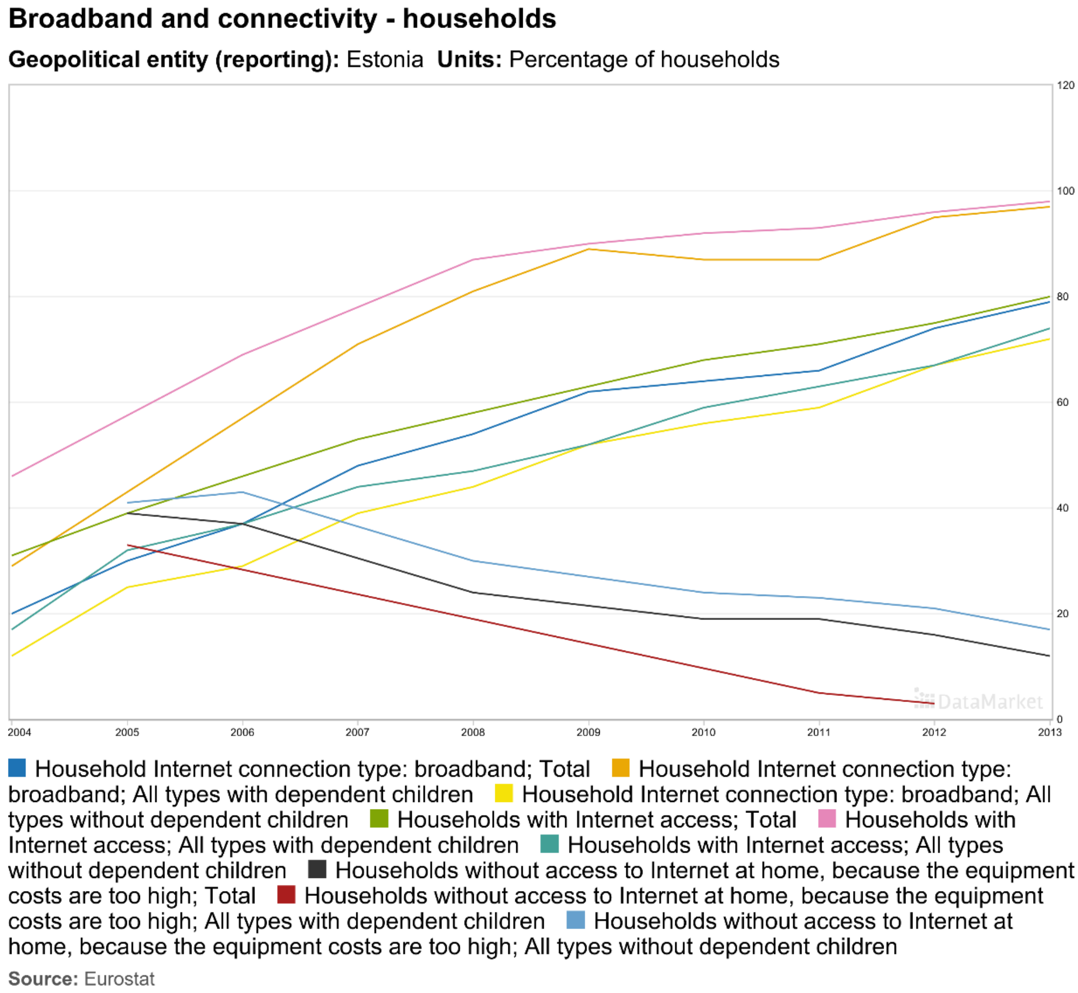

Figure 4.20: Different households with internet connectivity and households without internet connectivity because equipment costs are too high on the basis of data from Eurostat (2014).[26]

Households with children show faster adoption rates of internet and for them both access and equipment costs are less of the concern than for households without children. Obviously, households without children tend to be older and hence the age may be objective reason for not having internet access at home. However, previously I showed that even older people and people with low formal education in Estonia are eager to use internet in regular

[26] Detailed data is available in Appendix D.

basis in Estonia – particularly in comparison with Slovenia. Most importantly, Figures 4.19 and 4.20 present indicators, which points out the subjectivity of preferences among households concerning internet access. Households with children value internet access more and they are willing to pay for it even when households without children consider internet access at home too expensive because of access and equipment costs. Increasingly, most households in Estonia do not see the access and equipment costs an issue. This trend continued throughout economic recession which led to cumulative drop 20 percent to GDP in 2008-2009 and there has not been significant growth in real wages.

4.4.3 Overview of Institutional Changes in Slovenia

As the section on Estonia emphasized that the liberalization and regulation of the telecom sector, then this section discusses the role of these factors in Slovenia. It starts by outlining the general institutional changes in Slovenia, which is followed by the discussion on telecom sector and developments in the Slovenian ICT sector.

In the 1990s Slovenia experienced the smoothest political, social and economic transitions seen in Central and Eastern Europe. The country took a step-by-step approach to economic restructuring by starting with stabilization instead of facing stabilization, liberalization, complete re-orientation of international trade and other reforms all at the same time. This approach was made possible in Slovenia thanks to an important difference between Yugoslavia and other socialist countries in Central and Eastern Europe; the difference was found in its industrial and economic policy (Gray 1999, 104). The Yugoslav system emphasized the importance of “self-management” of industries; the state did not own manufacturing industries, nor did it dictate what factories produced. Workers played a considerable role in the decision-making process of each company. Even if Yugoslavia remained a one-party state, its economic system was decentralized. All of this was especially beneficial for Slovenia, where factories exported products to Western Europe and were often in direct contact with their customers in the West (Gray 1999, 104). Technology transfer was facilitated in socialist Slovenia by rules governing trade relations (Gray 1999, 104, 106).

In the 1990s, trade barriers were liberalized incrementally, but further reductions were required for entering the EU. Slovenia's simple average applied MFN tariff rate was almost 11 percent in 2001 (WTO 2002). Some significant trade restrictions were in place. Slovenia imposed taxes on exports, but had them removed by the late 1990s. In addition to the strict trade policy measures, the government used financial means, such as subsidies and capital controls in the 1990s, in order to offset the negative impact of import competition in the sectors that suffered most in the process of reforming trade policy (WTO 2002).

In general terms, Slovenia pursued relatively protectionist and targeted policies regarding FDI, which is also visible from the data on protection of incumbents provided in the OECD figures in the beginning of section 4.4 of this paper. Instead of opening entry for all investors on an equal basis, the government discriminated against foreign investors in the privatization process and attempted to meddle with direct financial incentives instead of following rules of fair play (WTO 2002, ix, x, 13, and 26). Protectionism in the 1990s was expressed in a discriminatory privatization process that preferred domestic investors to foreigners, pervasive capital account restrictions, and a hesitant process of liberalization in the service sector (WTO 2002, ix, x, 13, and 26). Moderate protectionism has not disappeared from the Slovenian economy as this has been brought out by research by various international organizations (OECD 2014; European Commission 2015).

4.4.4. Institutional Changes in the Slovenian Telecom Sector

In the 1990s protectionist rules against foreign investment were used to minimize the negative distributional effects of economic change, and influenced the restructuring of the telecom sector (OECD 2002, 11). The share of inward FDI in the category of postal and telecom services increased from 0 percent in 1994 to 0.4 percent in 2000. (OECD 2002, 11). Seventy-four percent of shares of the incumbent telecom company, *Telekom Slovenije*, are owned by the state; 13 percent of shares are owned by workers, the rest are state-owned, domestic investment funds. In addition, two employee representatives are also members of the board, as is typical of Slovenian companies. Ironically, the privatization of the incumbent telecom was agenda already in 2003, when I carried out first set of interviews in Slovenia. Interviews with supervisory board members and regulators in 2012 confirmed that it was still in the agenda but privatization plans are primarily driven by the EU pressure and resisted by the local politicians. By the beginning of 2014, Slovenia set concrete plans to privatize the telecom company because of constant EU pressure and economic difficulties which led government to look for additional sources of revenue. However, the European Commission still expressed its concern over the slow path of privatization in Spring 2015 (European Commission 2015).

As far as the sector regulation is concerned, then the Act of Telecommunications was adopted in May 1997, and it provided legal framework for establishing key principles of EU legislation. However, Slovenia was extremely slow in implementing the legislation. More specifically, insufficient resources in providing regulatory functions were apparent. The state preferred to spend money on infrastructure development rather than providing fair rules in the market. In the 1990s Slovenia had formally liberalized the market in data transmissions, but in reality, the market was still held by a monopoly (WTO 1995, 16, ESIS 1999). ISP services were partially liberalized but licenses were required, thereby increasing the cost of entry. Leased lines and alternative infrastructure use were partially liberalized (ESIS 1999). The Competition Protection Office (CPO) initiated two investigations into *Telekom Slovenije*'s alleged abuses of dominant market position, which concerned non-transparent pricing practices of leased lines in 1999 (Commission of the European Communities 2001). Most importantly, the opening of the telecom market in the fixed line telephony services has been constantly postponed both formally and informally. The market opening has been subject to constant pressure by the EU, which demanded the candidate countries to open their telecom markets by the end of 2002. The government had planned to open the market by the end of 2000. Slovenia formally ended the monopoly in fixed lines over voice telephony by the Telecommunications Act, which was not adopted until April 2001. The act legislated a transition period in the market opening in areas of leased lines, the local loop, number portability, and cost-based accounting mechanism for operators with significant market power until 2002 (Commission of the European Communities 2001, 67-69). Hence, the market was not opened until mid-2002, and the new competitive environment did not ensue informally even in 2002.

By the end of 2000 Slovenia had not established a separate regulatory authority in the telecom sector. Tariff rebalancing, liberalization of voice telephony and alternative networks for the provision of telecom services did not reflect the EU Telecom A*cquis* requirements. The regulator, the Telecommications and Broadcasting Authority, was set up in 2001. Several provisions of the 2001 Telecommunications Act concerning the work of the regulator did not allow this agency to function with full independence. The role of the executive in nominating the director and approving statutes and the involvement of operators in the Telecommunication Council, which oversees the work of the regulator, can lead to substantial conflicts of interests. This observation was supported by the European Commission's assessment in 2003, which stated that Slovenia still had to strengthen the regulator in order to make the agency truly independent (Commission of the European Communities 2003, 35-36). Furthermore, the Slovenia's ineffective implementation of anti-trust aspects of its competition law in meeting the EU standards was highlighted by the report of European Commission on the progress of EU applicant countries in November 2003 .

The need to solve the issues with the governance of the telecom sector was a part of the rationale that led to the creation of the Ministry of Information Society in 2001 was emphasized by the minister in the interview in 2003. The decision to create a special ministry grew out of the recognition that a more concentrated effort was needed to coordinate the government's ICT priorities. The existing relationships between the Ministry of Communication and the incumbent telecom company did not encourage reform of the telecom sector. However, as the former minister and now computer science professor explained in 2012, the ministry did not have sufficient power to tackle the vested interests involved in the telecom sector. The Ministry of Information Society lasted only for three years as it was shut down in November 2004, and its functions were distributed among other ministries (E-User 2005; Interviews 10-11). In the early 2000s, the development of ICT was one of key priorities of Slovenian government and Slovenia was seen as a model for other countries of Central and Eastern Europe. This was the main purpose why I was in initially interested in Slovenia and conducted first set of interviews in 2003. However, the impression from interviews conducted in 2012 is that ICT development has not been a priority in the second half of 2000. ICT experts were clearly unsatisfied with government's lack of interest (Interviews 10-11). Even though Slovenian telecom regulations and regulator meets the criteria of EU laws and regulations, then the state ownership of incumbent has distortive impact on the telecom market and discourage innovation (European Commission 2015; Interviews 10-11).

Overall, this story demonstrates that Slovenia has been very reluctant reformer of the telecom sector and there has been consistent refusal to accept more liberal rule-set imposed by the EU. The anger at EU pressure was also a main theme at one of the interviews with a former high level government official responsible for the EU integration when I first interviewed him in 2003 official and now the supervisory board member of incumbent telecom company. This has not been only the case in the telecom but also in the banking sector where the key player is owned by the government. As will be discussed in Chapter Five this is an important factor in discouraging entrepreneurial discovery in exploiting the benefits of internet in banking.

Nevertheless, the internet diffusion in Slovenia has been significantly greater than in other former member countries of Yugoslavia. Certainly, such comparison is not very telling because most ex-Yugoslav countries were in war with each other throught the 1990s when Slovenia developed and prospered. Furthermore, Slovenia's own aspirational reference point is not the former Yugoslavia but countries in the north and west such as Austria, Switzerland and Germany.

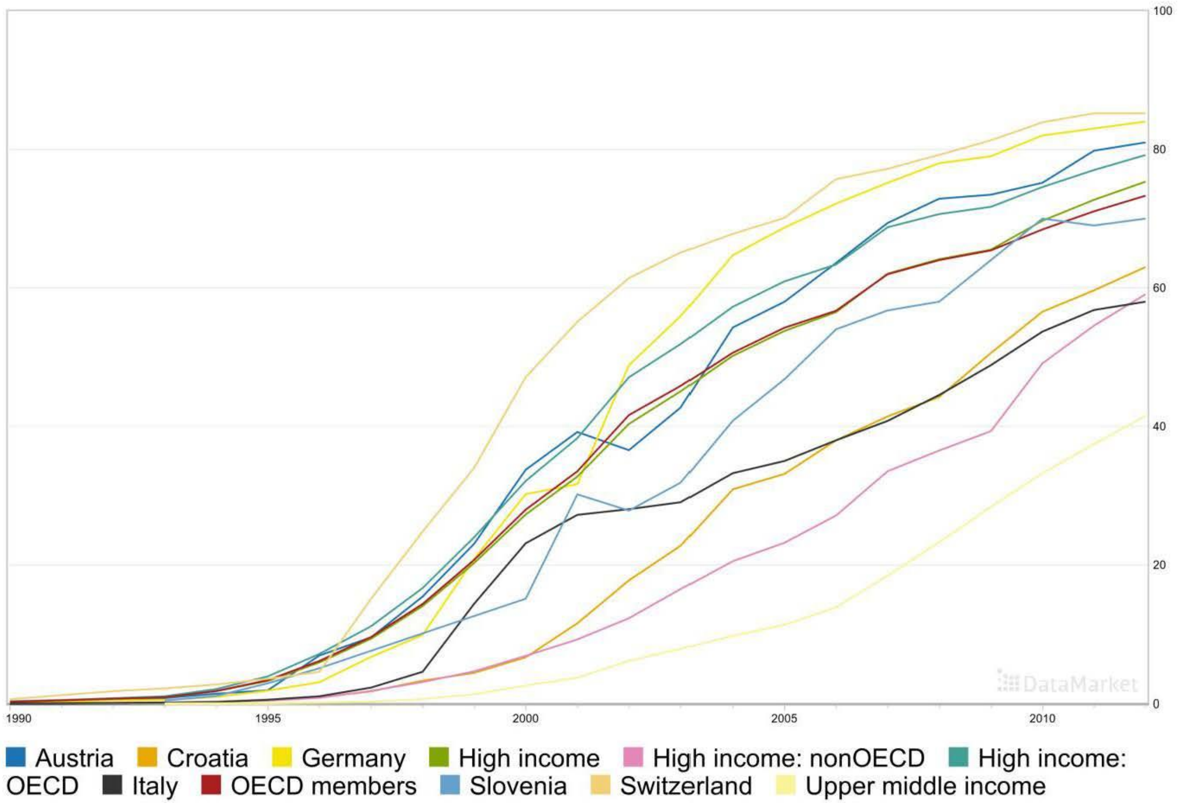

Figure 4.21: Internet users per 100 people in Slovenia and selected European countries, OECD, high-income OECD, high-income nonOECD, high income countries and upper-middle income countries in 1990-2012 on the basis of data from United Nations (2014).[27]

[27] Detailed data is in Appendix D.

The data in Figure 4.21 shows that percentage of internet users in Slovenia has caught up with the OECD average over the years. Slovenia has higher percentage of users than Italy and Croatia and upper-middle income countries. However, high-income countries tend to have about 10 percent more users as do Austria, Germany and Switzerland. The one way how the nature of telecom sector affects people is through internet access costs. In 2005, 19 percent of Slovenian households reported that they cannot have interent access because access costs are too high (Figure 4.22). In 2013, 12 percent of Slovenian households told so in the survey. For households with children access costs were not an important issue while for the households without children it was more significant.

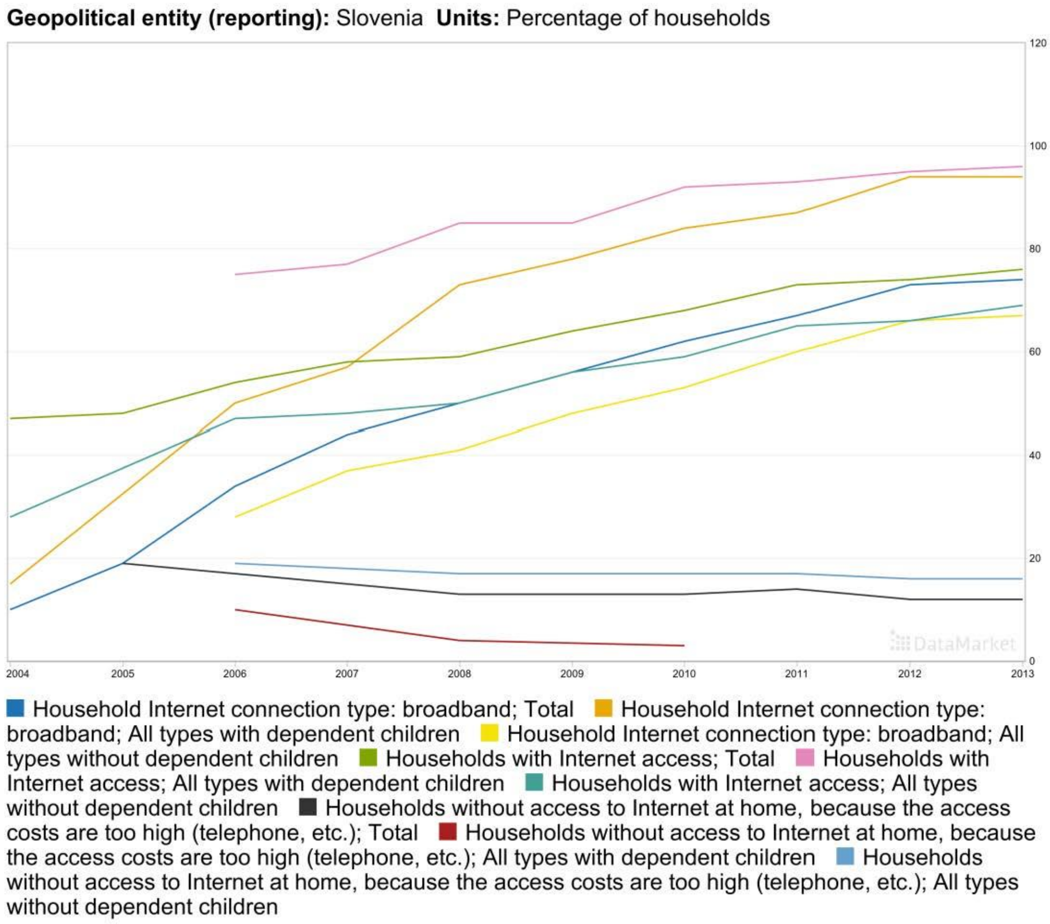

Figure 4.22: Slovenian households with internet access and without internet access because access costs are too high on the basis of data from Eurostat (2014) .[28]

[28] More detailed data is in Appendix D.

The households without internet connectivity because of high equipment costs show a similar pattern in Slovenia. In 2005, 21 percent of households without access gave the equipment cost as a reason. By 2013, it had fallen to 13 percent. Among the households with children the equipment costs have been smaller issue while among households without children it is somewhat bigger concern than on average (Figure 4.23).

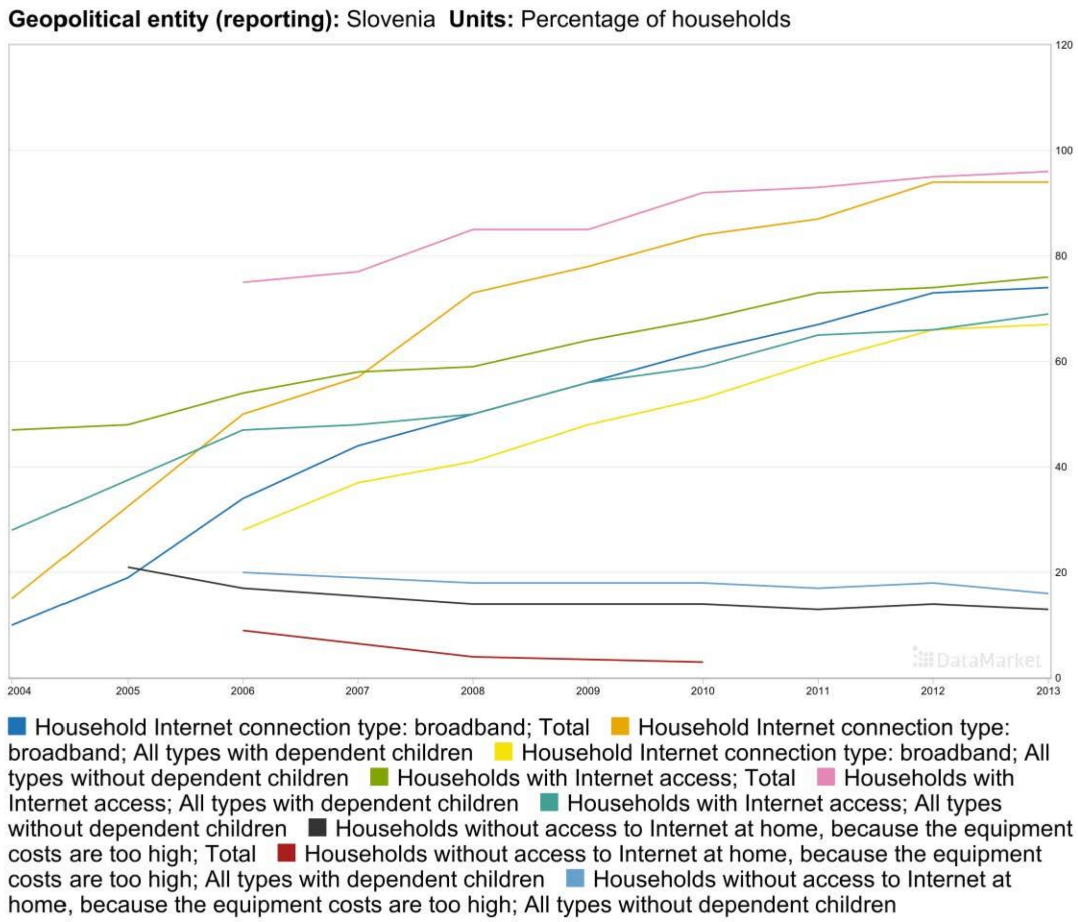

Figure 4.23: Slovenian households with internet access and without internet access because equipment costs are too high on the basis of data from Eurostat (2014).[29]

Overall, the decrease in people who say that access or equipment costs are too high is quite small considering that both costs have been falling. However, the percentage of people

[29] More detailed data is appendix D.

was small to begin with. Hence, it cannot be concluded that the perception among the people concerning internet costs is significant reason for not getting online. There is dynamic variance with Estonia where decreases among households have been more significant in Estonia. There is not nominal variance but there is real variance considering the both Estonian average income and that of poorest households significantly lower than in Slovenia.

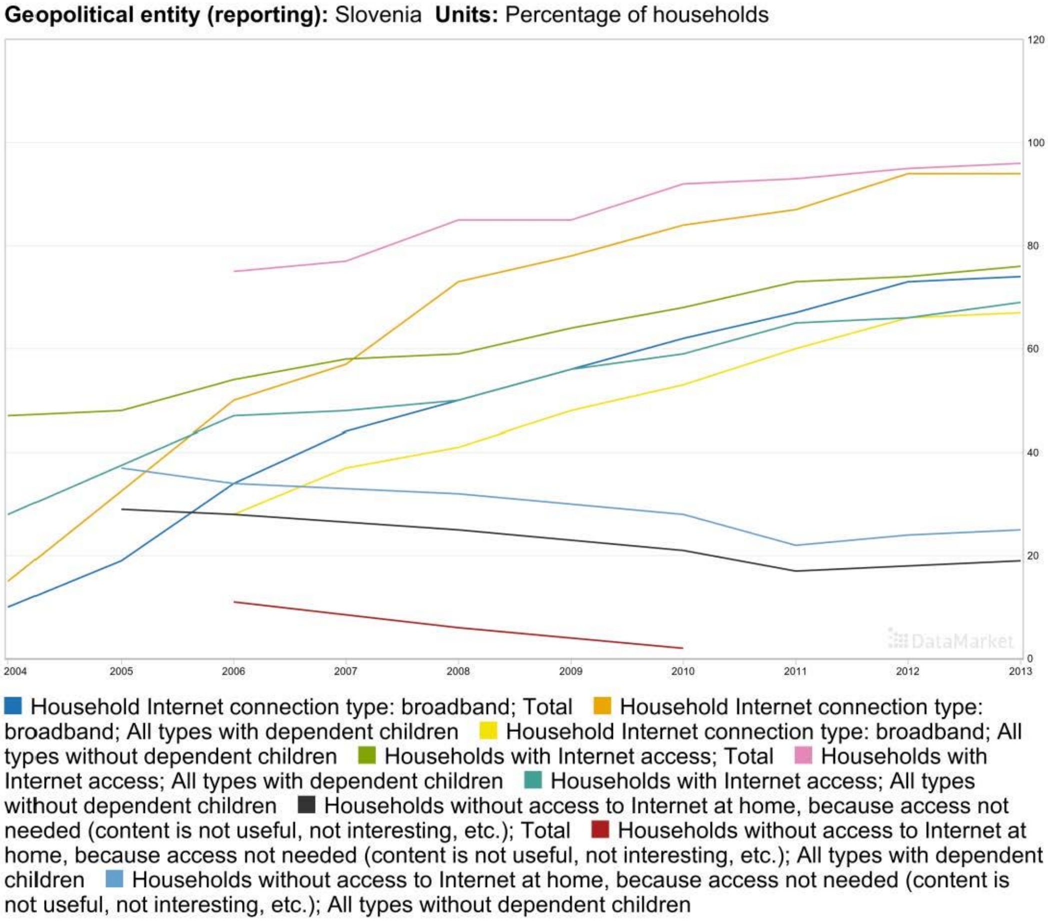

Figure 4.24: Slovenian households with internet access and without internet access because access is not needed on the basis of data from Eurostat (2014).[30]

More significant factor in Slovenia is the fact that 20 percent of households without internet connectivity told in 2013 that they don’t need the access because content may not be useful or other reasons (Figure 4.24). This percentage stood at 30 percent in 2005 but it is still significant. It is even more important reason given by households without children while

[30] More detailed data is in Appendix D.

households with children do not consider it important. This would suggest that many households have internet access because of children's needs.

4.4.5 Conclusion on Institutional Changes in Estonia and Slovenia

The formal institutions governing Slovenia's telecom sector are more restrictive than in Estonia despite of the fact that both countries have adopted same EU legislation. Yet the difference with Estonia in term of Internet access costs is very small - Slovenia, like Estonia, had relatively low Internet access costs in the early years. The largest difference between conditions in Estonia and Slovenia regards broader formal institutions and its approach to liberalization of telecom market. The overall institutional rule-set suggests that Slovenia is closest to the model of social democratic corporatism (see Olson 1982 and Garrett 1998 for discussion of social democratic corporatism). This observation suggests that the negative externalities of the incumbent telecom company's monopoly as well as costs of protectionist rules governing telecom sector are widely socialized. Slovenia is run like a partnership with highly-centralized bargaining between interests groups. Indeed, the ownership structure and control of the telecom company indicate a high degree of socialization. At the same time, Estonia relied more on liberalization of telecom markets which implied greater competition and lower barriers for entry. As was discussed through sections 2.4 and 2.5 supply-side constraints are important factor in internet diffusion and lower supply side constraints have facilitated process of entrepreneurial discovery and utilization of decentralized knowledge of entrepreneurs.

As the telecom sector regulation and related institutional changes looked primarily on supply side factors, then the comparison of Estonia and Slovenia must also consider demand. Obviously demand is affected by income but as Slovenia is considerably wealthier and egalitarian than Estonia, then this factor cannot claim much importance. As the literature review has emphasized the role of knowledge as one factor affecting the diffusion of innovations such as internet, then the next part of this chapter looks at the skills of internet users in Estonia and Slovenia. It starts by discussing Estonia, which is followed by elaboration on ICT skills in Slovenia.

4.5 ICT Skills in Estonia and Slovenia

As some perspectives in the literature review emphasized the importance of human capital, particularly skills, then this part will highlight human capital in Estonia and Slovenia. As both countries are highly developed and with literacy rates, then it focuses specifically on ICT skills.

4.5.1 ICT Skills in Estonia

In general, the Estonian government purused relatively noninterventionist and not sector specific policies in 1990s but development of ICT skills did receive specific attention from policy-makers. Estonia's public sector did support the launch of the *Tiigrihüppe* (Tiger's Leap) program in 1997, which provided information technology to many schools (Tiigrihüppe Sihtasutus 1999). The idea was generated and actively supported by Toomas Hendrik Ilves, the Estonian ambassador to the United States and Foreign Minister in the 1990s and Estonian President in 2006-2016. As many interviews pointed out, the most important element of promotion of ICT skills has not been funds but the emphasis of many politicians and experts on the importance of ICT. This has received a considerable attention in the public. In this sense, such government programs have served more as a propaganda tool and rhetoric. This is pointed out not to undermine the importance but to emphasize the importance of rhetoric as it has been crucial in changing public perception. Here again is important to recall the discussion of variety of perspectives in section 2.3 and 2.4 of Chapter

Two that nature of internet is epistemological and its use in specific context depends also on skills of users.

Most importantly, the private sector came along with such initiatives by providing both technology and emphasizing the importance of skills. Compared to earlier years of internet diffusion, when the main emphasis was on ensuring internet connections and take-up in general, projects and programmes aimed at increasing technology diffusion became gradually more targeted. Even self-interested behavior by banks in encouraging the use of internet banking is educational as customer service people had to guide and advice very different population segments how to use sophisticated online services. But private sector went further. In 2001, the largest banks, IT and telecom companies launched the Vaata Maailma SA (Look @ World Foundation). The foundation has trained 10 percent of Estonian adult population in computer skills. They have set up 442 public access internet points. They launched an e-school portal, which is used by most schools in Estonia for submitting grades and feedback for students. Their project “Ole kaasas!” (*Come Along*! in English) operated from 2009 to 2011 by helping 100 000 people to familiarize with the use of internet based services and was primarily aimed at people living in rural areas, people with lower education and wage levels, and older generation(Interviews 19-20, 28 and 32).. In addition, in the framework of “Ole kaasas” a new initiative was organized entitled “Uus algus” (*New Beginning* in English) in order to fix up old computers with the help of volunteers and donate them to those in need. All of this has run in parallel with programs of public sector. For instance, the aim of the programme “Raising Public Awareness about the Information Society” is to increase the skills and knowledge of the general public as well as to enhance the competence in the field of IT and information society of public servants. The program is funded by EU structural funds (Interviews 19-20, 28 and 32).

As Figure 4.25 demonstrates the lack of skills has become gradually a smaller factor given by households as a reason by not having internet access at home. In 2005, 26 percent of households gave lack of skills as a reason for not having internet access at home. In 2013, 14 percent of households surveyd said so. Here again, the households with children are less likely to give lack of skills as a reason for not having internet access. In 2005, 31 percent of households without dependent children said that lack of skills is a reason for not having internet at home while in 2013 19 percent of surveyed households did so.

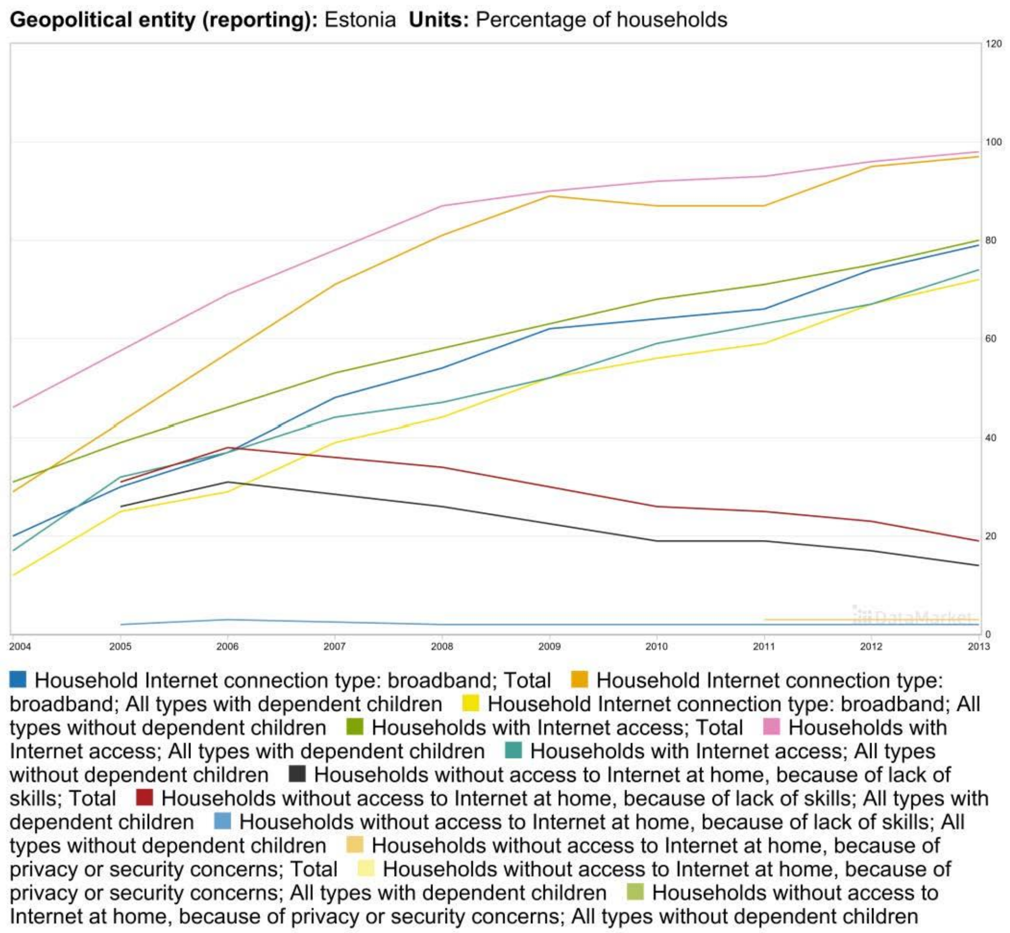

Figure 4.25: Households with internet connectivity and households without internet connectivity at home because of lack of skills and because of privacy and security concerns on the basis of data from Eurostat (2014). [31]

[31] Detailed data is in Appendix D.

Quite, tellingly privacy and security concerns have never been an issue for Estonian households. Throughout the years from 2005 to 2013 only two percent of households have reported that this is the reason for not having the internet access at home. Even the cyberattacks against Estonia in 2007, which cut the entire country off the global internet networks for several weeks, did not change this view. Nevertheless, Estonians were able to use the internet within country. People outside of Estonia could not access Estonian sites. This confirms further that people care primarily about the local content, not international content, even if the internet is often seen primarily as a global phenomena.

4.5.2 ICT Skills in Slovenia

Slovenia started to focus on IT-related research and education in the mid-1970s. In the early 1980s, secondary schools began installing mainframe computers. In the 1990s, the government also launched specific projects to increase Internet diffusion at schools, public libraries, and research institutions (E-User 2005). The government has also made interactive online services available starting in 2002, but two-way transaction capabilities remain constrained (E-User 2005). The strategies for information society and e-government were adopted in 2003.

Development of local ICT services was facilitated by the existence of the local technology industry, particularly companies such as IskraDelta. Siemens established a joint venture with Iskratel in 1989. Slovenia’s early ICT orientation in education allowed fairly sophisticated technology companies to grow and integrate with Western clusters (Biegelbauer *et al* 2001). Slovenian companies hold relatively high positions in the value chains of Western multinationals. Many multinational corporations (Siemens, Cisco, and Microsoft) have invested in Slovenia or have partnered with Slovenian companies in the 1990s. In addition, the country has a wide range of medium-sized hardware and software companies. However, as the data has shown above the internet is widely diffused in enterprises but has not reached all population segments equally despite the egalitarian social democratic corporatist nature of the country. There are still signifigants segments in population who do not have internet access because of lack of skills. Figure 4. 26 shows that in 2005 21 percent of household without internet connectity at home gave lack of skills as a reason. It was reduced to 15 percent in 2013 but among the households without dependent children the percentage has stayed the same over 20 percent throughout the same period.

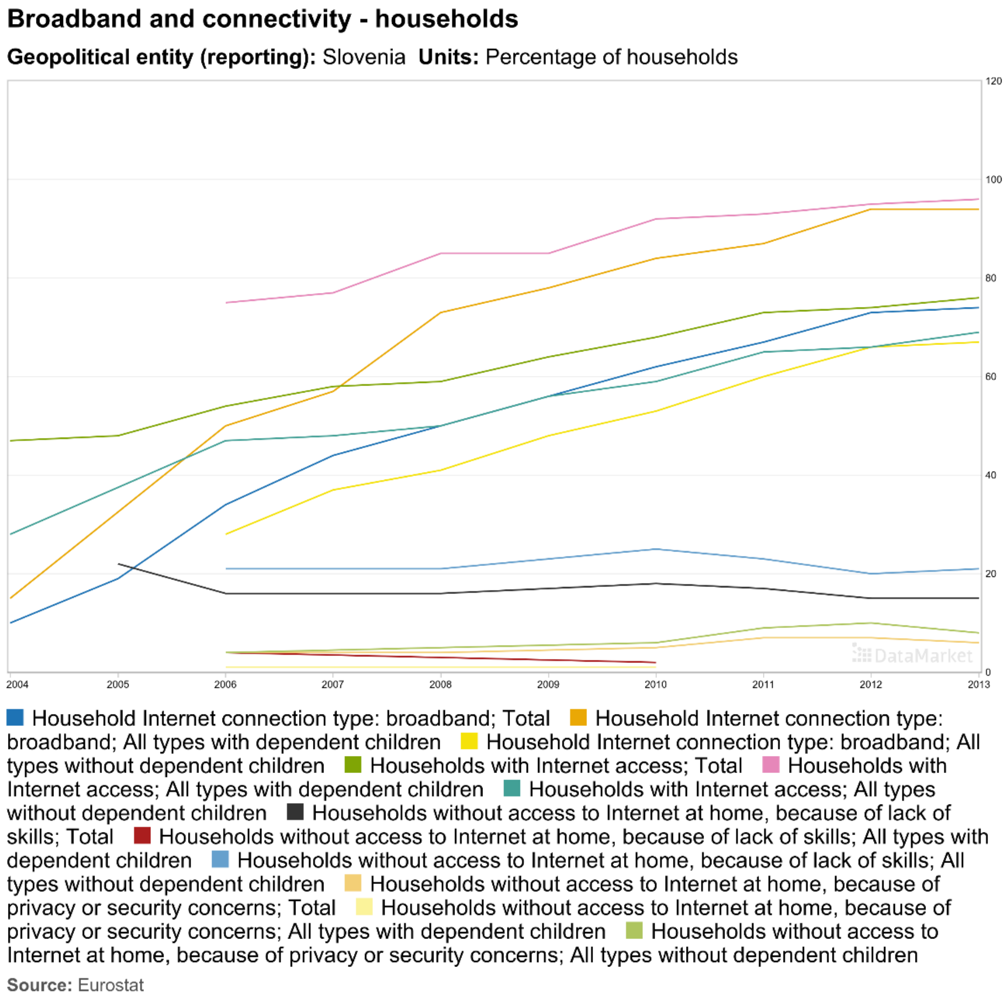

Figure 4.26: Slovenian households with internet access and without internet access because lack of skills and because of privacy and security concerns on the basis of data from Eurostat (2014).[32]

[32] More detailed data is in Appendix D.

Interestingly, Slovenians are increasingly worried about the privacy and security concerns as higher percentage of households reports this factor as a reason for not having internet access at home in 2013 than in 2005.

There is no significant variance in the ICT skills between Estonia and Slovenia. It was a bigger issue in Estonia in 2005 but percentage has been reduced to the Slovenian level or below depending on the group. There are some differences concerning the privacy and security concerns which is increasingly seen a bigger issue among Slovenians than Estonians. This is also reflected by the fact that Estonian internet users are more avid participants in social networks than Slovenian users. This holds in general and across different demographic groups on the basis of Eurostat data.

4.6 Conclusion

This chapter demonstrated that there is significant variance in the internet diffusion between Estonia and Slovenia when measured by both eleven indicators. Estonian internet users have been able to use better quality and higher speed internet for longer time period than Slovenian users. The more regular use, better supply of internet and demand for more sophisticated services have interacted more favorably in the Estonian case and contributed to both better intensity and extensity of internet diffusion. Most importantly, poorer, older and people with low education levels in Estonia are more regular internet than in Slovenia.

The comparative analysis of previous chapter also shows clearly that the national wealth cannot explain the variance between internet diffusion in Estonia and Slovenia. Estonia has been and is considerable poorer than Slovenia as the data on per capita GDP demonstrated. Furthermore, Estonia is considerably less equal than Slovenia as the data on the gini coefficient demonstrated. In spite of lower per capita GDP and higher inequality, internet has diffused more among Estonian population and among different population segments by income in Estonia than in Slovenia. Estonian households in the first quartile of income distribution are more avid users of internet than Slovenian households in the first quartile. This is particularly remarkable given that the Estonain households in the first quartile of income distribution are in relative and absolute terms poorer than Slovenian households. The data also shows, for instance, that poorer Estonian households are more avid users of online social networks than Slovenian households in the same income distribution quartile (Eurostat 2014). Thus, the propositions based on wealth and/or distribution of wealth as an explanation for the internet diffusion can be rejected as a crucial factor in the variance between internet diffusion in Estonia and Slovenia.

Therefore, the attention must be turned to institutions and particularly institutional changes have created preconditions for internet diffusion. Before outlining the key critical junctures in the institutional environment of Estonia and Slovenia the basic theoretical premises from synthesis of literature must be recalled: institutions matter because the institutional framework conditions the incentive structure of agents (North 1990; Denzau and North 1994, 15). Certainly, institutions as the rules of game do not do anything, but agents do within institutional context. However, agents are influenced by the transaction costs. As transaction costs for any undertaking depend on the institutions themselves, then agents' calculations of costs and benefits of any action is dependent on the institutional context (North 1990; Coase 1937). In this sense, agents are not perfectly rational, but their rationality is constrained by institutions. This "bounded rationality" (Simon 1955) or "adaptive rationality" (Mueller 1986) of agents is fundamental for understanding the role they play in the spread of internet diffusion. As there are many substitutes for the Internet and the adoption of internet depends also on many complements to this technology, then the limited individual rationality of agents may or may not lead them to adoption of the Internet and/or undertakings that encourage internet diffusion. The actions of semi-rationally individual agents may lead to socially suboptimal or optimal outcomes depending on the institutions that govern the supply conditions of the internet. Most importantly, the outcomes in terms of internet diffusion should be understood as not intended but *un*intended consequence of actions by rational agents. As was emphasized by Pierson in the literature review the social reality is full outcomes which are result of human action but not deliberate design. In other words, it is not possible explain the internet diffusion rates by insisting that forward-looking rational agents acted purposefully set to achieve the rate on this particular level. Rather, rational agents acting on the basis of their self-interests and short-term time horizons unintentionally contributed to the particular outcome. In many ways the diffusion process may be accidental where path-dependence on particular decisions made in the past matters more than rational calculation of costs and benefits of any planned action. This also implies that institutions and their design, accidental or not, cannot determine a particular outcome in the internet diffusion. The link between technology diffusion and internet is not deterministic and linear. Rather, institutions condition agents to see spectrum of alternatives but the process of deciding, which alternatives to pursue and to which final outcomes these alternatives can lead is overdetermined. There are too many variables to establish causality between institutions and technology diffusion however well it is modeled or not. Path-dependence works in curious ways. Estonia's decision to liberalize the telecom sector in the late 1990s created necessary but not sufficient conditions for entrance of new players in the telecom sector (which will be studied further in Chapter Five). However, Slovenia's inability to increase competition is a result of lock-in by vested interests which in turn increased the power of incumbents at the expense of potential competitors. As section 2.6 pointed out path-dependence does not imply inevitability. There are real alternatives available when choices are made. For instance, Slovenia could have increased competition earlier. However, previous choices will affect outcomes and sequence of events (Pierson 2004, 20). Path-dependence does not rely on causal independence through time but it allows narrowing down the set of choices and show how decisions are linked through time (Pierson 2004, 52).

When one would have compared Estonia and Slovenia in the early 2000s, then it was obvious that both countries had similar levels of internet users per 100 inhabitants and the lowest Internet access costs in Europe (EU 2002). But to say both countries got the prices right for internet connectivity is not an explanation, rather a restatement of the puzzle. Particularly, as this dissertation has argued the prices reflect subjective individual preferences vis-à-vis relative prices of other goods. As the chapter demonstrated by the static indicators a smaller percentage of Estonian households see the costs of internet access and equipment as a barrier for not connecting to internet than in Slovenia 2013. At the same time, the Estonian households are poorer and income is more unevenly distributed than in Slovenia. Furthermore, the dynamic indicator shows that the change in the perception of Estonian households concerning the costs has been significantly greater as the costs were seen as significant barrier by higher percentage of households in Estonia than in Slovenia in 2005.

The institutional changes in telecom sector have benefited supply and demand for internet by affecting prices and relative meaning of the prices. Estonia made simple and straightforward institutional changes to open the telecom sector for competition in the 1990s and early 2000s. Estonia opened an alternative infrastructure and leased lines to competition when in Slovenia and in other CEE countries, they were protected by the national government. This move suggests that many private sector agents were able to undermine the power of monopoly over the provision of internet services. This diversity in the early years is captured by Kitsing (2008) and Kitsing and Howard (2009) on internet hosts which can be seen as indicator of supply conditions. Estonia had in the time period of 2001-2004 more internet hosts than any other CEE country and 2-3 times more than Slovenia depending on the concrete year. As was discussed in the synthesis of literature in Chapter Two, scholars such as Mokyr (1990) suggested supply conditions are crucial than demand for understanding the technology diffusion.

Estonia also abolished the monopoly on fixed-line telephone services two years before the same was done in Slovenia. The timing of these changes of formal institutions (two years before the deadline stipulated by the EU telecom *acquis* and the WTO Basic Telecom Agreement) and the effectiveness of their implementation suggest powerful domestic interests backed the reform: the liberalization was not imposed in the top-down fashion by some outside agent such as the EU, as was the case with Slovenia which struggles with the EU telecom regulation. The bottom-up liberalization of the rules governing the telecom sector is consistent with the *zeitgeist* shown in Estonia's rule-making in the economic sphere (see Feldmann and Sally 2001).

Often scholars studying the EU regulations proceed as the EU is a federal state akin to that of the United States. Similarly, as interviews showed lobbyists seem to think that regulatory decisions are simply made in Brussels and there is no need to look beyond it (Interviews). Hence, telecom regulations and particularly effective regulations on the ground are simply imposed on Estonia and Slovenia. Thinking that that rules are written in Brussels and simply followed in national capitals represents a line of thinking reflects a profound failure to grasp the nature of EU. Obviously, the EU is much more than simply a regional international organization but it is not a Westphalian state either. Even though, the EU has been given a vast authority over the economic regulation it is far from becoming in any way similar to the US federal government. First, the EU directives however detailed and uniform may they seem in print have to be implement by national authorities. Second, there is on-going resistance to increase regulatory powers of the EU over that of national authorities.

As Oxford scholar Jan Zielonka has pointed out there are competing sources of authority in the EU with overlapping jurisdiction resulting in "maze Europe" (Zielonka 2006).

This implies that EU is not something in between an international organization and Westphalian state, which develops in the direction of the latter. Rather, it is something completely different which the state-centric approaches are not capable of grasping. According to Zielonka EU's model is closest to that of Neomedieval Empire – not to that of Westphalian state (Zielonka 2006). Most importantly, telecommunication regulations as expressed in the EU Telecom Acquis seem at first sight highly uniform and detailed. However, as the research has demonstrated these uniform rules are often implemented differently in different the EU member states (Tenbuecken 2006). For instance, the independence of telecom regulator has considerable variance across the EU countries despite the perceived uniformity of telecom regulations on this issue.

Hence, the decisions made in Estonia and Slovenia matter to great extent before the countries joined the EU in 2004 and after that. Interviews and data from the EU and OECD suggests that the regulatory capture by narrow vested interests is greater in Slovenia than by Estonia which has had consequences for the delivery of high quality and high speed internet. Nevertheless, the collective action literature highlights the difficulties in promoting general diffused interests against small groups with concentrated interests (Olson 1965, 22-52). This framework applies neatly to the technological change where benefits are diffuse but costs are concentrated (Mokyr 1990, 256). Obviously, the incumbent telecom company is more effective in lobbying – whether it is privatized or publicly owned – than consumers are. However, in the case of transition economies the timing of reforms matters and explains also why Estonian government was able to promote diffused general interests without ending up in the excessive regulatory capture. The collapse of the Soviet Union led to what Joseph Schumpeter called "[a] creative destruction" (Schumpeter 1975, 81-86). It was a period of "extraordinary politics," in the words of former Polish finance minister and current governor of the Central Bank of Poland, Leszek Balcerowics, as he described the utilization of the window of opportunity by radical reformers who enjoyed strong public support (Balcerowics 1995, 4, 145-165). Most importantly, vested interests were not present or simply ignored in the decision-making process of government in this time-period of radical reforms. As the time passed by and costs of reforms accumulated, political rationality changed. The vested interests gained considerable influence.

In the demand side analysis, yhe comparison of ICT skills does not show that there are considerable differences between Estonia and Slovenia. At the same time, intsitutional differences were greater. Slovenia has tried to encourage telecom sector development through top-down state directed policies and protected incumbent companies. Estonia has been liberalizer of telecom market and facilitated the process of entrepreneurial discovery.

The nature of social democratic corporatism in Slovenia would suggest in theory that broad set of interests are taken abroad in decision-making by government but as it has been discussed above the interests of incumbent telecom company prevailed. Hence, it is not surprising that despite a strong promotion of IT for decades and toying with strategies for promoting information technology, the provision of government services in Slovenia has not gone as smoothly as in Estonia. This implies that all the costs of negative externalities have not really been socialized in Slovenia. Internet diffusion in Slovenia is driven by the IT industry and other companies that are well integrated in the value-chains of Western clusters. The data on broadband take-up by enterprises demonstrates that Slovenia was quicker to adopt broadband than Estonia. However, the provision of government and domestic private sector services to ordinary citizens lags behind those offered in Estonia. However, Slovenia's long-term emphasis on IT education and its strong IT sector suggest that informal institutions have at least to some degree compensated any shortcomings concerning government rule-making in telecommunications and information technology.

CHAPTER 5

ENTREPRENEURIAL DISCOVERY: FROM INTERNET BANKING TO INTERNET VOTING

5.1 Introduction

The main purpose of this dissertation is to explain how internet diffuses in different contexts. The research strategy emphasizes the importance of "thick description" in achieving this goal. This approach allows capturing interactions of informal and formal institutions as well as agency in a more detailed manner. Chapter 4 discussed key differences between Estonia and Slovenia higlighting that internet diffusion is greater in Estonia than Slovenia. This is so when both static and dynamic aspects of diffusion are taken into account. It also emerged that formal rules of the game encouraged greater openness and competition in Estonia. Now it is time to move to the next step in research strategy and provide case studies within Estonia which allow demonstrating how the process of entrepreneurial discovery and institutional framework has played a role in contributing to the emergence of internet ventures and services which have created reasons for the regular use of internet in Estonia.

The approach in this chapter can be described as relying on positive cases. Essentially, it focuses primarily on key entrepreneurial venture (both public and private), online identification methods, internet banking and internet voting which all can be described as "success". Nevertheless, their success is mutually dependent and capture well the importance of network effects affecting internet diffusion which was described in the section 2.6 of Chapter Two. First, the availability of internet banking has made the use of internet in Estonia more valuable. Second, internet banking introduced online identification methods, which were exploited by government and created a culture which made it easier to introduce online identification methods by government and internet voting. Third, internet voting is not necessary for the emergence of internet banking and online identification methods but in the Estonian context it is hard to see how internet voting could have emerged without internet banking and online identification methods.

Ultimately this chapter offers a narrative how emergence of online identification methods in Estonia, not just ID card, contributed to the path-dependent process where both private sector and government organizations started to supply more services online and availability of these services encouraged the use and diffusion of internet. I will start by discussing internet banking and related online identification methods, which is followed by a narrative on the Estonian ID card and I conclude by offering a detailed overview of internet voting. The latter is the most unique development underlining the emergence of online identification culture in Estonia.

5.2 Entrepreneurial Discovery and the Emergence of Digital Economy

Throughout the interviews I conducted in Slovenia in June 2012 I asked local experts how they saw the differences in developments in the diffusion of internet and related technologies in Estonia and Slovenia. Since I had also conducted interviews in Slovenia in January 2003, it allowed me an opportunity for a comparison over time. In addition, some of the experts I interviewed were the same in 2012 and 2003.   The main difference that was emphasized between Estonia and Slovenia is the existence of sophisticated online identification method in the form of an identification card (ID card) in Estonia and lack of such an ID card in Slovenia. A former Slovenian government minister and current computer science professor at a major university pointed out explicitly that the introduction of the ID card has made the use of internet in Estonia qualitatively different from Slovenia. Privacy concerns and bureaucratic inertia had made launch of similar system in Slovenia of combining physical identity card with digital and online identification method impossible (Interviews 11).

Obviously, the ID card is not just unique innovation when Estonia is compared to Slovenia, it is unique innovation when Estonia is compared to the most countries in the world. However, there are countries such as Belgium, which has fairly similar ID card (Martens 2010). Estonian ID card allows user to access both private and public sector services online such as banking, voting, paying taxes buying bus tickets and so on. In all other countries people need different identification methods for accessing different services. The nature of ID card will be discussed will be discussed extensively in the following sections of this chapter. However, interviews with Slovenian experts revealed a widely spread tendency to see the development of online identification methods as a purely government project and overemphasize the importance of ID card while ignoring developments which took place before the introduction of ID card by the government (Interviews 11). This overemphasis on ID card is also found in several reports on Estonian e-government (Maaten and Hall 2008; Ernsdorff and Berbec 2007; Dutta 2006). Ernsdorff and Berbec's understanding of ID card is simplistic and naïve as they write that government introduced them in 2002, made it mandatory and all citizens will have it by 2006 (Ernsdorff and Berbec 2006, 173). Even if this is true, then it does not mean that they will use them online and that by 2007 ID card played important role in online transactions - actually opposite is true as shown by Martens (2010). For Maaten and Hall writing in 2008 "the widespread use of national ID card"… is one of the factors "why I-voting has been success in Estonia" (Maaten and Hall 2008, 32).

National ID card was widespread in 2008 but this does not automatically mean that it was widely used in online environments in 2008 as it will be demonstrated below. If this is a question of emphasis and interpretation, then Dutta writing in the World Economic Forum Network Readiness Report states bluntly the following: "Thanks to the use of electronic ID cards as a safe way to access private data, citizens can declare their taxes online" (Dutta 2006, 84). First, Estonians were able to declare their taxes online already in 2000 – two years before ID card was introduced in 2002. The ID card started to be used more widely in online environments in the late 2000s. Dutta writes in 2006 when as will be reported below and has been reported by others (see Martens (2010), for instance) ID card was not even sufficiently diffused in Estonia to be a major contributor for online tax declaration. Second, the use of ID card is not necessary for declaring taxes online. It was and is only one option. Even in 2015, a brief visit to the website of Estonian Tax Authority reveals that their online services can be accessed by the following methods: 1) ID card, 2) Mobile ID, 3) internet banks (links to six banks are provided) and 4) user ID issued by tax authority (this information is available in English at the website of Tax Auhtority at http://www.emta.ee/index.php?id=29761). The option three -access by internet banks- also means actually at least three options because banks can be accessed by the use of ID card, Mobile ID as well as older identification methods used by banks since 1996. All of this will be discussed more in detail below but the key point here is to emphasize that reports on Estonian ID cards often lack of context and understanding of a specific development trajectory of online identification methods in Estonia. Most importantly, they often talk about developments about Estonia in general terms and are not able to distinguish between the respective roles of private and public sector agents in launching these initiatives.

Furthermore, there is even more profound principal point that needs to be made concerning the introduction of ID card and role of government in the development of digital economy. The ID card and a numerous related Estonian government initiatives have received significant attention by scholars, then it should be kept in mind that in free and democratic societies most citizens do not interact with government online and offline very often. People primarily use services provided by private sector such as banking. Their adoption of internet depends on services and content provided primarily by private and less on public sector. For more sophisticated interactive services it is necessary to create reliable online identification tools. The existence of such tools encourage further use of internet and increases demand for high quality connectivity. Hence, the involvement of the Estonian public sector in encouraging wider use of internet is not comparable with the developments that ensued in the private sector. The following sections will point out some key developments that took place in private sector and how these various initiatives intertwined with government policy. It starts by mapping out emergence of new internet business in Estonia – some of them gained global significance and then focuses on internet banking.

5.2.1 Skype: An Estonian Company

One of the most well-known ICT companies that emerged in Estonia is Skype, which was founded by Niklas Zennström, Janus Friis, Jaan Tallinn, Priit Kasesalu, Ahti Heinla and Toivo Annus in Tallinn in 2003. Skype was acquired by EBay for 2.6 billion dollars in 2005 (Skype Technologies 2009). In 2009 Ebay sold 65 % of Skype to venture capital firms Andreessen Horowitz, Silver Lake and Canadian Investment Plan Pension Board for 1.9 billion dollars valuing the company at 2.75 billion dollars. Microsoft acquired Skype for 8.5 billion dollars in 2011 (Skype Technologies 2009; Skype Technologies 2014; Tiits and Kalvet 2012). In 2015, Skype was listed by UK investment banking group GP Bullhound as the most valuable European technology company in Europe in so-called billion dollar club (Ahmed 2015). Skype's valuation at 8.5 billion dollars exceeds considerably club's average of three billion dollars.

Estonian founders of Skype had excellent technical skills. They had developed computer games already when they were high schools students and sold one successfully in the early 1990s. Tallinn graduated with BSc in theoretical physics from the University of

Tartu in 1996, while others studied computer science. Nevertheless, the technical skills are not sufficient for developing world class software. Success of Skype can be described as accidental. When Skype was founded, it was obviously not clear to the founders as in many start-ups and outsiders that one day it will be worth of billions of dollars. In the early 2000s, many Estonian IT and telecom analysts were still underestimating the role Skype might play in changing the traditional telecom landscape. And then overnight, millions of dollars poured into the country and Skype has become a part of eBay. All of this was a big surprise (Interviews 14 and 16).

Two Skype founders Zennström and Friis moved to Estonia from Sweden and Denmark respectively already in the 1990s. They placed an ad in English in an Estonian newspaper in 1999 with catchy slogan: “Supermodels not wanted. We want your brain” (Kitsing 2005). This ad attracted several Estonian programmers with whom Zennström and Friis created a portal called www.everyday.com, which does not exist anymore. This was followed by peer-to-peer (P2P) file-sharing company Kazaa in 2000, which made them famous and fugitive together with Estonian programmers from the US legal system. Kazaa was actually developed first by Tallinn and other programmers and then sold to Zennström and Friis. In 2001, Kazaa was sold to Australian based Sharman Networks in order to avoid law suits by US based music and movie industry (Pasick 2006). Zennstöm, Friis, Kasesalu and Tallinn could not travel to the United States and had to avoid situations where they could be served legal papers for years. In 2003, Kazaa was most downloaded computer program in the world with 315 million copies residing in computers (Roth 2004). However, once Skype founders made hundreds of millions for selling Skype to eBay they also settled lawsuits with music industry by paying more than 100 million dollars to music industry plaintiffs (Pasick 2006).

This background makes it obvious that the process of entrepreneurial discovery behind both Kazaa and Skype was messy and it had nothing to do with Estonian government policy – other than government stayed out and open economic environment enabled such activities to take place. It is difficult if not impossible to establish causality between the success of Skype and numerous social, legal, economic, political, individual and other variables. However, it can be said with certainty that Skype was a result of entrepreneurial discovery process. It did not emerge as a result of government intervention in creating innovative companies or because of top-down social engineering. Economic openness and Estonian government efforts in liberalizing telecom market as discussed in previous chapter probably contributed to its birth but this cannot be claimed with certainty. The broad institutional framework might have been necessary for its birth and perhaps attracting its founders from Scandinavia to Estonia but it was certainly not sufficient condition.

The early years of Skype are well capture by Fortune magazine, which opened its article titled “Catch Us If You Can” on Skype in 2004 with the following paragraph:

> “Near the center of the walled medieval district of Estonia's capital, Tallinn, sits the NoKu bar. It's almost impossible to find, on a cobblestone street behind a pair of old, unmarked wooden doors that unlock only with a magnetic keycard, and up a set of rickety stairs. In Estonian, "NoKu" is an acronym for "young culture"; the private club is full of twentysomethings in jeans, drinking local Saku Original beer to rock music. The bar's name has another meaning: Read as one word, it's slang for "penis." Both the hidden nature and the cheeky attitude of the place fit perfectly with the company I'm here to meet. Almost a dozen computer programmers and engineers are gathered around a large wooden table in the back of the bar on this bitterly cold mid-December night. They work for a startup called Skype, which produces software that allows people to make free, incredibly clear voice calls from their PC to any other PC in the world.“ (Roth 2004)

This description makes it difficult to believe that the venture was sold for 2.6 billion US dollars one year later. However, in the section 2.3 of the dissertation I highlighted perspectives on startup communities (Feld 2012) and creative classes (Florida 2005), which all emphasize the process of entrepreneurial discovery in explaining diffusion of technologies such as internet as well as broader outcomes in innovation. These approaches emphasize the role of entrepreneurs and their agency in ecosystems and deemphasize the role of old-fashioned top-down national or regional public policy in shaping diffusion of technologies. The description of early years of Skype above fits particularly well with Florida's concept of creative classes where both bohemians and computer programmers are included in the creative class. Existence of creative class helps to encourage economic development through innovation (Florida 2005).

Technologically, Kazaa has obvious connection with Skype as both businesses relied on peer-to-peer (P2P). It cannot be claimed that the team invented peer-to-peer technology[33], however. Entrepreneurs behind Kazaa were good at turning earlier inventions into innovation and building entire business model around it. Skype team's previous undertaking, Kazaa, had often been called the new Napster. Napster was a Californian peer-to-peer file sharing service which was founded in 1999 and ended up in legal difficulties because of copyright infringement in 2001.

However, the Napster comparison to some extent misses an important technological difference. While Napster utilized client-server structure for some tasks, Kazaa relied entirely on P2P technology and it was located outside of the United States . Naturally, the technological difference as well as geographical location of service provider translates into crucial legal and economic implications. In the case of Kazaa, it was more difficult to hold the distributors of file-sharing program responsible for illegal downloading of files. Due to the use of server-client structure for some tasks by Napster, documentation of its direct involvement in illegal file-sharing was easier (Kitsing 2005; Tambur 2013).

[33] Peer-to-peer is a distributed application architecture which distributes processes among peers, i.e. participants in the network. It does not require central coordination by servers and stable hosts as peers make resources such as bandwith and processing power available for other peers. Peers are both suppliers and consumers of the resources. This is different from traditional client-server model where the role of suppliers and consumers is divided.

Unlike many other VoIP service providers, Skype (like the file-sharing program Kazaa) relies entirely on peer-to-peer technology. P2P technology creates important technological advantages compared to the traditional server-client model. The Skype directory is entirely decentralized and distributed among network nodes. This in turn implies that Skype can increase its scale rapidly without added investments for expensive and centralized infrastructure. Essentially, Skype excels in exploiting the decentralized nature of internet (Kitsing 2005).

This technological aspect explains why P2P VoIP is economically superior to server-client VoIP as well as to traditional telephony. Economic superiority has a tremendous effect on the competitive rivalry in the telecom market. Skype has a lower cost structure, thereby enabling lower prices in comparison with non-P2P VoIP and traditional phone services. It is also easier to scale Skype's subscribers, because Skype does not need to invest in additional infrastructure for accommodating new users - a necessary investment for non-P2P centralized VoIP service providers and, obviously, traditional telephony companies. Hence, Skype grew rapidly because of its technological and thus economic superiority.

In the beginning Skype grew rapidly in Estonia and their main engineering and development center is still bases in Tallinn, Estonia. At peak Skype employed over 400 workers in Tallinn. However, this has been slightly declining recently. It is not reflected yet in companies financial statements but in the second half of 2014 Microsoft restructured Skype business in Estonia, which means that employees were laid off and some of the same employees will continue working for Skype as contractors. Table 5.1 gives overview of main financial indicators of Skype operations in Estonia as a comparison of financial year 2008 and 2013/2014 (Skype has changed its financial year from full year in 2008 to two half years of one full year in 2013 and 2014). As Table 5.1 shows labor costs are 64 % of revenue in 2008 and 57 % in 2013/2014. Hence, there has not been significant change in the proportion and it remains most important cost of the company. Number of employees has grown from 318 to 415 but sales revenue and profitability has more than doubled. Monthly labor cost per employee in 2008 was about 3400 euros, which means gross salary of approximately 2500 euros. Monthly labor cost per employee was about 5000 euros in 2013/2014, which translates into average monthly gross salary of 3700 euros (after social insurance taxes but inclusive of income tax). The average salary in Estonia was at the same time 1000 euros and in the ICT sector close to 1600 euros (Ministry of Economic Affairs and Communications 2015). This increase in salaries during the time period including economic recession in 2008 and 2009 where most salaries did not grow or stagnated, signals that Skype has difficulties in finding qualified employees.

Table 5.1: Indicators of Skype operations in Estonia.

Indicator/Period	**01.01.2008-31.12. 2008**	**07.01.2013-30.06.2014**
Number of employees/ average monthly gross salary[34]	318/2500	415/3700
Labor costs	13.1 million euros	24.8 million
Sales revenue	20.5 million euros	44.2 million euros
Source of sales revenue	EU 100 %	US 100 %
EBIT[35]	1.7 million euros	3.7 million euros
Return on Equity (ROE)	39 %	14,4 %

Source: Author on the basis of Skype Technologies (2009) and (2014).

[34] The average monthly gross salary is calculation by the author on the basis of data provided in annual reports (Skype Technologies 2009 and 2014). It is an approximation..

[35] Earnings Before Interest and Tax (EBIT) is an indicator of company profitability. It is calculated by subtracting expenses from revenue but not including interest and corporate tax payments on profit. It is also known as „operating profit“, „operating income“ or „operating earnings“.

All sales revenue comes from transactions within group. In 2008, revenue source was European Union but in 2013/2014 it has changed to the United States. ROE as a measure of efficiency has decreased from 39 % in 2008 to 14.4 percent in the 2013/2014 financial year.

Already in 2009 Skype's annual report reflected natural limits for potential expansion in Estonia by pointing out that the main barrier for growth in Estonia stems from the lack of qualified software engineers (Skype Technologies 2009, 3). It was also emphasized in an interview with a former Skype top manager in Estonia in 2011 who also expressed concerns about Estonian immigration policies and overall low levels of social tolerance for inflow of international workers (Interviews 14). In order to deal with the small pool of labor in Estonia, Skype also established engineering centers in Prague as well as offices in Stockholm, Sweden, London, UK, Luxembourg, Silicon Valley as well as various locations in South America and Asia (Tiits and Kalvet 2012). The relative importance of Tallinn for Skype operations has been declined over time as company expanded overseas and increased its staff to 1600. However, 400 employees in Tallinn out of 1600 is still quite significant 25 percent of total workers at Skype. It would be unrealistic to assume that company with global presence would recruit only in Estonia because it would make it difficult to attract sufficient number of talented people.

Partially, limited labor pool stems from the fact that Estonia is a small country of 1.3 million inhabitants and it does not have sufficient number of qualified workers. The size of labor market is roughly 600 000 people. ICT sector employs 20 000 people (without manufacturing of electronics). Through interviews with various IT companies in Estonia and government officials it is also clear that supply of IT workers does not meet the demand. It is also difficult to attract workers from overseas because of strict immigration regulations for non-EU citizens as well as unwillingness of some potential recruits to move to Estonia (Interviews 14, 23, 24). In section 2.4, I highlighted stylized facts on the basis of smart specialization literature, which emphasized that innovation and entrepreneurship tends to be widely spread in more densely populated areas and ICT can actually increase the differences between core and non-core regions. Tallinn, Estonia, with 400 000 inhabitants is certainly not densely populated and is not a core region.

Hence, factoring in the locational disadvantages, it can be considered a success that Skype has maintain substantial presence in Estonia from 2005 to 2015 when it has become a global player. Obviously other factors can help. Other stylized facts in section 2.4 pointed out that sectorial diversity and high number of internationally connected multinational companies tend to benefit entrepreneurship and innovation while innovation tends to be lower when a small number of large firms dominate the economy. Estonia scores well on all these accounts. As chapter 4 highlighted it has had open trade and foreign direct investment regime – particularly in comparison with Slovenia. It has diverse manufacturing base. 52 percent of Estonian exports were produced by 100 companies in Estonia in 25 different sectors in 2013 (Ministry of Economic Affairs and Communications, 2015). There is a strong presence of multinational companies such as Ericsson and ABB in Estonia. Successful Estonian manufacturing companies are well integrated into global value chains of multinationals.

Obviously, Skype has joined the ranks of multinationals which operate in Estonia. Estonians consider Skype an Estonian company and it is often used by country's officials for marketing purposes. At the same time, one of the main founders of Skype, Niklas Zennström, usually does not even mention Estonia when he discusses Skype. He usually refers to Skype as Swedish company. For instance, Zennström wrote in the Financial Times in 2015: "When we founded Skype, our aim was never build the best peer-to-peer communication service in Sweden" (Zennström 2015) The fact that Zennström does not mention Estonia in his public statements refers to a locational disadvantage because Estonia is considered a periphery and is not well known as a country. Even more importantly, GP Bullhound report on Europe's most valuable technology companies considers Skype to be Swedish and Transferwise, a financial technology company founded by two Estonians, one of them former Skype employee, to be UK company (Ahmed 2015). Transferwise has headquarters in London but significant presence in Tallinn, Estonia. The fact that two companies with significant presence in Estonia and involvement of Estonian entrepreneurs are in the list of 13 most valuable technology companies in Europe is quite remarkable and reveals that entrepreneurial discovery process works quite smoothly in Estonia. But at the same time, the same entrepreneurs prefer to present their companies as Swedish and British and usual coverage in financial press does not even mention Estonia in relation to these companies, reveals that Estonia comes with locational a disadvantage. Usually, Estonians tend to see Skype and Transferwise as Estonian companies and may overemphasize the Estonian connection.

However, at least in these two cases the connection to Estonia and its entrepreneurial ecosystem is strong. For instance, a scholarly piece on e-government has even suggested that Hotmail originates from Estonia (Ernsdorff and Berbec 2007, 171). This is a clear misrepresentation which has also been replicated in numerous publications. The first backer of Hotmail was Steve Jurvetson from Silicon Valley venture capital firm Draper Fisher. Jurvetson whose parents are immigrated from Estonia to the United States after the World War II. Hence, the Estonian connection is loosely indirect at best and certainly Hotmail did not originate from Estonia.

To sum up, the case of Skype illustrates the opportunities that emerged in the entrepreneurial ecosystem of Estonia in the 1990s and 2000s. Certainly, Skype created more reasons for Estonians to use internet and even more importantly, the success of Estonian based company increased the visibility of internet and related technologies among Estonian public. However, for the diffusion of internet among different socio-economic groups the developments in banking sector were even more important. The next section explores the emergence of internet banking.

5.2.2 Internet Banking as a Critical Juncture in the Emergence of Digital Economy

The importance of entrepreneurial discovery in bringing new innovative products and services to the market and by doing so encouraging the use of internet refers more than just the birth of numerous of IT companies such as Kazaa and Skype. The liberal economic regime and sound financial policies benefited the birth of the banking sector, which became an influential IT innovator by introducing Internet banking in 1996 (Lustsik 2003, 24). The internet banks were introduced by Estonian banks Hansapank and Ühispank, which were owned by Estonians. However, both banks were taken over by Swedish banking groups Swedbank and SEB in the late 1990s. However, interviews confirmed that in many ways Estonian internet banking solutions were superior to Swedish internet banking solutions and Swedish banking groups actually learned from the Estonian experience (Interviews 28 and 32). It other words, reverse technology transfer took place – usually it is assumed that superior technology is transferred from economically more advanced to economically less advanced countries.

Estonian new banks in the 1990s were effectively start-ups because there were no old legacy banks. The Soviet banking system was undeveloped. To great extent it was cash-based system. The use of checks was not widespread. Hence, it was possible to start from blank sheet and avoid the same development trajectories that were experienced by more advanced countries. This provided a critical juncture because Estonian banks did not have to deal with legacy costs and path-dependencies of old banking systems. It was possible to move from cash-based system to internet banking without ever introducing checks and other old technologies. When a typical bank in the west such as Bank of America has essentially made its check-book based system electronic and calls it internet banking, then the Estonian internet banking was from the beginning in term of speed and quality of service. Transfers could be made within the same day, within few hours instead of waiting at least 24 hours. It was cheap as most consumers using the service did not even qualify for credit-cards in 1996.

The quality, security and simplicity of internet banking service attracted the majority of Internet users as its customers (Lustsik 2003, 27). In 2005, 35 percent of Estonian people used Internet banking. In 2013, the use of Internet banking was almost universal among internet users as it reached 73 percent of total population. As the Figure 29 below shows clearly, Estonian lead in the internet banking is exceptional among the CEE countries that joined the EU in 2004 and 2007 as well as in comparison with EU average. In 2004, the use of Internet banking in Slovenia was four times smaller than in Estonia and in 2013 it was almost 2.5 times smaller. Slovenia has not just been a laggard in comparison with Estonia but also in comparison with the Czech Republic, Latvia, Lithuania and Slovakia. Only 4-5 percent of internet users used internet banking in Romania and Bulgaria in 2013. The huge variance of outcomes quite remarkable in the context of Chapter Two, which emphasized the epistemological nature of technology and role of local context in internet diffusion. Even various internet banking solutions have been available for 20 years, these solutions have not diffused evenly to countries characterized by relatively similar socio-economic development (as countries which joined the EU in 2004 and 2007 are).

For those unfamiliar with the Estonian context, the emphasis on internet banking may seem unusual. However, the quick uptake of internet banking provides another critical juncture for the spread of internet and particularly high speed and high quality internet because the service would not be useable without it. The internet banking was introduced when the internet diffusion was still making baby steps in Estonia. Thus, it provided crucial reason for getting online – particularly as banks encouraged their customers to use this option in order to cut costs and provide more efficient service. Already in 2002, internet banking classified as the third most important reason for Internet use among Estonian population, behind communicating via email (76 percent) and using search engines (62 percent) (Lustsik 2003, 27).

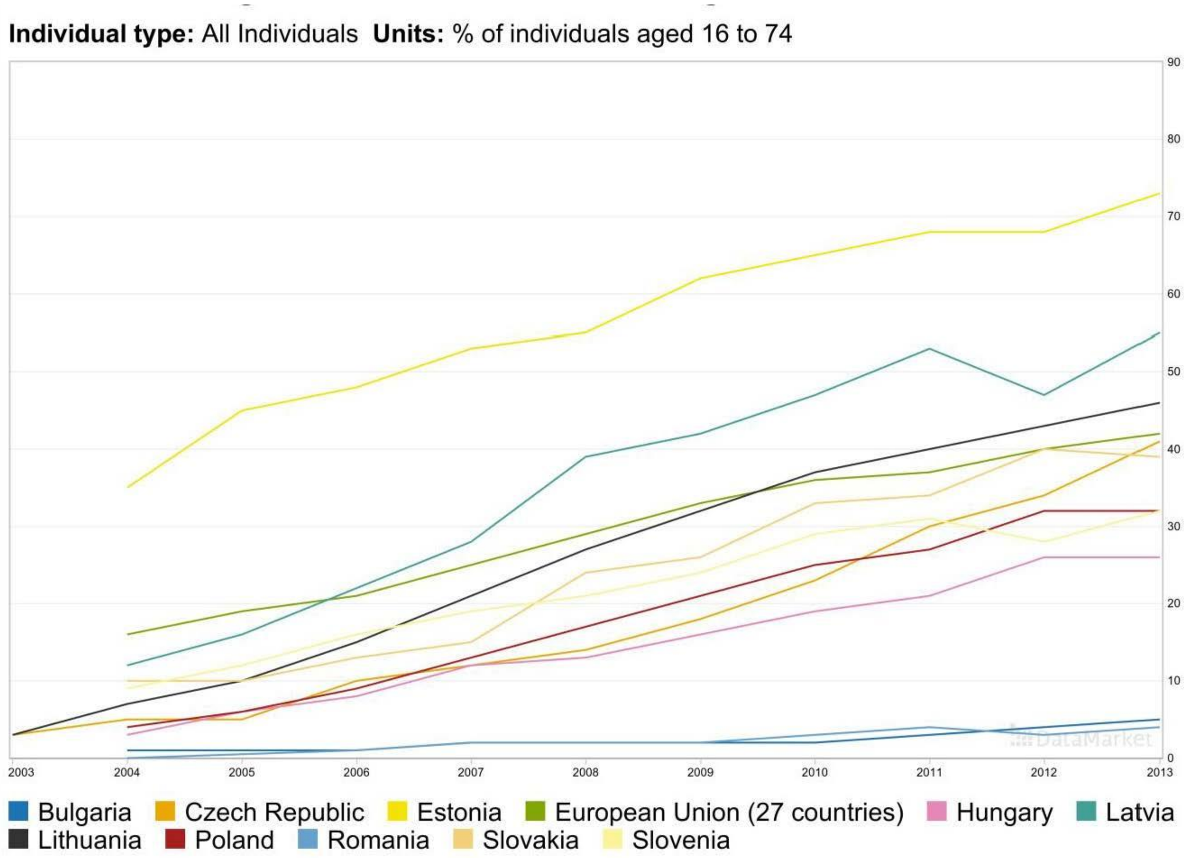

Figure 5.1: Individuals using Internet for Internet banking in selected CEE countries and EU on the basis of data from Eurostat (2014). [36]

It is also important to keep in mind that most people do not need to interact and make transactions with government often. At the same time, the use of banking services can be a daily or weekly necessity. According to Alexa.com data on top sites in Estonia in 2015, the government portal eesti.ee, a gateway to different government online services, is ranked 113 among top sites in Estonia (Figure 5.2). At the same time, the website of the largest bank by market share in Estonia swedbank.ee was ranked 8 and second largest bank seb.ee was ranked

[36] Detailed data is available in Appendix D.

16 among top websites. The websites of smaller banks lhv.ee was ranked 62 and Nordea.com was ranked 110. In other words, even small banks beat the government central portal in attracting users. To be totally objective, it has to be mentioned that the website of capital city Tallinn.ee was ranked 49 and rik.ee, which provides online access to land, property and enterprise registers, was ranked 65 (Alexa, 2015). Figure 30 provides historical traffic trends showing that websites of two largest banks www.swedbank.ee and www.seb.ee have considerably higher global rank by attracting number of visitors than three most popular public sector websites www.tallinn.ee, www.rik.ee and www.eesti.ee.

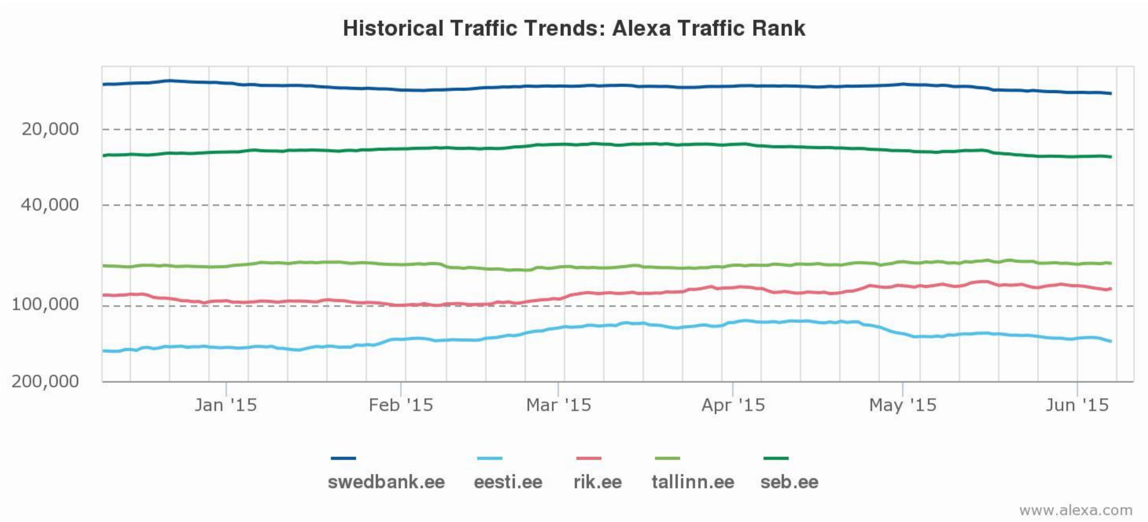

Figure 5.2: Top government and bank websites in Estonia from January 15 to June 15 in 2015 on the basis of global traffic rank with data from Alexa (2015).

This indicates two trends. First, many users go directly to subwebsites of government services rather than access them through government portal. Second, the websites of large banks attract considerably more users than any government service. The data collected by Alexa is based on monthly traffic rank which is combination of average daily visitors and page views over past month. Certainly, monthly data may not be representative of broader trends and some websites may experience considerable volatility of visits on monthly basis. Nevertheless, all this websites are well established in Estonia and have loyal visitors. We can assume that most visitors have to access their banking and government services with certain regularity and are not likely to change their bank or government often. Hence, it can be describe as a path-dependent process where initial decision to use particular bank and its internet banking services will lead to the regular use of their services. For the sake of understanding the importance of internet banking plays in Estonia Figure 5.3 compares top government and bank websites on the basis of global traffic rank with Slovenia. Slovenia's result are opposite to Estonia's. Slovenian government portal has almost as high rank as most popular bank website in Estonia while most popular bank website in Slovenia lags significantly behind top bank website in Estonia by global ranking – nlb.si global rank is 56.306 in comparison with largest Estonian bank swedbank.ee's ranking of 14.324.

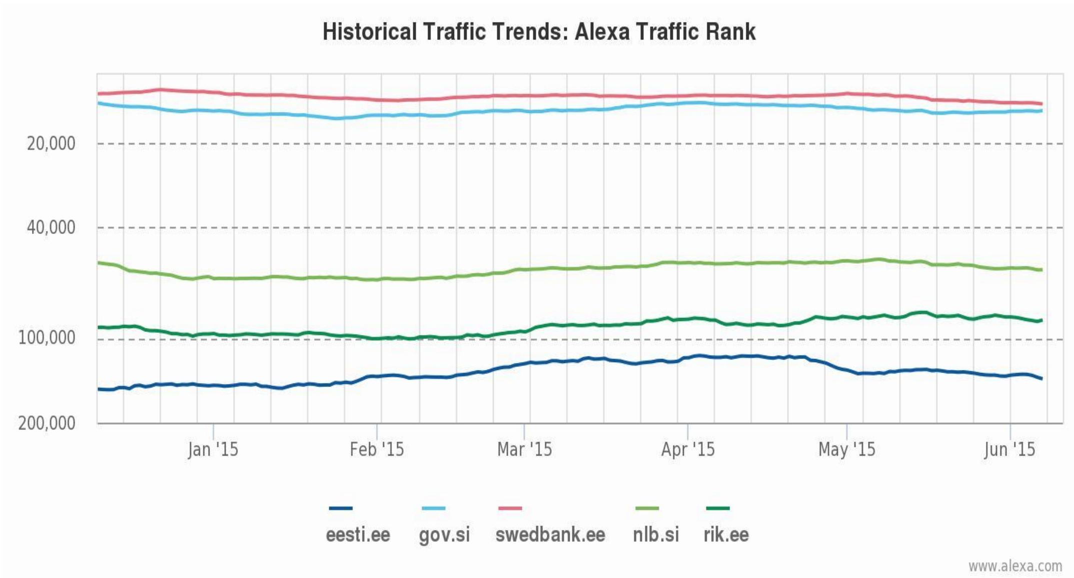

Figure 5.3: Top government and bank websites in Estonia compared to top bank and government websites in Slovenia from January 15 to June 15 in 2015 on the basis of global traffic rank with data from Alexa (2015).

It must be kept in mind that Estonian population is 1.3 million while Slovenia's population is 2 million and in absolute terms Slovenia has higher number of internet users as well as regular bank customers. Hence, one would expect Slovenian websites to be more popular by global ranking than Estonia's websites. To illustrate this key difference further between Estonia and Slovenia, then it must be pointed out that the Slovenian government portal gov.si is ranked number 11 among top websites in Slovenia on the basis on monthly data. Slovenia's largest bank nlb.si is ranked 56 in among top websites in Slovenia.

Furthermore, often scholars fail to grasp the Estonian context where internet banking is not just about providing one service but providing a platform for many services. Many state agencies started to use the identification verification offered by internet banking, thereby enabling government services online. Estonian Tax Authority developed a new software solution in cooperation with companies Sema Group Belgium and AboBase Systems and started to offer an option to declare taxes online already in 2000. The availability of bank-based online identification system allowed them to do so. In fact, in online banking environments it is possible to enter directly to Tax Authorities webpage and declare taxes online. In 2014 95 percent of people declared their taxes online.

According to Aivar Sõerd, General Director of Estonian Tax Authority from 1999 to 2003, the implementation of online services cost to taxpayers only 85 000 euros (Sõerd 2015). "Cooperation with banks led to considerable cost savings,"[37] wrote Sõerd in the leading Estonian daily (Sõerd 2015). Sõerd emphasized that "two largest bank at that time Hanspank and Ühispank offered to government an opportunity to rely on their bank portals for logging into the (tax authority online) environment" (Sõerd 2015). It is obvious from Sõerd's comments that the main focus was on cost saving and control. Since identification tools were made available by the banks, then the tax authority relied on them. Questions whether the use of private sector identification methods is acceptable or not in providing government services were not discussed. It was implemented as a tax authority service project and it did not require any special legislation and wider discussion in the government. Again, functional focus on implementing a concrete project by specific government department without consideration of broader issues and without general government strategy fits neatly into what Kitsing (2011)

[37] Direct quotes from Sõerd (2015) are translated by the author from Estonian into English.

called “success without strategy” in discussing the development of Estonian e-government. It is also a prime example of what this dissertation in the section 2.5 discussed as an entrepreneurial discovery process.

Let me recall the dissertation defines entrepreneurs very broadly: policy makers, public universities and research institutes can be entrepreneurial and part of the process. In many ways development of online services by Estonian Tax Authority is also consistent with Mazzucato’s concept of “entrepreneurial state” or what Crouch calls “institutional entrepreneurs” (Crouch 2005). Mazzucato emphasizes that different public sector bodies can contribute towards innovation outcomes. It does not have to be central government and centralized top-down policy-making (Mazzucato 2011).

Aivar Sõerd of Tax Authority and his employees acted as entrepreneurs by making tax declarations accessible online to public and minimizing costs in doing so. According to Sõerd (2015), the project was implemented in two phases: a pilot took place in 1999 and in 2000 full services made available for individuals and companies. 12 000 people used the Tax Authority online services which consisted of submitting and correcting income and value-added tax declarations, make inquiries about tax liabilities and other transactions. Sõerd argues that in principle the online services of Tax Authority have remained the same from 2000 to 2015 and it should serve as a model for optimization of othe government services. Again, his focus is on optimization and for him public sector “is by nature a large organization which offers public services”(Sõerd 2015).   Again, focus is on functionality and tax services are seen as any other service available in the private sector.

Similarly, many private companies offered services which were accessible through banks making basically banks verifiers of online identities. Essentially, this is a service which is provide by five major banks to third parties (Martens 2010). The authentication methods offered by banks are following: 1) password cards containing 24 one time passwords or 2)

PIN calculators which are offline card readers with a keypad. Customer has to enter his bank card into reader which generates a PIN code which has to be entered when accessing bank online. The system introduced by Estonian banks was more sophisticated than the system used by many American or Western banks today, for example, where only password and username is required. This system introduced already in 1996, is still in use – even as its role has been gradually decreasing making ways for newer identification methods such as ID card and mobile ID. By 2009, one million bank password cards were issued, 50 000 pin calculators were in use and about one million government ID cards were issued (Martens 2010). What is the relative role of bank based ID in comparison with government issued ID card in online environments cannot be verified because the data is not available publicly. However, the leading authentication expert Tarvi Martens wrote in an article in 2010 that bank based ID system is still more widely used accounting for 80 percent of all online transactions than government issued IDs (Martens 2010).

The bottom line is that emergence of internet banking benefited directly provision of e-government services. Since 2000 Estonians have been able to file their taxes online, using the identification system offered by electronic banking services. The study on use of government online services conducted in 2002 already indicated then that the 48 percent of Estonian Internet users pay for e-government services through the internet banking (Krull 2003, 58). Other ways of using e-government services were less exploited by the people. Hence, the Internet banking demonstrates that changes in the formal rules provided incentives for self-interested agents through the process of entrepreneurial discovery to find innovative solutions that encouraged Internet use.

The contribution of political leaders and that of the IT community in the public sector has been primarily in the form of rule-making and provision of services based on private sector developments. In other words, rule-making specific to the electronic government has answering demands in the marketplace and/or seeking to provide services in the areas where transaction costs were lowest. As has been documented by Kitsing (2011), the provision of online government services was not universal and even. Some agencies were truly innovative such as Tax Authority, while other lagged behind such as Labor Market Agency. In this sense, the provision of government services online can be also seen as a process of entrepreneurial discovery in the broadest sense.

This is well characterized by X-Road system that forms the backbone of Estonian e-government. The X-Road system was outlined in the Master of Science thesis of Arne Asper in 2001, a programmer working for small Estonian IT firm Cybernetica employing about 100 people (Interviews 20 and 29). The distributed nature of X-Road makes it more secure than centralized system and allows to exploit the benefits what was called "stupid network" by Icenberg (1998) in the literature review. The X-Road can route queries with different databases in the public and private sector as demonstrated in the Figure 5.4. As systems are technologically different, then they have to use adopters to send and receive information through X-Road. Each computer system uses its own secure server for encryption to protect sensitive data. The following Figure 5.4 illustrates the X-Road system demonstrating how public sector registries, telecom and energy companies, banks, government portal as well as electronic ID infrastructure are all connected through a decentralized network.

Essentially, Cybernetica created similarly decentralized system for Estonian government that Kazaa did for file-sharing and Skype for phone calls exploiting the benefits of internet as a distributed network. Most importantly, it has been cost-effective. Both Taavi Kotka, undersecretary for information technology at the Ministry of Economic Affairs and Communications and Oliver Väärtnõu, CEO of Cybernetica confirm that the cost of X-Road has been up to 67 million dollars over lifetime, including all maintenance costs, salaries, investments and all other costs (Bershidsky 2015). Usually, countries spend more than that per year for their e-government information systems with significantly more modest results.

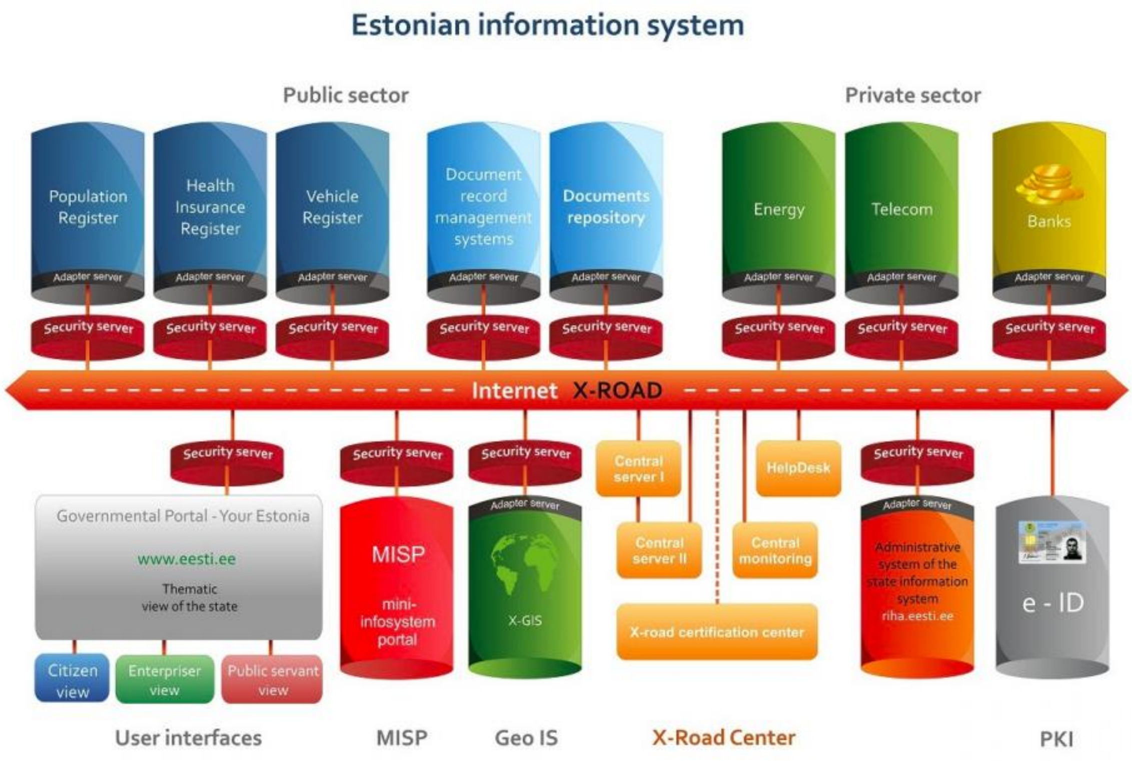

Figure 5.4: Estonian Information System based on X-Road adopted from the State Information Agency (2015).

The bottom-line is that the emergence of government online services did not result from a top-down centralized approach rather it was based on de-centralized approach where some agencies were eager to launch new services while others were not. Some were more eager to exploit online identification methods and opportunities offered by X-Road. Kitsing (2011) has labelled it “success without strategy”. As in private sector new services were provided by experimenting policy entrepreneurs and some of them turned out to be successful. More online services created additional reasons for using the internet. It must be emphasized that the X-road connected private sector agents such as banks with government databases which made it possible for both sectors to cooperate and offer services online. The next part will discuss how the cooperation between private and public sector played out in the case of ID cards and their use in a digital environment.

5.3 From Private to Public: ID Cards

One of these examples of successful policies is Estonian ID card. In 2002, the government introduced electronic identification cards that can be used as identification method for online transactions. One reason why the government introduced ID cards in 2002 was to provide a more secure and sophisticated substitute for online identification method provided by the internet banking where cards with numerical codes were used. The work for ID card project started already in 1997 but it took three years to prepare draft law called Digital Signature Act. The decision to go ahead with the project and deliver the cards to all citizens as one of the last decisions of Prime Minister Mart Laar's government in October 2001 (Martens 2010).

The decision led to establishment of private company AS Sertifitseerimiskeskus by two largest banks and telecom operators in 2001. The company was essentially the certification center for ID card and in the center of network of apps and businesses built around it. In the early years ID card received considerable public criticism and there was initial outrage over investment of 20 million euros in the project (Martens 2010, 224). Martens (2010) emphasizes that initially government agencies were not active promoters of ID card but gradually they started to promote and procure new generation software for their use. Since important private sector playes were behind the project by becoming shareholders in the company responsible for certification process, then the ID card gradually took off and public attitude became for "This unique setup of private and public cooperation with strong players enabled to build a uniform platform," writes Martens (2010, 226). There were also attempts to challenge the monopoly of Sertifitseerimiskeskus by Cybernetica who launched alternative tools based on different standards in 2002. However, this competition ended in 2008 when uniform standard prevailed.

Even though it was made obligatory to have the ID card, they did not become widely used immediately in online environments (E-User, 2005; Martens 2010). As was emphasized above the previous simple identification method provided by internet banking remained the primary form of online identification. Even though government had issued a half million ID-cards by March 2005 (Estonian population is 1.3 million) and reached 1 million by 2009, the new identification method did not gain immediately considerable following in the online environments (E-User, 2005; Martens 2010). People use these cards primarily offline – ID card is a regular identification card with chip that allows it to be used also online. The bank-issued online identification cards have been used in parallel and before the ID card as an identification method for government provided online services. Overall, only 25 000 ID card owners used their cards online in 2006 – four years after the launch. In 2009 the number of online users of ID card had increased ten-fold to about 250 000 (Rudi 2009). Between 2012 and 2002, 500,000 people had authenticated themselves electronically with the ID card at least once. Total number of authentications reached 131 million, which makes 260 authentication per average user in this 10 year period. Out of these 131 million transactions 78 million have been digital signatures, which implies that 156 digital signatures have been given by average user. Obviously, this is just indicator of abstract averages. In reality, some people are heavy users, some light users and some do not use ID card at all electronically. In 2011, 86 percent of Estonian citizens had ID card but only 40 percent of the ID card holders used the digital options of the card – either to authenticate their identity online or to give digital signature (State Information Agency 2015). This implies that most citizens use ID card offline as a regular ID. Ownership of ID card is mandatory by law. However, law does not specify any penalties for not owning the ID card and nobody has not been penalized for not owning the card. Ownership of ID card can make life more convenient. For example, the card can be used as a substitute for a passport for travelling within the European Union.

In 2009, Estonian government also introduced the mobile phone based identification method called mobile ID. The mobile ID does not imply that people can transact on any mobile phone. Rather it is a mobile phone based identification method alternative to ID card, which allows conduct transactions in online environments using smart phone as a substitute for ID card. Prerequisite for activating mobile ID is existence of ID card. It also requires a special Mobile ID compatible SIM-card in the mobile phone which is provided by all mobile operators in Estonia. The cost of changing regular SIM-card to Mobile ID compatible SIM card is about 12 dollars. However, the use of Mobile ID has not become as widespread as the use of ID card. It is a newer innovation and primarily used by early adopters. As of October 2012, 30,000 people had Mobile ID and about 80 percent of them actually used it. By October 2014, the number of users had reached 50,000 and 1.8 million transactions were conducted by Mobile ID per month. 75 percent of these transactions were banking transactions. The use of Mobile ID as a substitute for ID card is encouraged by the spread of smart phones and tablets. ID card cannot be used with smart phones and tablets because of lack of ID card reader. Mobile ID can be used by both (State Information Agency 2015).

Over time, the online identification methods provided by banks and ID card have become of prerequisite for using most Estonian government online services as well as services provided by private companies. It is possible to speak of “forced digitalization” as many government services are not easily available without the ID card or the use of other online identification methods. Offline services are still there but their users face significantly higher transaction costs than users of online services. For instance, it has basically become very complicated to submit documents to Business Registry unless ID card and online channels are used (personal observation). However, some government officials responsible for the digitalization efforts in the Estonian government still complained in interviews that a significant share of online service users rely on bank-based old identification methods and do not use ID card online (Interviews 20).

Nevertheless, the increasing availability of secure online services and innovations such as ID card have created additional reasons to use internet. As the following figure 5.5 suggest, over the years less and less Estonian households are without internet access at home because access is not needed.

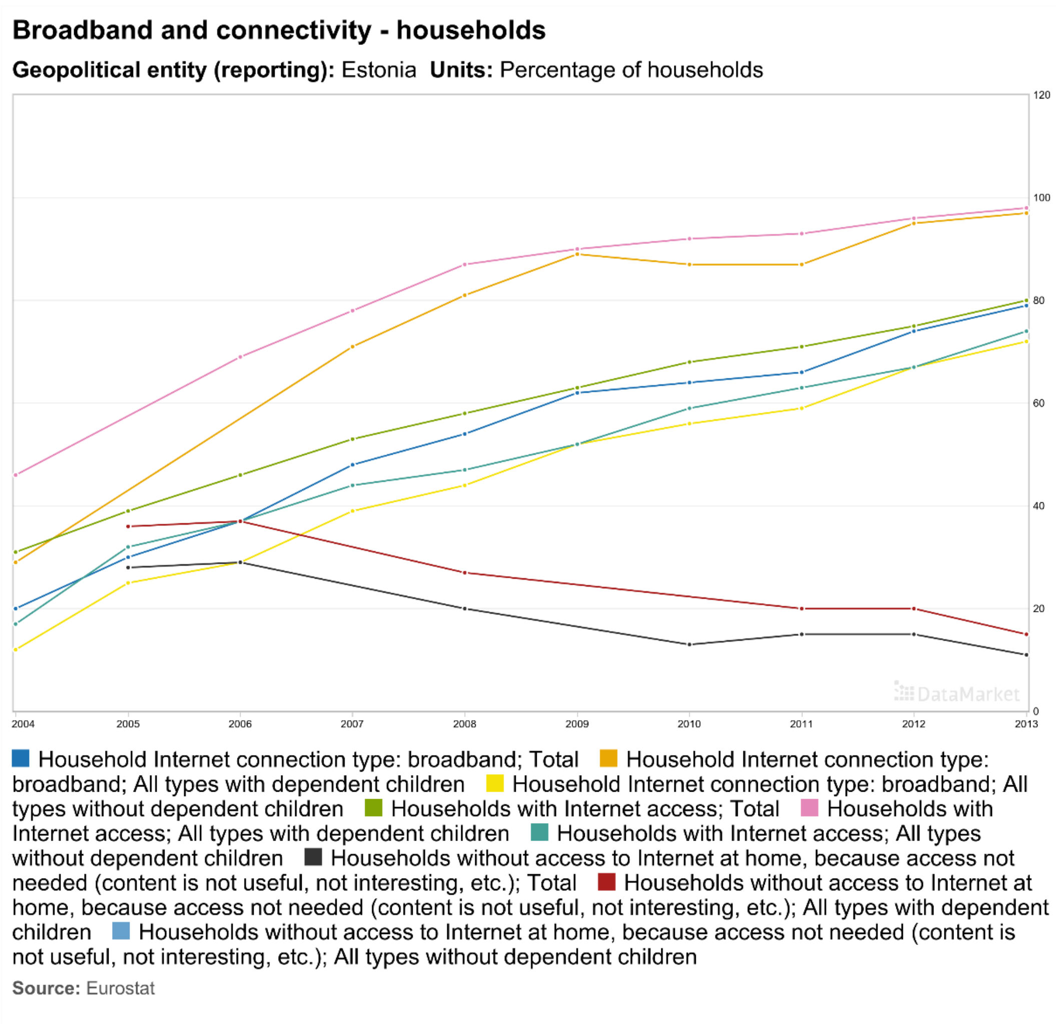

Figure 5.5: Estonian households with internet connectivity at home and without internet connectivity at home because access is not needed 2004-2013 on the basis of Eurostat (2014).[38]

[38] Detailed data is in Appendix D.

In 2005, survey results show that 28 percent of households without internet connectivity at home said that they don’t need it while in 2013 the percentage of such households was decreased to 11 percent. 36 percent of households without children said so in 2005 and 15 percent in 2013.

It is also important to note that the spread of ID card adds to the cost of internet use. The use of ID card requires a purchase of ID card reader or a computer with ID card reader. But it is not sufficiently significant or at least perceived not significant as it has not been a major barrier for its adoption. Cheaper versions of the reader can be purchased for slightly less than $10 dollars. More expensive versions can cost $40-50 dollars. The ID-card itself costs slightly more than $20 dollars (personal observation and calculation). While the reader is required for online interactions, the ID-card can be used as a regular identification document within Estonia and it serves as a substitute for passport for traveling within the 28-countries of the European Union.

In recent years banks have actively supported the use of ID cards in internet banking by lowering the amount of daily transactions that can be made by old internet bank identification method and price discriminating in transaction fees. In addition to private sector, ID cards have become widely used by municipalities and other organizations. However, these are more recent developments, which build on the initial success of internet banking. From the perspective of long-term evolution the Internet banking was more fundamental in explaining the early take up of internet and its more recent initiatives such as the ID-card have helped to diffuse the use of internet further.

But the cost of ID-card and its reader represent only the tip of the iceberg. Any analysis of costs has to go beyond it and consider entire process of its use. Obviously, some transactions such as banking or voting are relatively simple and less complicated than conducting transactions with government in some other online environments such as the business register. Hence, the complexity and costs of using ID card in online environments may vary depending on a particular service. The following is a description of simplified process to illustrate how the ID card can be used. The user starts by inserting the ID-card into card reader and opening the webpage for transaction such as bank, tax authority or some other service provider. Then the voter verifies his/her identity using the first four-digit personal identification number (PIN1) of ID-card. This number is given to user when the card is issued together with PIN 2 and PUK code. Both PIN codes are used also for all online transactions with the ID card that require digital signature. After entering the first PIN number the server checks whether the user is eligible by using the data from the register.

Once the eligibility is verified, the user can fill in data for transaction and can click on to complete the transaction. This decision has to be confirmed by inserting digital signature in the form of second five-digit PIN code (PIN 2). Certainly, user may experience difficulties in this otherwise straightforward process. User have different levels of sophistication in using internet, they have different computer skill levels, their computers may be configured differently and they may use software that is not always compatible with the ID card reader. The practice in Estonia has shown that cheaper ID-card readers may be sometimes quite unreliable and at least in the early years of experiment it did not work properly with some browsers (such as Firefox and Google Chrome). When new versions of browsers and operating systems are released, they may not be always compatible with the ID card software. Hence, the technology may create additional barrier for using online services for some individuals rather than to move the barriers. It creates uncertainty as this way of completing transactions may not always be reliable. The next part discusses the use of ID card and mobile

ID in the internet voting. Other online identification methods cannot be used in the internet voting.

5.4 Internet Voting[39]

Internet voting is the most well-known government initiative to engage public in democratic process in Estonia. It is also an example of policy entrepreneurship in Estonia. The internet voting started as an small experiment in the 2005 municipal elections and now one third of votes are submitted this way. As Estonia is the only country in the world where citizens have voted online in the municipal, national and European elections, then the internet voting in Estonia has received a considerable scholarly attention (Alvarez et al., 2009; Bochsler, 2010). Particularly, the 2007 parliamentary elections have been scrutinized from various angles. Similarly, this initiative was emphasized by interviews as an unique phenomena which demonstrates how sophisticated can be the use of internet in Estonia. Obviously, the internet voting cannot be a major driver of internet adoption. However, it demonstrates the interaction of institutions and internet at the very core of democracy. Increasing availability of secure, high speed and good quality internet makes voting online possible. This leads to the institutional changes, which give an additional reason for the use of internet. Hence, this section offers an overview of last eight elections, highlights key elements of voting process and discusses the reasons for internet voting in Estonia.

5.4.1 Ten Years of Internet Voting Experiment

The possibility to vote online was first used in October 2005 when almost two percent of all voters (Table 5.2), which translates into one percent of the electorate, used this opportunity in the municipal elections as the following table demonstrates. This experiment

[39] An earlier version of this section has been presented in various conferences and published by ACM in the conference proceedings (Kitsing 2014).

was followed the parliamentary elections in April 2007 where about 5 percent of casted votes were submitted online. The European Parliament Elections in 2009 saw close to 15 percent of votes were submitted online. In the municipal elections in October 2009 almost 16 percent of the votes were casted online. The parliamentary elections of 2011 achieved a record where over 24 percent of votes were submitted online. The municipal elections of 2013 saw somewhat lower turnout of internet voters – slightly over 21 percent. However, the latter should be compared with the municipal elections where obviously it is the best turnout of internet voters as well as offline voters among the last three municipal elections. In the 2014 European Parliament and 2015 National Parliament elections one third of all votes were submitted online. The latter is particularly remarkable as it broke all the previous records - 176,491 people participated in the internet voting and overall turnout was 64 percent. This outcome is higher than in any elections between 2005 and 2015.

Table 5.2: Turnout and Internet Voting in the Estonian Elections (2005-2015).

Type of elections	Date	E-votes (% of all votes)	Turnout (%)	E-voting turnout (% of all eligible voters)
Municipal elections	October 2005	1.8	47.4	0.9
National Parliament	April 2007	5.4	62	3.4
European Parliament	June 2009	14.7	43.9	6.5
Municipal elections	October 2009	15.7	60.6	9.5
National Parliament	March 2011	24.3	63.5	15.4
Municipal elections	October 2013	21.2	58	12.3
European Parliament	May 2014	31.3	36.5	11.4
National Parliament	March 2015	30.5	64.2	19.6

Source: Composed by the author on the basis of data from the Estonian Electoral Commission (2015) and Kitsing (2014).

The core idea behind the Estonian internet voting system is that the provision of these online channels for voting removes another barrier by making voting more "convenient" (Alvarez et al 2009, 502). Proponents of remote electronic voting in Estonia, however, often extend their argument beyond convenience and insist that this type of voting will increase turnout in elections. Electronic voting will reduce transaction costs and enhance efficiency in the voting process. Citizens find it easier to cast their vote and they face lower costs of voting (Interviews 20).

Of course, benefits of electronic voting such as reduced transaction costs are only one side of the coin. On the other side, the electronic voting has also potential costs – e.g. reduced civic engagement, privacy and security concerns. Indeed, these costs are not just technical or emerge from a particular civic republican and/or communitarian theoretical perspective. Starting with the consideration of instrumental facts, internet voting reduces some transaction costs for voting while it does increase some other costs. From a purely practical point of view, voters do not simply need access to the computer but the use of the national ID card is required as well. The use of ID card requires a purchase of ID-card reader or a computer with an ID card reader. Since most people use banking services often, then it has created habit to make transactions online, which in turn, has made adoption of ID card and internet voting easier. This allows understanding the role of ID-card in the elections. Naturally, it follows that one of the main reasons for low participation in online voting in the municipal elections of fall 2005 is simply the fact that the online use of ID card was not wide spread. Many people did not use ID card for online transactions because they used old identification techniques (Martens 2010). As the following table 5.3 shows, 61 percent of all internet voters were first online ID card users in the 2005 elections. In the 2007 elections the first time online users of ID-card users made up 39 percent. Subsequently, the percentage of first time online ID card users in the European elections dropped to 19 and in the municipal elections to 18.5.

Similarly, voters were able to use mobile ID instead of ID card in the last four elections. The data shows that in 2011 election only 1.9 percent of internet voters used mobile ID while in 2013 the percentage had increased to 8.6 percent. 11 percent of voters used Mobile ID in 2014 and 12 percent did so in 2015.

Table 5.3: Characteristics of internet voting in the Estonian elections (2005-2015).

Type of elections	E-voters outside of Estonia (% of all e-voters/number of countries	Length of internet voting (days)	Internet votes as share of all pre-election day votes (%)	Mobile ID users (% of all e-voters)	First time online ID-card users (%)
Municipal 2005	N/A	3	7.2	N/A	61
National Parliament 2007	2 / 51	3	17.6	N/A	39
European Parliament 2009	3/ 66	7	45.4	N/A	19
Municipal 2009	2.8 / 66	7	44	N/A	18.5
National Parliament 2011	3.9 / 105	7	56.4	1.9	N/A
Municipal 2013	4.2 / 105	7	50.5	8.6	N/A
European Parliament 2014	3.7 / 98	7	59.2	11.0	N/A
National Parliament 2015	5.71/116	7	59.6	12.2	N/A

Source: Compiled by the author on the basis of data from the Estonian Electoral Commission (2015) and Kitsing (2014).

In sum, the role of ID card and mobile ID demonstrate that internet voting is a typical adoption process as described by Rogers (1995), where early adopters proved ID card as well as mobile ID a reliable way to submit votes and conduct transactions online. As a result increasingly higher percentage of voters have started to rely on these methods. It cannot be argued that internet voting caused people to use more ID cards and this led to wider use of sophisticated online services, which all contributed to the use of internet. Rather, as individuals gained more experience in using internet and ID card online, then they become more comfortable in voting online as well. But certainly the fact that in the first elections significant percentage of citizens used their cards first time online also gave some early adopters more experience and allowed them to experiment with the ID card in online environments.

Coming back to costs and benefits, it is obvious that the adoption of ID card and its reader did represent significant costs in the early voting experiments in 2005 and 2007. However, it does not represent significant costs for the considerable proportion of voters anymore as they have adopted this technology already as consumers in using internet banking and other services. Even institutionally, the process has changed. Internet voting is spread over 7 days since 2009. It used to be three days in 2005 and 2007. If the voter changes its mind, then there is a possibility of electronic re-vote: e-voters can cast their votes again electronically and in that case, their previous votes will be deleted. As far as privacy and security are concerned, then at the vote count, the voter's digital signature is removed. The members of the National Electoral Committee can together open the anonymous internet votes and count them.

One way of tackling these challenges is to vote early and not to leave it for the last minute. If any technical difficulties occur, there is sufficient time to solve these problems or vote in the traditional way at the ballot box. Table 5.3 shows that in the first two elections the share of internet votes as a percentage of all pre-election day votes ranged between 7 and 18 percent. At the same time, in the last six elections it ranged between 44 and 60 percent. The 7-day internet voting period has it made easier for voters to submit their votes and half of the voter prefer to do it early rather than on the last day. This is one way for tackling potential uncertainty which technology may sometimes cause. It also reduces the symbolic importance of election day and makes voting as a result more transactional.

Table 5.3 shows also that the percentage of internet votes by Estonians abroad is miniscule in comparison with votes submitted in Estonia. In 2015 only close to 6 percent of internet votes were submitted abroad. Over the years only 2-6 percent of internet votes have been submitted outside of Estonia. Even though, number of countries from where Estonians submit their voters has increased from 51 in 2007 to 116 in 2015, internet voting is still a domestic matter as 94 percent of votes are submitted by residents of Estonia.

This fact alone brings attention back to the importance of context for explaining the nature of internet voting. It seems that this method of voting would serve best the Estonians outside Estonia and would allow increasing turnout by making voting for them possible. However, the expat community has not been eager to pick up internet voting and it really gathers primarily for domestic audience who could without major difficulties vote also in the traditional voting booth.

5.4.2 Internet Voting and Digital Divide

The qualities of ID card reader, computer hardware and software as well as skill-level in using these technologies are important factors whether internet voting makes voting more easier to citizens or not. The role of resources and knowledge, of course, raise the issue of digital divide and its effects on internet voting in Estonia (Bochsler 2010, 4-6). The digital divide is when certain social groups have resources, skills and knowledge for utilization of information and communication technologies while other social groups lack these necessary preconditions for internet use. A digital divide may exist between countries and regions as well as within regions, countries, cities, towns and villages (Norris 2001). Thus it relates back to the very topic of this dissertation on how internet diffuses differently in different countries, geographic areas and among different social groups. The segments of society with a lower income, and insufficient computer skills are less likely to cast their votes online than wealthier and better educated citizens. Particularly so by considering that a considerable amount of internet voters are urban and the distance to voting booths is smaller in urban locations than in the countryside. The votes of residents of two largest cities – Tallinn and Tartu – have amounted to 40-50 percent of all internet votes in the elections between 2005 and 2015. By attempting to see the impact of internet voting on educational and economic criteria the distribution of votes between cities and rural areas can be used as a proxy. More than half of the votes were submitted in capital city of Tallinn and its surrounding Harju county in 2013, where the GDP per capita is highest in Estonia and people have the best education. However, if one considers that 60 per cent of Estonian GDP is generated in this region, then the distribution of votes does not seem distortive. If the second largest city Tartu and its surrounding county is added to the picture, then over 60 percent of internet votes were submitted in the two largest metropolitan areas (Estonian Electoral Commission 2015).

The same pattern has persisted in 2015 when almost 60 percent of internet votes were submitted in the two largest metropolitan areas. At the same time, voters in quite urbanized and industrialized but primarily Russian-speaking county of Ida-Virumaa in the north-east Estonia counted only four percent of internet votes in 2013. The same pattern persisted in 2015. As non-citizen residents can vote in the municipal elections, then this low turnout cannot be explained by ineligibility. Rather, the internet voting has not been adopted among Russian speaking population to the extent it has spread among Estonian speakers (Estonian Electoral Commission 2015).

In addition to geographical distribution, one additional way to measure the impact of digital divide is to examine the age structure of internet voters. 18-34 year olds made up 43 percent of all internet voters in 2005 and 44 percent in 2007. After that their share has been dropping and reached 36 percent in 2011. At the same time the share of over 55 year old voters was 15 percent in 2005 but has increased to 21 percent in 2011. The share of internet voters between 35 and 54 has stayed more or less constant in all 10 elections with slightly more than 40 percent (Estonian Electoral Commission 2015). This does not indicate a significant divide considering that young are always eager to adopt new technologies while older generations tend take a more conservative view. The dynamic comparison shows that the older generation is actually following the young in the adoption process. The data on distributional impact of internet voting on different sexes is showing the same pattern. In 2005, 54 percent of internet voters were male and 46 percent were female. Their roles had been reversed by 2011 as 54 percent of internet voters were female and 46 percent were male (Estonian Electoral Commission 2015).

Additionally, the distributional impact can be analyzed by considering the influence of internet voting on political parties. Parties representing less fortunate segments of population were skeptical about the internet voting, while center-right parties were the main champions of the internet voting initiatives (Drechsler, 2006). However, Alvarez et al (2009) argue that the results of Estonian internet voting have not introduced socio-economic and political bias when controlling for other variables (Alvarez et al, 502). Nevertheless, their own data about the 2007 elections shows that only 9.1 percent of internet voters voted for the Center Party, which received 26.1 percent of overall votes. The Center Party is a populist, left of center political party, which represents older, Russian-speaking and economically challenged segments of Estonian population than other main parties. Naturally, it might be that the supporters of this party have lower levels of computer skills and this is the reason for lower share of internet votes. Nevertheless, seeing skills as more important explanatory variable than socio-economic status is just a restatement of the argument.

It is clear that there is an uneven distribution of internet voting along the party lines (Table 5.4). For instance, Reform Party received 35 percent of internet votes while its total score was 28 percent of votes. Similarly, the Isamaa ja Res Publica Liit (IRL) received 27 percent of internet votes in comparison with 18 percent of total votes. In other words, two main center-right parties received a total of 63 percent of internet votes while their share of total votes was 46 percent. Both of these parties were actively pushing for the implementation of remote electronic voting and the results show clearly they have bigger share of internet votes than other main parties. Similar pattern has been persistent also in all other elections between 2005 and 2014 (Estonian Electoral Commission 2015).

Table 5.4: Distribution of internet votes among political parties in the Estonian elections - percentage of all internet votes (2005-2014).

Type of elections/Party	Reform	IRL	Center	Social democrats	Greens
Municipal 2005	33	18 + 10[40]	9	10	N/A
National Parliament 2007	35	27	9	13	11
European Parliament 2009[41]	20	17	11	10	3
Municipal 2009	25	23	15	11	2
National Parliament 2011	37	25	10	18	4
Municipal 2013	22	26	9	15	N/A
European Parliament 2014[42]	32	19	6	15	N/A

Source: Composed by the author on the basis of data from the Estonian Electoral Commission (2015) and Kitsing (2014).

One way how the Center Party has tried to minimize their lower share was by setting up special internet voting booths in Tallinn, a capital city of Estonia whose municipal

[40] The IRL was two separate parties in 2005. Isamaliit (IL) got 18 percent of votes and Res Publica (RP) 10 percent of votes. In the next elections both parties had jooned forces and were running as one party - Isamaa ja Res Publica Liit (IRL).

[41] Independent candidate Indrek Tarand received 32 percent of all internet votes. More than any political party in these elections.

[42] Independent candidate Indrek Tarand received 16 percent of all internet votes.

government they control. Even though such actions were not technically violation of electoral law as long as it was not done directly by political party but by city government or other organizations, such booths do raise the question of privacy and introduce additional political biases into the voting system. Ironically, it turns the whole idea of internet voting on its head as the process reminds more of traditional voting. Instead voting in their home or office, people will go to special internet voting booth to cast their vote. Nevertheless, such internet voting booths may be good at promoting civic engagement and offering an opportunity for people without home computer to cast their ballot online.

The previous discussion showed that the electorate of center-right parties used more internet voting than center-left parties. However, the crucial question is whether these gains came by increasing turnout or simply substituting internet voting for ballot-box. Alvarez et al (2009) argue on the basis of data from the 2007 parliamentary elections that online voting mobilized "more casual voters" (Alvarez et al, 502). They found that 11 per cent of online voters probably would not have or for sure would not have voted without this option (Alvarez et al 2009, 502). Similarly, Vassil (2007) found that 14 percent of internet voters would not have voted in the 2007 parliamentary elections by other ways than internet (Vassil 2007, 41). Both of these studies relied on survey data, which is of limited nature and cannot properly estimate substitution effects. In a methodologically more sophisticated approach, Bochsler (2010) estimated the magnitude of substitution effect and found that the internet voting in 2007 elections did not lead to increased turnout, but attracted the same social groups who usually vote (Bochsler 2010, 18). This is also consistent with more qualitative preliminary conclusion drawn from the early experiments in the 2005 municipal elections is that it did not increase participation in the election but was used as an alternative method to cast one's vote (Drechsler 2006).

The internet voting does not necessarily increase participation in the elections. In democracies, adult citizens can vote but large minorities or even majorities choose not to exercise this right even if the transaction costs are low. Similarly, internet voting may decrease transaction costs but does not necessarily increase participation. In many cases, it may simply serve as a substitute for citizens already actively engaged in political participation. Nevertheless, the last results of municipal elections were correlated with increased participation. The turnout is unusually high for a municipal election, which seems to suggest that internet voting might have contributed for the increased participation. However, online voters made up almost 15 percent of voters also in the European Parliament elections, where the turnout was close to 44 percent in 2009 and overall turnout was 37 percent in 2014 . Of course, there are other factors at play such as economic issues and dissatisfaction with particular municipal governments in explaining the high turnout. Most importantly, the elections results are overdetermined and correlations do not imply causation.

My results of analysis of internet voting across several elections in Estonia indicates that political parties misunderstand the nature of internet voting by thinking it creates winners and losers. Center Party has been actively campaigning against internet voting but this is based on misunderstanding. Internet voting does not reduce their total share of votes as it does not increase turnout. In 2014, the city government of Tallinn, a capital of Estonia, commissioned a study by American and European internet security experts, who argued that internet voting is not secure and Estonia should abandon this practice (Springall et al 2014). Since the city government of Tallinn is controlled by the Center Party, then by the supporters of internet voting it is seen as a political attempt to delegitimize the internet voting. It can be argued that the Center Party engages in rational behavior with the objective to abolish internet voting. The Center Party perceives that internet voting benefits other parties at the expense of its potential electorate. But their rationality is bounded by asymmetric information. This has led them to learn wrong lessons andbelieve something which is not necessarily the case. However, it can be seen as entrepreneurial discovery process where agents are bounded by institutional complexity. The Center Party aims at eliminating internet voting because they see it as threatening their interest and they believe that they lose votes as a result.

5.4.3 Internet Voting and Path-Dependency

Constantly increasing number of Estonians has used opportunities to vote online in the last ten elections. This follows the logic of diffusion of innovations. Early adopters showed the way and more and more people follow their lead. The data shows that older people and more women are using online voting option, which reveals that this method of voting is becoming more widespread and ordinary voters may simply use it as a substitute for offline options. This is in line with the data that shows that internet has become a more widely used among different segments of Estonian society. Internet voting has not been the main cause for the wider use of internet but it has certainly given at least one additional reason, if not symbolic reason, for getting online.

The discussion of internet voting has indicated the role played by online identification methods in encouraging the widespread use of internet and sophisticated online services. Section 2.6 emphasized that internet is a network good where its use depends on applications connected to the network. Once Estonian started to use ID card in online banking transactions, it also made easier for them to use it for internet voting. ID card and internet voting are both applications which broaden the options for internet users. The internet voting would not have been possible without the adoption of government issued ID cards by increasingly greater segments of Estonian society. As the ID card can be used in multiple offline and online environment, its widespread use in using both online services provided by public and private sectors has contributed to the internet voting turnout. Internet voting is primarily used by residents of Estonia, not by expats and institutional changes to increase voting period from three to seven days have encouraged adoption of internet voting.

Furthermore, section 2.6 emphasized the importance of path-dependency in technology diffusion. Network goods are often characterized by path-dependency because of increasing returns associated with their diffusion. It was not certain in 2002 when ID cards were introduced that they will be a success. As it was highlighted above there was rivalry among different players. Similarly it was not certain that internet voting will be a success in 2005 when it was introduced. Similarly, it is not certain whether these technological solutions are superior to alternative options. However, choices were made within the constraints. As a result the spread of internet voting is a path-dependent process, where early adoption of online identification methods for internet banking has contributed to the use of ID cards, which in turn have made internet voting more widely spread. Obviously, the path-dependence may also imply that individuals accustomed to traditional methods of voting may be reluctant to adopt new innovative methods of voting – even if these methods will save their time. Hence, it seems unrealistic to assume that majority of voters will start voting online soon. Particularly, as it has been pointed out above that significant segments of society still do not use ID card online, not to mention Mobile ID. Internet voting is not possible without the use of ID card or Mobile ID (Mobile ID use requires the existence of ID card).

Nevertheless, path-dependence may also imply that heavy users of sophisticated online services may find it less costly to use internet voting than offline alternative. Their previous choices in using internet and online identification methods have given them experience and trust in such methods, which can be transferred to internet voting. The reasons for internet voting cannot come from a calculative singular approach, where we assume perfect rationality and utility maximization. Voters have many different identities and they have multitude of preferences. Some voters may be encouraged to vote simply because remote electronic voting is available. This does not imply that they will vote next time. For many others the availability of internet voting is not even necessary (not to mention sufficient) condition for submitting their vote. Hence, we should assume “bounded rationality” instead of perfect rationality, when approaching theoretically and analyzing empirically the role of internet voting. Internet voting might be a good substitute for offline alternatives for some people but certainly not for everybody. It is difficult to see how the internet voting contributes to increased turnout on the basis of Estonian experience and inadequate evidence. Hence, the instrumentalist case that making voting convenient will contribute to increased turnout does not hold on the grounds of instrumentalist logic. As it was demonstrated above descriptive data does not allow inferring that turnout has increased because of internet voting. Share of internet voting of total votes has increased but turnout has fluctuated between 34.5 and 64.2 percent depending on election in the last 10 years.

5.5 Conclusion

Radical change in the rules of the game led to the entrepreneurial discovery process and emergence of many new agents, such as banks, who became heavy internet users and promoters of their own interests in Estonia. The positive externalities of private sector internet use spilled over to other parts of life, including civic engagement. Indeed, the story of internet banking development suggests that the incentive structures of public and private sector agents were consistent with each other, and thus led to the use of internet banking technology in interactive transactions with government as well (such as filing taxes). This mutual re-enforcement made it possible to exploit the positive network externalities of the internet yet further by both private and public sector agents. Users benefited from increasing returns as more users joined the network. This weakened the position of substitutes (e.g., walking to the local bank branch office or submitting income tax returns by regular mail) by replacing them with the demand for Internet. Most importantly, it was rational for the banks to cooperate with government because it allows reaping benefits from the Internet as a network good. Essentially, banks such as Hansapank (it was renamed Swedbank in 2008) became hubs in the network. Clients are able to access services of government agencies as well as other services provided by private sector with a few mouse clicks while being logged onto the online banking environment. Citizens accessing government agencies are directed to the websites of banks if it was necessary to identify his or her identity. It was rational for government agencies to rely on this solution and cooperation because it was efficient, secure, simple and kept costs minimal. It has been rational for the banks to cooperate with government because it allows reaping benefits from the Internet as a network good.

Even though, the government ID card initiated a change from privately driven online identification methods to publicly driven methods, it was essential for banks to be part of ID card project and allow its use instead of creating their own identification system. In this sense, the behavior of Estonian banks is completely different from many other banks in the world, who are usually eager to create their own identification systems. The use of game theory can help to illustrate these fundamental differences. Essentially, Estonian banks play the coordination game such as the battle of sexes with the government while alternative option is to play prisoner's dilemma. In the game of battle of sexes both players are better off coordinating their activities with each other. Multiple equilibrium are possible – (3, 4) or (4, 3) (Figure 5.6). The outcome depends on the relative bargaining position of different parties. At the particular juncture from 1996 to 2005, the outcome is closer to the preferred position of banks rather than that of government (4,3). However, it is still beneficial for them to cooperate rather than not to cooperate. Banks benefit from the network externalities and government from the platform to provide services to the citizens. The lack of coordination and creating incompatible public and private platforms would result much worse outcome for both parties (1, 2) or (2, 1) (Figure 5.6). However, the ID card project increases the bargaining position of government and new equilibria emerges (3,4). Banks gradually start shifting from their old identification methods to new one.

	Private: internet bank based identification	Public: ID card based identification
Private: internet bank based identification	**4, 3**	2, 1
Public: ID card based identification	1, 2	**3,4**

Payoffs: (Banks, Government)
Note: 4 is the highest payoff. 1 is the lowest payoff.
Figure 5.6: Coordination game between Estonian government and banks .

It is still beneficial for them to cooperate with government because alternative option of setting up own identification methods which are incompatible would lead to worse payoffs. Hence, the strategies of government and banks have been incentive-compatible in the time period of 1996-2013. In the terms of game theory, government and banks could have played the cooperation game of prisoner's dilemma during the throughout the same time period. In ideal world, they could reach optimal outcome in terms of equilibrium (3,3) but instead they play repeated game of one-shot prisoner's dilemma with suboptimal Nash equilibrium (2,2) (Figure 5.7).

	Cooperate	Defect
Cooperate	3, 3	4, 1
Defect	1, 4	**2,2**

Payoffs: (Banks, Government)

Figure 5.7: Cooperation game: prisoner's dilemma between government and banks.

Win-lose payoffs in the scale of (1,4) or (4,1) are not characteristic to this game (Figure 5.7) because rational decision based on assumption that other side acts rationally as well. Banks would see cooperation on government driven solution as a loss and government would see cooperation on bank driven solution as a loss.

Of course, this is a stylized narrative based on analogies of two games. It is also based on perception of players as identified through interviews rather than the calculations of actual payoffs. In this sense, it serves illustrative purposes in order to highlight key points. Reality is certainly much more complex and interests of all banks and government agencies are not perfectly aligned as the chapter on Estonia and previously Kitsing (2011) has highlighted that different government agencies have used the possibilities of online identification platforms by banks in a diverse way.

The empirical analysis in Chapter Four followed the discussion of perspectives in section 2.1 which emphasized the importance of formal institutions, particularly changes in telecom policy as well as income and skills. From the comparative analysis it emerged that competition and openness in telecom sector reduces supply side constraints for internet diffusion. This section brought in additional factors emphasizing the process of entrepreneurial discovery in banking and in certain agencies of Estonian public sector, which has been crucial for encouraging the use of internet for a variety of purposes.

My analysis of the development of internet banking in Estonia demonstrates that changes in the formal rules provided incentives for self-interested agents to find innovative solutions through the process of entrepreneurial discovery. Leading banks started to offer online banking in 2000 and cooperate with government and telecom companies to launch ID card project in 2002. This made internet voting possible in 2005. These new innovations of online identification and internet voting encouraged internet use in Estonia. The government's contribution to Internet diffusion was primarily in the form of rule-making and policy entrepreneurship. Government enabled entrepreneurs in private and public sector to take initiative. Most outstanding example of this policy entrepreneurship is internet voting, which has been unique not only in the European context but also in the world because it is used in local, national and European elections and it relies on the use of ID card. The emergence of internet voting, for instance, is reaction to increasing use of internet in society rather than factor that led to increased use. Hence, changing the specific rules governing electoral process can be seen more in terms of political propaganda to show the enthusiasm of Estonian government about internet. Since people have voted in the elections eight times between 2005 and 2015, it can hardly count as a reason to get internet access. Nevertheless, it does contribute to sophistication of internet use. Open and liberal institutional framework which has encouraged the entrepreneurial discovery process has allowed both private and public sector to offer more sophisticated services to the public. This has contributed to heavier use of internet on micro level and to the internet diffusion macro level.

CHAPTER 6

INSTITUTIONAL COMPLEXITY AND POLICY HETEORGENEITY

6.1 Introduction

The Chapter Five discussed experimentation in Estonia from 1991 to present with different ICT services in both private and public sectors. It emphasized the importance of entrepreneurial discovery process in both public and private sectors and path-dependency in delivering positive results. As all of these different projects such as internet banking, ID card and Skype were surrounded by uncertainty in their early stages of development, when nobody knew whether they will be widely adopted. However, in order to offer more balanced assessment this chapter aims to offer heterogeneous cases in addition to positive cases in the Chapter Five. In doing so it employs concepts of institutional complexity and policy heterogeneity. The section 2.2 draw attention to the institutional complexity, which by creating uncertainty may constrain entrepreneurial discovery process. If the Estonian Tax Authority would have faced complex legal requirements in both national and European level in 2000, then introduction of online tax services would have been difficult if not impossible. Also, if they would have faced hostile public opinion primarily focusing on security concerns of online tax declaration, then this project would not have been as successful as it is seen now. Let me re-call that institutional complexity refers to the interactions of formal such as government regulations and informal institutions such as habits and attitudes of people as well as interactions of formal institutions on different levels of government regulations such as local, national and European levels. This implies that broad rules governing macroeconomic environment may conflict with regulations on micro level. There is considerable literature on institutional complexity and one way to define it is “incompatible prescriptions from multiple institutional logics" (Greenwood, Raynard et al. 2011, 317). Different institutions, their interactions, conflicts and institutional logics create institutional complexity.

Policy heterogeneity is closely linked with institutional complexity because institutional complexity reduces certainty and means ambiguity in rules governing our daily interactions. Policy making depends on both formal and informal rules. Broadly policy heterogeneity can be seen that public policies often have heterogeneous context and design. Starting with formal aspects, Knoepfel et al (2011) argue that if implementation of public policy falls under several ministries, or several departments within one ministry, then policy context is heterogeneous. If policy is implemented by one unit at the same ministry, then it is homogeneous. They give defense policy as an example of homogeneous administrative context while policies dealing with natural disasters are heterogeneous (Knoepfel et al 2011, 186-187). For instance, introduction of online tax services was a project of one agency in Estonia. There was relatively little interaction with other agencies and the Tax Authority was able to rely on already on existing solution provided by internet banking as documented in Chapter 5. At the same time, the introduction of ID cards was considerably more heterogeneous policy-making case involving legislative, executive branches of government, several ministries within executive branch as well as private sector agents such as leading retail banks and telecom companies (Martens 2010).

Nevertheless, it is difficult to imagine completely homogeneous policy context. Hence, it is a question of degree of heterogeneity and homogeneity. Most importantly, ICT policies have high degree of heterogeneity by administrative context as well as design. ICT is by nature horizontal dependent on physical infrastructure as well as humans skills in different administrative units and in society as well. For instance, the successful implementation of online tax declaration depends on existing infrastructure, available identification methods and many other factors, which are not directly under control of Tax Authority. Knoepfel et al

(2011) approach seems also narrow considering nature of public policy implementation in general and ICT policies in particular. Even if policy context and design is homogeneous, then the impact of public policies can be heterogeneous. This may stem from unintended consequences, interactions of government regulations with informal rules as discussed under institutional complexity. In international economics policy heterogeneity is used to highlight regulatory differences between countries (Kox and Lejour 2005). However, there might be also regulatory differences within countries or among the group of countries such as EU as discussed in section 2.8, which formally have adopted same telecom regulations. It is a fact of life that regulations may conflict with each other and may be implemented differently by policymakers. True nature of policy heterogeneity is captured by Room (2011) who combines theories on complex adaptive systems, institutional analysis and policy analysis in his book "Complexity, Institutions and Public Policy". He writes:

> "The real world of policy-making may be so turbulent that there are few familiar patterns by reference to the regularities of the past, even fewer plausible 'mental models' or conjectures for the future. Public policy-makers may be able to reduce this uncertainty by actively shaping the future, rather than just attempting to predict it; however, even they are limited in the capacity and knowledge of which they dispose." (Room 2011, 244).

Room's emphasis on limits of knowledge of policy-makers echoes Hayek's understanding of limits of knowledge in centralized decision-making as it is discussed in the Section 2.8 of Chapter Two. According to Hayek (1945) considerable amount of useful knowledge is decentralized and tacit which implies it that it is difficult to centralize it without collected knowledge becoming useless. Room (2011) is somewhat more optimistic than Hayek about policy-makers abilities to shape the future and reduce some uncertainties but, nevertheless, their limits must be recognized. The concept of policy heterogeneity can be also seen in the context of smart specialization literature as discussed in the Section 2.4, which argued that countries follow different development trajectories. This means that same or similar policies in different context may yield heterogeneous policy outcomes.

This chapter will discuss the following cases to illustrate institutional complexity and policy heterogeneity. First, the ICT-specific policy making will be discussed in general. Second, it will be followed by analysis on EU-wide network neutrality legislation and Estonian policy contributions. As Chapter Four identified rule-making concerning telecom liberalization as a crucial factor in Estonia, then it will be important to see how Estonian public policy makers have been able to tackle more complex policy challenges. Third, government intervention in venture capital market with the aim of supporting ICT companies will be discussed. All of these cases are used to demonstrate policy heterogeneity and explore how institutional complexity may lead to heterogeneous outcomes. These cases are offered in order to balance the understanding that the Estonian government has pursued homogeneous and centralized public policy to promote ICTs and their use in all segments of society.

6.2 Innovation, ICT and Policy-Making in Estonia

Let me start this section by recalling a quote from Paul Pierson's book: "Every step and every movement of the multitude, even in what are termed enlightened ages, are made with equal blindness to the future ; and nations stumble upon establishments, which are, indeed, the result of human action, but not the execution of any human design." (Pierson 2004, 102). Chapters Four and Five argued that Estonia is quite different – at least in comparison with Slovenia and some other countries in the Central Eastern Europe. However, it is not different because Estonian policy-makers had particularly good vision and did not stumble upon establishments. Here as everywhere out there outcomes are result of human action but not human design. As argued in Chapter Two, the galvanizing changes are often spontaneous.

However, *a posteriori* rational reasoning that the good outcomes in internet diffusion and related technologies were result of some grand master plan is quite widespread in policy circles. If politicians do it, it is understandable because it is their job often to turn complexity into simplicity, research into soundbites, uncertainty into certainty and nonlinearity into linearity. Similarly, civil servants may have incentives to overemphasize their contributions and impact of public policies. Furthermore, simplified accounts of ICT developments and policies may simply be used as marketing tool in targeting international audiences with limited attention span. For instance, Estonian government's marketing website www.e-estonia.com states bluntly at the front page: "”e-Estonia” is a term that is commonly used to describe Estonia's emergence as one of the most advanced e-societies in the world – an incredible success story that grew out of a partnership between a forward-thinking government, a proactive ICT sector and switched on, tech savvy population" (e-Estonia 2015).

The website goes further and claims that "interaction among government agencies, and between the government and citizens, has been completely transformed in e-Estonia, quickly making bureaucracy a thing of the past and making the running of all levels of government more efficient than ever before" (e-Estonia 2015). Even if this is understandably a marketing text, these are bold claims about complete transformation of citizen-government interaction, disappearance of bureaucracy and efficiency. The Chapter Two emphasized that transformational role of technology does not come without any costs and government ICT projects do fail. The discussion of institutional complexity and policy heterogeneity in the beginning of this Chapter should also remind us the trade-offs. As Room (2011) reminds us "the challenge of ensuring both security and transparent governance for these new institutional forms" is one key area of focus for scholarship in this field. In this context, these claims are particularly bold. Estonia claimed to have solved the challenges with gusto, while leading experts and academics still spend sleepless nights thinking about them. Even if seen as a pure marketing text, it should avoid overselling and overpromising establishments that are out of government control.

Academic research tends to be more balanced but even there similar notions can be found (Ernsdorff and Berbec 2007). They write the following about Estonia:

> „…it is setting an example in terms of e-democracy throughout the European Union, being the first country in the world to enable all its citizens to vote over the Internet in political elections. But it was not just the EU membership that expanded the use of Information and Communication Technologies (ICT) in Estonian society; it was mainly the strategic thinking within the government to implement e-democracy, good attention to detail and a positive attitude towards ICT policy, innovative thinking and the development of a legal framework, and the economic growth and the macroeconomic stability of the country. The progress made by Estonia in the field of information technology has led to the development of some of the most dynamic ICT companies in the world, placing Estonia on the world map with three major technological innovations: Kazaa (software that allows file sharing), Skype (Internet-based free phone service) and Hotmail (free web-based e-mail) – all three originating from Estonia." (Ernsdorff and Berbec 2007, 171)

Chapter Five already pointed out that the example of Hotmail is a mistake or simplistic interpretation of some Estonian government marketing text, which sometimes used Hotmail as an example of company funded by Steve Jurvetson, an American-Estonian venture capitalist in Silicon Valley. Most importantly, such accounts fail to account for institutional complexity and policy heterogeneity. If the EU membership is an important variable, then diverse outcomes in internet diffusion among different EU members cannot be explained. Ernsdorff and Berbec (2007). It also fails to distinguish between private and public sector projects. Often the success of Skype is given as an example of successful ICT policy in Estonia or even a reason to increase government support for ICT sector. But as was discussed in previous chapter Skype was founded by Swedish and Estonian programmers who were fugitive from the US justice system for a while because of their previous project Kazaa allegedly infringed the copyrights of Hollywood music industry. Estonian government did not give any support for the project. Once Skype had become a success story politicians started to exploit its success.

Most importantly, such mischaracterizations tend to rely on the following three misunderstandings. First, Estonia is particularly innovative country. Second, ICT sector plays a large role in the Estonian economy and politics. Third, Estonian success in ICT is result of well-coordinated public policy which in centralized top-down fashion has turned the country to "e-Estonia". The latter claim can be found in simplified accounts written by international experts and scholars (Dutta 2006; Ernsdorff and Berbec 2007). Nevertheless, Estonian own policy-makers avoid emphasizing centralization and bring attention to the benefits of decentralization. Even Estonian government's marketing website states the following:

> "The e-Estonia digital society is made possible largely due to its infrastructure. Instead of developing a single, all-encompassing central system, Estonia created an open, decentralized system that links together various services and databases. The flexibility provided by this open set-up has allowed new components of the digital society to be developed and added through the years. It's that power to expand that has allowed Estonia to grow into one of Europe's success stories of the last decade." (e-Estonia 2015)

If all or some of these claims were true, then obviously internet would be widely diffused. Simplified analytical accounts of internet developments are based on understanding of this stylized Estonian model can somehow be transferred to other countries. Estonian policy entrepreneurs want outside world to believe that Estonia is a great success story in the field of ICT, and naturally, they are interested in exporting some of the Estonian IT solutions such as X-Road and internet voting to other countries. The new example of this marketing strategy is Estonian e-Residence Program, which aims to make Estonian ID Card and online services accessible with the card such as company registration and banking available to 10 million international residents (e-Estonia 2015). US President Barack Obama was one of the first foreign dignitaries to receive Estonian ID card when he visited Estonia in 2014. It cannot be confirmed whether he has used Estonian ID card or not in online environments. However, he was quite convinced of achievements in the Estonian ICT sector and decided to dedicate a paragraph to it in a speech, which primarily focused on the security situation. Obama said the following about ICT development in Estonia in a speech in Tallinn on September 3, 2014:

> „ Look at the evidence. Here in Estonia, we see the success of free markets, integration with Europe, taking on tough reforms. You've become one of the most wired countries on Earth, a global leader in e-government and high-tech start-ups. The entrepreneurial spirit of the Estonian people has been unleashed. And your innovations, like Skype, are transforming the world." (Hanrahan 2014)

During the press conference on September 3, 2014, Obama went further and said that "I should have called the Estonians when we were setting up our healthcare website." He pointed out that "With their digital IDs, Estonians can use their smartphones to get just about anything done online — from their children's grades to their health records" (Hattem 2014). This actually is an overstatement and quite ironic because of delivery of Estonian healthcare records online can be hardly described as a success. The Estonian State Audit Office carried out analysis of electronic health initiatives in 2014 which concluded that most projects had failed. Government has spent five times more funds on these health initiatives than initially budgeted. The result is digital prescription, while all other components of electronic health services such as digital patient history, digital pictures and other services which would eliminate repetitive data collection and would make data available for all doctors electronically have failed (Riigikontroll 2014). Reforming health care does not require only technological solutions but requires changes in the institutions. Obviously, the process of entrepreneurial discovery has not been able to deal with institutional complexity of health care information systems and it has resulted in policy failure. This experience, of course, does not make Estonia unique as the world is littered with policy failures in this field as health care information systems have many problems everywhere. The next section will tackle the role of innovation in Estonia. This is followed by discussion of ICT sector in the Estonian economy and politics. The third issue concerning (de)centralization of decision-making will be discussed last and has been already covered to some extent in Chapter 5 concerning online tax services and X-Road infrastructure.

6.2.1 Estonia as an Average Innovator

Each year European Union tries to measure innovation among its member states with the European Innovation Scoreboard. The scoreboard is a result of EU attempts to develop indicators for measuring "knowledge economy" (Room 2011, 271). EU's Lisbon agenda established a new process of "soft" governance, which extends beyond policy areas with a clear EU mandate. One method for such governance is constant benchmarking. This seems rather crude and simplistic once institutional complexity and policy heterogeneity but at least policy-makers in Estonia do pay attention to the European Innovation Scoreboard (personal observation, Interviews). The scoreboard uses a large number of indicators such as R&D activity, number of science graduates, patents, weight of high tech industries, innovation by Small and Medium Size enterprises and others. The detailed methodology is described in the scoreboard (European Commission 2015, 79-90). As the following Table 6.1 demonstrates Estonia is slightly above the EU average, Slovenia and other CEE countries in innovation in 2009 but still has a significant room for advancement. It cannot be concluded that Estonia is particularly innovative in comparison with all other EU countries. However, it was more innovative than Central and Eastern European member states in 2009. However, if we look at more recent data in 2015, then Estonia has actually fallen in the ranking below the EU average and Slovenia is slightly more innovative than Estonia as shown in the Table 6.1 above Estonia is not anymore among innovation followers but classified as a moderate innovator while Slovenia is still classified as innovation follower. In other words, Estonia's performance in innovation has got worse between 2009 and 2015.

Table 6.1: Position of Estonia and Slovenia in European Innovation Scoreboard.

Indicator/Country	Estonia	Slovenia
Position from highest to lowest/Below or above EU average /Classification in 2009[43]	12/Above/Innovation follower	14/Below/Innovation follower
Position from highest to lowest/Below or above EU average/Classification in 2015	13/Below/ Moderate innovator	12/Below/ Innovation follower

Source: Author on the basis of data from European Commission (2009; 2015)

Estonia scores highly on indicators of knowledge-based innovation such as non-R&D innovation spending by firms. However, it does not score well in knowledge creation as measured through patents and R&D spending (European Commission 2015). This drop in ranking happened in spite of the fact that total expenditure and private sector expenditure on research and development (R&D) had been increasing until 2012. As the following Figure 6.1 demonstrates, total R&D expenditure was around 0.6 percent as a percentage of GDP in 1998 but it increased to more than 2 percent in 2012 but declined to 1.7 percent in 2013. The main reason for increase is expenditure by private sector on R&D. This implies that public sector expenditure has not increased in relative terms in this time period. Hence, it challenges the notion that there has been a coordinated government intervention, which has made Estonia innovative over time. It also challenges the idea that R&D spending can rely only on private sector because as the Figure 6.1 shows this implies also volatility in the spending which makes it difficult to make investments in the long-term and risky projects with potential positive externalities. Private sector has incentives to underinvest in R&D because they cannot capture the positive externalities of innovation. However, it must be noted that rapid increase in private sector R&D in 2011 in comparison is partially caused by investments of state owned energy company. This creates conceptual challenges in distinguishing between

[43] Countries are classified int four categories: 1) Innovation leaders, 2) Innovation followers, 3) Moderate innovators and 4) Modest innovators

public and private spending as some private spending as classified by Statistics Estonia is actually public. Figure 6.1 shows also a drop in total and private sector R&D spending in 2012 as well in 2013 in comparison with 2011 which is partially caused by investment of state energy company in 2011.   Nevertheless, the key trend remains the same. In 1998 private sector spent almost nothing on R&D and gradually it has become a bigger spender than the public sector.

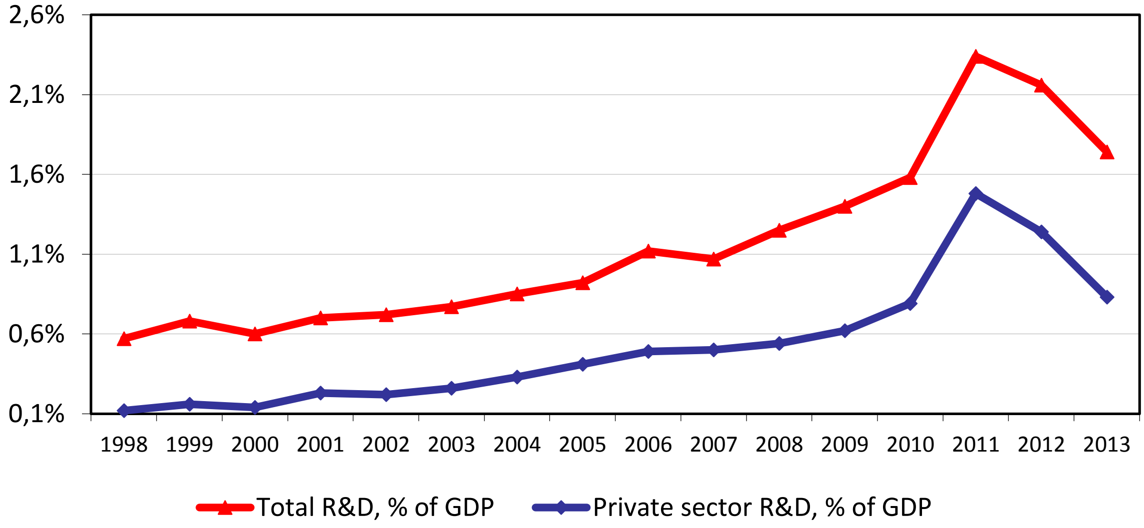

Figure 6.1: Research and development expenditure as a percentage of GDP in Estonia from 1998 to 2013 adopted from the Ministry of Economic Affairs and Communications (2015) on the basis of data from Statistics Estonia (2015)

To conclude, Estonia is about average in innovation performance in the EU context. In recent years, its performance has actually got worse as the R&D spending as a percentage of GDP has declined and Estonia's ranking in the EU innovation scoreboard has dropped. This brief overview at least partially challenged the myth that Estonia is particularly innovative country. However, it may be that these more general innovation trends are not representative of Estonia's innovation in the fields of internet and ICTs. Hence, the next section will study innovation in ICT sector.

6.2.2 Innovation in ICT Sector

Obviously, the EU innovation scoreboard and R&D expenditure as a percentage of GDP are imperfect measures to understand innovation. They provide abstract overview but lack details. Academic criticism of the innovation scoreboard has pointed out the some data on innovation performance is based on self-reporting which reduces measurement validity. Even more importantly, the scoreboard oversimplifies innovation which is “a complex process involving interactions at the level of enterprise between technological investment, organizational change, entrepreneurship and workforce development” (Room 2011, 275). Therefore, the innovation in the Estonian ICT sector may require more detailed attention.

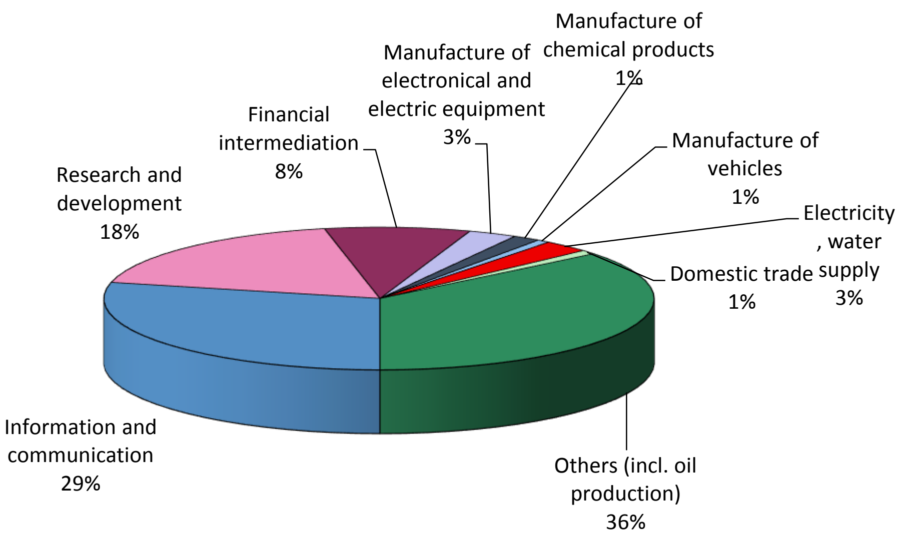

Figure 6.2: Intramural R&D expenditures of business sector by economic activity adopted from the Ministry of Economic Affairs and Communications (2015) on the basis of data from Statistics Estonia (2015).

Private sector R&D spending on ICT as a share of total spending has actually increased in the recent years. In 2011, ICT sector accounted for almost 18 percent of private sector R&D spending (including both software development and hardware such as manufacturing electronics). Figure 6.2 shows that by 2013, the share is at 32 percent where manufacturing of electronics is 3 percent and information and communication technologies 29 percent. However, the change in share is partially caused by decrease in R&D on oil production from shale oil, which also influenced total private sector R&D spending after 2011 as I discussed above.

However, a look at spending on R&D is still too general to understand and compare ICT sector innovation. Hence, even more detailed analysis is needed. The Eurostat conducts regular surveys on innovation called Community Innovation Survey (CIS) which serves as one input to the innovation scoreboard. However, since data collected is not fully utilized in the scoreboard, it also allows taking a more detailed look into innovation in specific sectors. Table 6.2 partially relies on CIS but also on data available from Statistics Estonia and Estonian Business Registry to compare ICT sector and subsectors with other important sectors in the Estonian economy. It uses NACE two-digit codes to classify these sectors. It looks at level of innovation as a reflection in the value-added per employee (more innovative firms can pay higher salaries and have higher profits per employee) and R&D spending by the firm. It also considers the concentration ratio of firms. Sectors with high concentration ratio have smaller number of firms and hence the number of innovative firms must be compared among sectors with similar concentration ratios. The most straightforward sector that falls under ICT is programming. Value-added in programming 30,000 euros per employee annually is higher than Estonia average which is slightly over 20,000 euros.

However, logistics with similarly low concentration ratio of firms has value-added per employee at 44 000 euros and 78 innovative companies while programming has 72. Wood production with similarly low market concentration ratio had 145 innovative companies. However, logistics and wood production had non-existent R&D expenditure, but of course, it does not mean that companies in these sectors do not innovate. Their innovation is practice-based rather than science-based.

Another ICT subsector, telecommunications, has similar market concentration ratio with chemical production, transport equipment, vehicles and electrical equipment ranging between 50-76 percent but the number of innovative firms is in telecom sector is 20 while in electrical equipment it is 27 and in chemical products it is 20 as well.

Table 6.2: Value-added per employee, number of innovative firms, research and development expenditure and 4-firm market concentration ratio in selected sectors.

	Value-added per employee in thousands of euros (2013)	Number of innovative firms in sector (2012)	Total R&D expenditure by firms in sector in thousands of euros.	Market concentration ratio – share of 4 largest firms in total sector turnover (%).
Production of computers and electronics	26,5	27	1,7	90,9
Programming	30,3	72	23,4	15,9
Production of transport equipment	24,4	7	0,0	70,5
Production of electrical equipment	28,0	27	1,2	63,9
Logistics	44,1	78	0,0	14,2
Production of wood products	20,8	145	0,2	22,7
Production of chemicals and chemical products	29,0	20	1,6	52,4
Telecommu-nication	36,2	20	0,0	69,3
Production of motor vehicles	22,8	15	0,8	76,2
Information services	17,9	17	8,5	38,3

Sources: Compiled by Author on the basis of Community Innovation Survey (2014), Statistics Estonia (2015) and Estonian Business Registry (2015).

Hence, telecom sector does not stand out as particularly innovative – even though its value-added is considerably higher than sectors mentioned above and higher than the Estonian average. Telecommunication does not have any R&D expenditure, while this is the case with chemical products.

If very loose definition of ICT can be applied, then production of computers and electronics as well as information services do not stand out by a large number of innovative firms. However, they have somewhat higher R&D expenditures than most other sectors but not high value-added per employee. In sum, it is not possible to conclude that ICT firms in Estonia are particularly innovative when compared with other sectors.

The role of ICT firms can also be measured by looking at the share high tech exports of total exports of Estonia. Figure 6.3 compares high tech exports in Estonia with the Central and Eastern European countries and with the EU average. Estonian high tech exports account for 16.3 percent of total exports while the EU average is 15.6 percent in 2014. In other words, Estonian performance is about the EU average. At the same time Estonia also has higher share of high tech exports than any other Central and Eastern European country. For instance, Slovenia's high tech exports are 5.3 percent of total exports in 2014. Only Hungary and the Czech Republic come close to Estonia with respective shares of 14.4 and 15.3 percent in 2014. Even more remarkable is the dynamic performance. The share of Estonian high-tech exports used to be 7.8 percent in 2007 while the EU average was roughly the same and Hungary's share exceeded 20 percent. Since 2010 Estonia has been catching up and going ahead of other countries. However, this outcome is explained by a single decision. Ericsson decided to open manufacturing plant in Estonia to produce RBS family mobile network stations. Since electronics is classified as high tech in Eurostat manuals, then this single decision impacted also macro level data. Ericsson share of total Estonian exports exceeds 10 percent as the Tallinn factory produces equipment for a half of the world.[44] Obviously, if ICT would be defined very loosely and production of electronics would be included in the ICT, then the importance of ICT would be quite significant for the Estonian economy. However, this would be very loose definition.

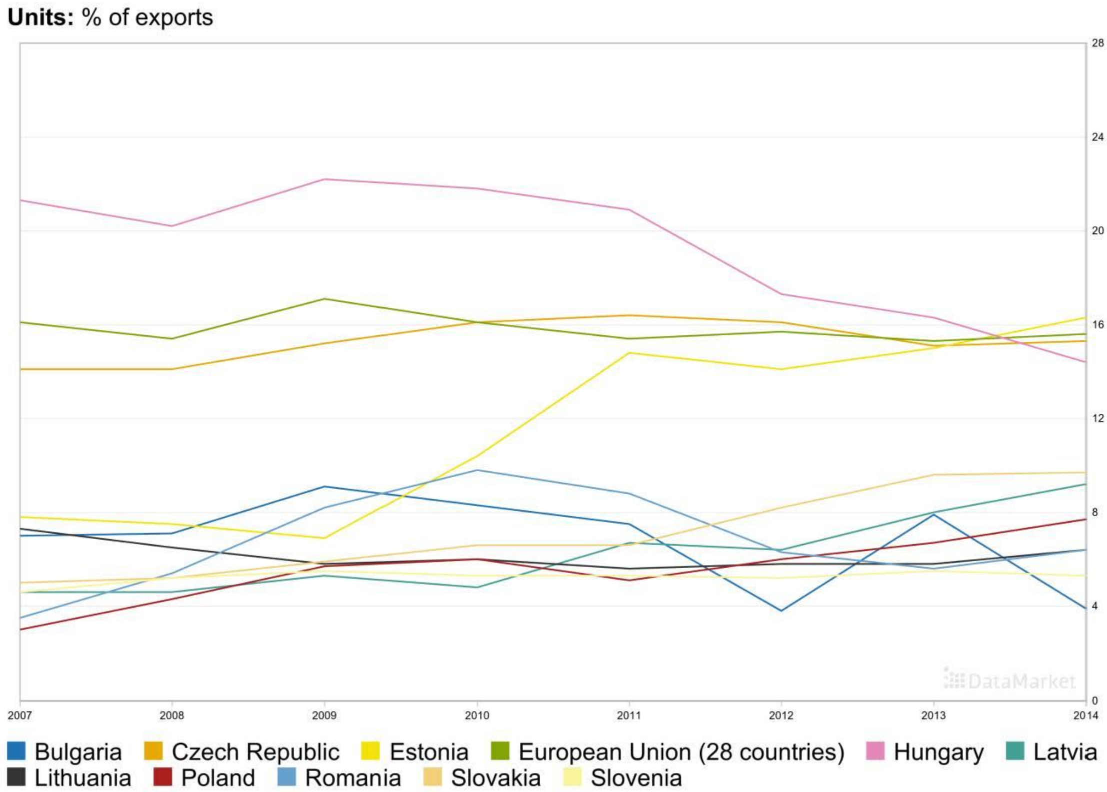

Figure 6.3: High tech exports as a percentage of total exports in the European Union and selected Central and Eastern European countries from 2007 to 2014 on the basis of Eurostat (2015).

If ICT sector is defined more narrowly, the role of ICT sector as such is not as crucial for the Estonian economy as some accounts suggest. This definition would be more appropriate because exaggerated claims are not usually made about electronics manufacturing by large multinationals but about software development and start-up companies. Computer services account for 1.3 percent of total Estonian exports (including both service and product

[44] Obviously, Statistics Estonia does not reveal data about single company. The calculation is made by the author on the basis of Business Registry (2015) data on Ericsson's revenues and Statistics Estonia (2015) data on the total value of Estonian exports.

exports) and for 4.3 percent of Estonian services exports in the first 9 months of 2014 (Ministry of Economic Affairs and Communications 2015).

This section demonstrated that Estonian ICT sector is not particularly innovative when compared with other key sectors of Estonian economy. Electronics manufacturing plays a considerable role in the Estonian exports, while software does not. Certainly, there are some innovative companies in ICT sector but their connection to real economy is not strong. Indeed, one way to read Figure 6.5 83.7 percent of Estonian exports of total exports are not high tech.

Actually, some representatives of more traditional ICT companies told in the interviews that a few start-up companies receive considerable attention in Estonia while sector-wide problems are left unsolved. For instance, ICT related research at the universities often has little relevance for industry. Labor market for ICT workers is tight and attraction of new companies through government sponsored marketing campaigns makes it even tighter. At the same time, government strict immigration policy does not allow to recruit necessary number of new workers from outside of the EU (Interviews 30). At the same time, utilization of ICT in manufacturing sector has been low as well. At the same time, manufacturing sector is a real engine of Estonian exports and economy. Since innovation in ICT depends on the skills of workers, then the next section will tackle some of these issues more closely.

6.2.3 Labor Market Constraints and ICT Skills

Chapter Two emphasized that supply-side constraints matter more for internet diffusion than demand side constraints. This is so because demand for internet and related technologies is derived demand. There are many substitutes available. Chapter Five discussed Skype and showed that one important factor that constrained the growth of company in Estonia is a tight labor market where demand for professionals with good ICT skills exceeds supply in Estonia. In other words, labor market and shortage of ICT professionals represents a serious supply side constraint in Estonia. It does not just affect ICT sector. If manufacturing sector or public sector would want to higher new ICT professionals, then they have to face the same issue. As a supply side constraint it limits internet diffusion in macro level as well as in specific sectors. It is also a case where demands of powerful agents have not been able to reduce institutional complexity and led to suboptimal policy outcomes. Hence, the mismatch between supply and demand for ICT professionals in the labor market is tackled in this chapter as a case to show that Estonian policy has not as homogeneous and innovative as it is often perceived. This issue was brought up in six interviews with government officials and representatives of ICT sectors (Interviews 19-21 and 23-24, 30). The discussion below is a summary of these interviews.

Let me recall that Chapter Four did not show that lack of ICT skills was an issue among general population when Estonia is compared with Slovenia. At least it is not a variable that explains a difference between outcomes in the internet diffusion in two countries. Chapter Five discussed sophisticated services such as internet banking. Since the internet banking required increasingly sophisticated skills among different population segments, it also created broader, more enlightened self-interest among private sector agents and a path through which development of ICT education progressed. Banks together with ICT companies and government became also active promoter of ICT education and set-up specific foundations to carry out the projects. Hence, the creation of semi-public goods in the form of online identification methods led to need to create more semi-public goods in the form of ICT training and education in Estonia. Obviously, improvement of ICT skills benefited the wider diffusion of internet among different population segments as these path dependent activities were deployed.

However, ICT skills is not just about the skills among general public. General perception around in Estonia and in the world in crucial places such as Silicon Valley is that Estonian ICT professionals have excellent skills. Skype was founded by four Estonian programmers and two entrepreneurs from Nordic countries in Estonia. As Chapter Five pointed out Skype still has a significant presence in Estonia which implies that skilled ICT professionals are represented in a broader population than only among Skype six founders. Nevertheless, interviews with leading Estonian ICT companies clearly reveal there are two major challenges Estonia is faced with in the context of ICT skills: first, shortage of ICT specialists and, second, quality of ICT education in universities. Companies point out that Estonia needs to train thousands more IT specialists which is a significant increase because broadly the sector employees about 20,000 people in Estonia, including all employees, not just ICT professionals. Even companies such as Skype employ only 400 people in Estonia while majority of their employees are located outside. Most of hiring by Skype also takes place outside of Estonia and company has not expanded its staff in Estonia for years was articulated in Chapter Five.

Hence, the ICT sector has been actively promoting in the last decade ICT education and loosening of immigration restrictions on countries outside the European Union (within the EU there is a free movement of people). One entrepreneur even speaks of a need for Estonia to become like Singapore which would mean bringing in more ICT professionals from other countries. Both campaigns have not been very fruitful as the students consider IT somewhat boring and prefer to focus on social sciences. The attitudes of general population and population are not hospitable towards loosening the immigration restrictions because of concerns about the survival of Estonian nation and its culture (Appendix 1, Interviews 23-24, 30).

Interviews also reveal that government agencies react differently to the industry demands. Ministry of Economic Affairs and Communications pushes for changes in immigration system while the Ministry of Interior is reluctant because of security consideration. Government officials are on defensive and through interviews tell that for popularization of ICT education the following steps have been taken: The number of IT students both in state-funded and private higher education institutions has been considerably increased. In addition, to increase the popularity of sciences among the young, the Association of Estonian IT and Telecommunications Companies (ITL) and the Ministry of Education and Research have launched a program for the popularization of sciences. They also mention that to boost interest in technology, general education system needs to be modernized as well.

Officials also point out that in order to tackle the challenge of both the quality of ICT education and the limited number of IT specialists, an an international IT Academy was launched in Estonia. The IT Academy, was launched in cooperation with telecom and ICT businesses, government and two main and largest public universities University of Tartu and Tallinn University of Techonology in 2012. In essence, it is a program for the engagement of best Estonian and foreign lecturers and students in learning process in ICT areas. Thus its not a new university but a program of collaboration among various public and private institutions for IT education. Its work will be based primarily on the most competitive existing IT curricula in Estonian universities. The academy is managed by the Estonian Information Technology Foundation – a non-profit organisation founded by the Estonian Government, Tartu University, Tallinn Technical University, Estonian Telecom company and the Association of Estonian Information Technology and Telecommunications Companies. Again, this is an example of public-private partnership on how the development of ICT skills is being tackled. However, it started quite recently as a reaction to the tight supply of skilled professionals in the labor market. Clearly, such program is not sufficient for solving labor market issues.

Government officials also point out that with the inflow of EU structural funds started in 2004, there are also initiatives aimed at increasing professional ICT skills managed through Enterprise Estonia, a government agency distributing business support grants. The program called "Involvement of highly-qualified staff" aims to facilitate the mobility of highly qualified people, including those in the ICT sector (Interviews 19-21). The program enables to involve R&D workers, engineers, designers, innovation managers or international marketing managers to carry out innovation projects helping to create new value for companies. The involvement of highly qualified competence can be used for product development, preparing the entering or enlargement to foreign markets, designing new business models. Eligible costs under the mobility program are the salary costs and costs that are related to using recruitment agency services. The support rate of these costs is maximum of 50 percent. The maximum project support period is 3 years (Interviews 19-21).

Government officials also say that within the Enterprise Estonia's Knowledge and Skills Development Support scheme companies can apply for a grant to upgrade the knowledge and skills of their workers on work-related topics and to bring new knowledge into the enterprise (Interviews 19-21). The grant can be used for trainings, to involve a consultant outside of the company to come and help to improve the performance of the company, to do practical training in another company or to pass an qualification exam or to apply for a qualification standard.

Ironically, availability of EU funds and ICT savvy nature of Estonian public sector did not reach labor markets services for many years. Earlier research on Estonian E-Government has indicated that the labor market services do not use the basic potential offered by ICT (Kitsing 2011). However, more recent interviews revealed that the years 2010-2011 have seen rapid developments in the field labor market and unemployment services (Interview 19-20). The labor market information system EMPIS of the Estonian Unemployment Insurance Fund that earlier provided some simpler electronic employment related services, has been considerably developed and new modules have been added to it. Government officials pointed out in the interviews that a module for employment mediation allows to automatically match the existing job offers and the unemployed and sends information on suitable openings to the unemployed person's mailbox. A self-service environment has been created for job-seekers. The self-service area enables job-seekers to browse job offers, create a CV, apply for jobs, view the applications they have submitted to the Unemployment Insurance Fund and the corresponding decisions, and notify the Unemployment Insurance Fund of changes in their personal details or of starting a job (Interviews 19-20).

The interviews with both public sector officials and private sector representatives confirmed that ICT skills are important factor for further development of innovation capacity in Estonia. As Estonia does not have large scientific institutions and research and development by companies is limited, then skills were considering crucial for further innovation in the area of ICT. The innovation in this area is practice based and traditional innovation indicators do not capture them well. More innovative products and services available online will increase the use of internet further. However, as the Estonian population is ageing and Estonia is not **a** very attractive destination for international ICT professionals, then the mismatch between demand and supply of ICT professionals will continue. So far there is no sign that industry demands will be met by government in significantly relaxing immigration regulations (Interviews 19-21)..

Obviously, in terms of skills both demand side of internet and supply should be considered because they are both important that new services and content can be created. This means that supply and demand interact as more and more it services benefit from user driven innovation and it becomes difficult to distinguish between demand and supply as they both constantly interact. Hence, knowledge and skills that matter for internet diffusion are decentralized, dispersed and tacit – crucial elements in the process of entrepreneurial discovery. However, the labor market constraints need to be tackled by multitude of agencies involved in immigration, education and labor market policies. In addition, formal rule-making interacts with informal rules such as attitudes of public about inflow of immigrants. This institutional complexity has led to suboptimal policy outcomes in facilitating the process of entrepreneurial discovery as potential ICT entrepreneurs and professionals from all over the world cannot move easily to Estonia.

6.2.4 ICT Policy Making

The chapter Four suggested that government rule-making in the telecom sector was consistent with overall economic framework in Estonia and institutional changes in the telecom provided a critical juncture for the supply of high speed and high quality internet. Chapter Five suggested that internet diffusion was further bolstered by public-private partnerships in the use of online identification methods. Now it is crucial to look at specific institutional changes concerning government use of ICT, which have benefited the internet diffusion in society.

As far as specific changes in the rules concerning the IT are concerned, the local IT community became crucial in forming government policies on IT spending, procurement, and use in the early 1990s. In 1993, a strategy paper by government officials, IT specialists, and scientists was prepared with the sole aim of establishing principles for the management of modern, well-functioning state information systems (Ott and Siil 2003). The existence of such a community stemmed from the fact that Estonia had fairly advanced human capital in IT. Estonia began investing in its Institute of Cybernetics as early as the 1960s (Dyker 1996 915-

916; Landler 2005). While similar institutes in other Soviet republics focused on math and engineering, the Estonian institute concentrated on computer programming (Roth 2004; Dutta 2006).

A special state information systems department of the central government was formed at state chancellery in 1993, and the central government budget included a single category entitled “Number 37” for all IT expenditures of the various government agencies (Ott and Siil 2003). Government IT procurement was subsequently unified. Nevertheless, according to interviews, the management of Estonian Government IT system has been relatively de-centralized throughout the decades. It has been so technologically as well as institutionally. Technologically it is based on de-centralized X-Road system which was discussed in Chapter Five allowing different, old and new systems in various government agencies and private sector to communicate with each other. Institutionally, the State Information System Department acts as a coordinator. It was initially under the State Chancellery but moved to the Ministry of Economic Affairs and Communications in 2000. Only in 2012 a national IT coordinator was appointed to the State Chancellery. For many years, position of undersecretary for state information systems at the Ministry of Economic Affairs and Communications remained unfilled. In 2013, Taavi Kotka, an IT entrepreneur and former CEO of Estonian IT company Webmedia was appointed as undersecretary for state information systems (which is effectively government Chief Information Officer).

Throughout interviews a number of ICT initiatives by Estonian government were brought out which may have encouraged the use of the internet (Interviews 19-21). Similarly, scholarship and articles in popular media have focused on these initiatives. However, even if there are currently many different initiatives which one way or another target ICT sector and services and intervene in the market, it must be kept in mind that they are relatively recent phenomena. In the 1990s Estonia did not have an industrial policy, nor did it engage in policies that would target the ICT sector or companies directly (Kilvits 1999, 263-265). Estonian did not have sufficient resources to make large-scale ICT investments. As the Estonian Prime Minister Mart Laar from 1992 to 1994 and from 1999 to 2002 put it: “Most disadvantageous was that we did not have large enough resources to build up e-government, and this was very good because then we had to build public-private partnerships.” (Dutta 2006, 86). The key public-private initiative was ID card which was launched by Laar’s government and was already discussed in Chapter Five.

The late president Lennart Meri started a national discussion on the necessity of creating an “Estonian Nokia” in the 1990s but it did not translate into any concrete policy action. General government spending on research and development in the 1990s was below 0.5 percent of the GDP, and there were no crucial technology or innovation policies to speak of (Kilvits 1999, 268-277). Even the spending on information and communication technologies (ICT) remained modest from 1995 to 2003 in comparison with other countries. Estonian government budget has allocated about one percent for the ICT expenditure throughout this period, while many other countries spend 2.5-4 percent of the budget (Krull 2003, 52-53). In spite of availability of unique and pioneering online identification methods provided by banks, Estonia’s government services remained inconsistent and it took a while for them to develop. While the Estonian government made international headlines with its paperless “e-government” sessions and most citizens filed their taxes online, the simple task of applying for a driver’s license still required physical visit(s) to the Department of Motor Vehicles (Kitsing 2011). Estonia does not have a e-government strategy, nor did it create a special office or ministry for information society, as was the case in Slovenia, for instance. The 1998 Principles of Information Policy was very general strategy document and all the following acts have been quite specific (Krull 2003, 49).

If we look at legislative changes in Estonia and compare them with a selected Central and Eastern European countries in Table 6.3, the we see that the Estonian e-government specific legislation was not passed significantly earlier than it was the case of other countries in the CEE. Certainly, the mere time of adoption does not indicate the true impact of legislation. Indeed, the quality of Estonian legislation may be better than in the case of the other CEE countries.

Table 6.3: The time of adoption of e-government specific legislation in Estonia, Latvia, Slovakia and Slovenia.

Act/Document	Estonia	Latvia	Slovakia	Slovenia
Strategy for e-government	NA	2002	2004	2001
E-signature and E-document	2000	2002	2002	2000
Strategy for information society	1998	1999	2001	2003
Data protection	1996	2000	2002	1999
Access to public information	2001	1998	2000	2003

Source: adopted from Kitsing (2008) and compiled by the author on the basis of information retrieved from IDABC (2005).

Formal law-making in IT, as in many other areas of public sector, has been quite minimal in Estonia. My analysis suggests that Estonian approach has seen implementation as the key, and no need for writing excessive documents and creating additional layers of bureaucracy. Indeed, the standard critique of the local e-experts was in the early years that Estonian government does not have a clear vision and a work plan and there is a lack of cooperation among different government agencies and between private and public sector (Krull 2003, 49). Nevertheless, in these early years the ground was prepared for diffusion of internet in Estonian government and private sector.

The implementation of ICT policies has been successful in the CEE context without such documents and formalized cooperation, while many other countries which at least formally have adopted such documents and formalized cooperation do not score that well on the e-government rankings. This is so because the institutional setting as encouraged entrepreneurial discovery - at least in some key initiatives which have been crucial for internet diffusion.

One of the key initiatives that has lowered both transaction costs in the market as well as in public sector has been the use of digital signatures and electronic authentication, which are widely used both in the public and private sectors (as was discussed in previous chapter in the context of ID card). In 2000, Estonia adopted digital signature law, which made it mandatory for public sector institutions to accept digitally signed documents in 2001 (Republic of Estonia 2000). Obviously, the development of digital signatures does not affect only Estonia , but it is possible to establish a company in Estonia over the internet with the use of Portugal, Finnish, Lithuanian and Belgian electronic signatures. The public sector has led the way in the use of digital signing, as accepting digitally signed documents and it has been made mandatory through legislation. Since 2014 through the e-Residence program citizens of other countries can receive Estonian ID card and use it for signing documents and transact digitally online.

Nevertheless, the efforts to harmonize ICT policies within different government ministries and departments did not go smoothly. Actually, it offers the most straightforward case for illustrating the constrained nature of agency, policy heterogeneity and diversity of outcomes in practice. In other words, government's practice was often quite different from stylized narratives about e-government in Estonia. The electronic exchange of official government documents was still limited in 2007 because different departments purchased different software solutions, which are not compatible with each other (Riismaa 2007). Even if they purchased same software packages, then often the same software was configured differently which lead to incompatibilities within government for handling data. For instance, interviews revealed that the Ministry of Environment was eager adopter of open source software while others are not. As a result, the ministry has to deal on daily basis with the challenges of converting different documents to the usable formats as interviews with officials revealed. These incompatibilities imply that data may have to be re-entered manually. Since the Estonian government departments tend to rely on proprietary solutions, then vendor lock-in is widespread. This lock-in may not only mean always dependence on a company but on a particular person.

However, government officials I interviewed argued that despite of shortcomings and setbacks, it can be argued that the public sector is leading the way in electronic document exchange in general (Appendix 1, Interviews 19-20). Most of the invoices sent and received by public sector bodies are electronic. One government official I interviewed pointed out that in 2011, a study was conducted with an aim to analyze electronic records management in the entire public sector of Estonia. “According to the results of the survey, approximately 90 percent of public agencies use electronic document and records management systems. Electronic invoices are widely used with 64 percent of public sector organizations sending and 86 percent receiving electronic invoices,” was pointed out by the same government official (Interview 20). Nevertheless, only 25 percent of electronic invoices are in the machine-readable format such as EDI and XML which make fully automated processing possible.

To sum up, this section demonstrated that Estonian ICT policy has not been as homogeneous and unified as sometimes it has been characterized. By looking at development over two decades, it is clear that policy-making in the area of ICT has been decentralized and heterogeneous. There have been some successful initiatives where the impact of local IT community has been strong. In addition to some islands of excellence, there areas such as harmonization of ICT policies within different government agencies where progress has been slower. Many of these changes have been taken place gradually, their role in the internet diffusion in the early years cannot be considerable. Rather, they have contributed to the opportunities for using the internet in recent years. Since the discussion of policy-making in this section was relatively general, then the next sections will look at specific cases to show institutional complexity has constrained the process of entrepreneurial discovery and led to diverse policy outcomes. The next part will look at institutional complexity and policy heterogeneity on the basis of the case of network neutrality.

6.3. Institutional Complexity and Network Neutrality[45]

Since Estonia became a member of the European Union and was quick liberalizer of its telecom market, it is crucial to discuss the Estonian government position in the institutional changes implemented by the new telecom package of the EU, which was adopted in 2009. This discussion allows understanding the ability of policy-makers to deal with institutional complexity and reveals the nature of policy-making concerning an important ICT issue. I will discuss network neutrality only in the context of the 2009 telecom package. This limitation stems from the following reasons. First, the 2009 telecom package is a fundamental legislative attempt to shape the EU telecom market. There has not been any comparable reforms in this scale after that. From the point of view of a relatively new member country such as Estonia, the telecom package represents an important reform, which is comparable for taking over all EU telecom related legislative acts in 2004 as it was discussed in Chapter Four. Second, the EU telecom package mobilized key actors in the preceding years. This was when actors revealed their preferences concerning institutional changes in the EU. It is difficult to discuss

[45] This case has been also presented at the conferenses at the Oxford University, UK, in 2010 and at the ICEGOV 2011 in Tallinn, Estonia, and made electronically available in the respective conference papers (Kitsing 2010; Kitsing 2011). As the Kitsing 2011 is the latest paper published by the ACM conference proceedings, I will refer to these conference papers on the basis of Kitsing (2011) below.

the role of entrepreneurial discovery and institutional changes in the process on the basis of secondary sources. I had unique access to some key actors and I was able to interview them in 2008 and 2009 (Interviews 14-17). Hence, the data limitations also mean that the focus will be on the 2009 telecom package and not on the developments that took part later.

6.3.1 Network Neutrality in the European Union

Before I start discussing the position of Estonian government, it is important to highlight the broader context of how network neutrality has been understood in Europe. This is particularly important because as I have emphasized in the Chapter Two technology and its use is epistemological and therefore concepts associated with the technology use may also carry different meanings in different context. In other words, there is a danger of "conceptual stretching", a term used by Sartiori (1971) here applied in the network neutrality debate. Furthermore, the institutional framework of the EU telecom markets and its members is quite different from that of the United States.

The EU's legislative attempts in the different drafts of 2009 telecom package defined network neutrality quite narrowly. The EU Commission's understanding of the network neutrality is not as comprehensive as scholars approach it (Cave and Crocioni 2007, 270; Hart 2006; Sidak 2006) and as in the case of US administration (Kitsing 2011). EU Commission's Communication as a step towards the 2009 telecom package published in September 2008 discussed network neutrality solely in the context of network management:

> "It is against this background that concerns have been raised about preserving "net neutrality" as the internet evolves. New network management techniques allow traffic prioritization. Operators may use these tools to optimise traffic flows and to guarantee good quality of service in a period of exploding demand and rising network congestion at peak times. However, traffic management could be used for anti-competitive practices such as unfairly prioritising some traffic or slowing it down and, in extreme cases, blocking it. "
> (Commission of the European Communities 2008, 7)

This concern over traffic prioritization found its way into so-called telecom package, which in its first versions set forth narrow but straightforward net neutrality provisions. The European Parliament included in the first draft of its regulations a prohibition against “hindering or slowing of traffic” (European Parliament 2008). However, this was excluded in the final version versions of the telecom package. The Council of Ministers and European Parliament reached a compromise and approved the telecom package in November 2009 (European Commission 2010). The EU Commission summed up the net neutrality provisions found in the package in the following way:

> “…Under the new EU rules, national telecoms authorities will have the powers to set minimum quality levels for network transmission services so as to promote "net neutrality" and "net freedoms" for European citizens. In addition, thanks to new transparency requirements, consumers must be informed – before signing a contract – about the nature of the service to which they are subscribing, including traffic management techniques and their impact on service quality, as well as any other limitations (such as bandwidth caps or available connection speed).” (European Commission 2010)

The approved version of the package gives authority to national telecom regulators to ensure minimum quality of service requirements. It also asks service providers to provide information to consumers about the quality of service. In other words, already narrow network neutrality provisions as initially envisioned by the EU Commission were further narrowed down and almost non-existent in the package (Kitsing 2011).

However, the package includes some other provision, which relate to a broader concept of network neutrality such as backward vertical integration. EU Commission points out that “National telecoms regulators will gain the additional tool of being able to oblige telecoms operators to separate communication networks from their service branches, as a last-resort remedy” (2010). Nevertheless, these are additional measures. The functional separation has been already legislated through previous measures as will be discussed below. The implementation of these measures differ in the different member states. At best, the EU gained a new formal measure to implement functional separation – success of which may depend more on national authorities than the EU Commission. In other words, the telecom package did not reduce institutional complexity and policy design and outcomes can still be quite heterogeneous because of potential differences in interpretation and implementation of rules by national regulators.

Social science research on information technology about the network neutrality has sometimes accepted the normative claim that network neutrality legislation is in the public interests (Kitsing 2011). It has been argued that large corporations block network neutrality regulations, because it damages their business interests (Hart 2006). What is forgotten in this characterization, of course, is the fact that many companies that support network neutrality are content providers. Network neutrality may or may not be good for public welfare depending on what is exactly meant by its proponents (Kitsing 2011). However, it is certain that content providers are convinced that supporting network neutrality legislation is beneficial to their business agenda. Hence, the basic political economy of network neutrality is simple: interests of content providers clash with those of network providers. It is an attempt by content providers to change existing equilibrium in the cyberspace and increase their power vis-à-vis network providers by using government regulation. This is how the leading European regulatory experts characterize the push for the network neutrality regulations:

> "Net neutrality being an attempt by content and application providers –
> the likes of Amazon, eBay, Google, Microsoft, Yahoo! and Intel -
> to constrain the behaviour of broadband Internet access providers –
> such as AT&T, Verizon, Comcast and Sprint - through political pressure."
> (Cave and Crocioni 2007)

In other words, it is a classic case of political rent seeking where a group of companies tries to advance their business interests by government intervention (Kitsing 2011). Usually, it is assumed in the public choice literature that political rent seeking serves vested interests - but not the general interest of wider public (Krueger 1974). However, there are exceptions to this rule if certain conditions are met. For instance, lobbying for opening a protected market can simultaneously serve interests of the lobbyist, other companies planning to enter the market and general public because it will increase competition, which potentially may lower prices. Certainly this is the way in which content providers characterize their position by emphasizing the importance of openness of and freedom to use the internet that the network neutrality legislation should secure. Even the term "network neutrality" puts content-providers support for new regulations in a more favorable light than network operators who have to be against "neutrality" (Kitsing 2011). Hence, it is to a great degree to activism of content-providers that "mundane conflict of business interest - content versus the network industry and its vendors – has risen to such a high position on the business agenda" (Thorngren, 2006).

Of course, network operators see the network neutrality legislation as purely benefiting content providers at the expense of other business and consumers. As the network neutrality regulation would reduce flexibility in management of the networks, then network providers argue that the network neutrality regulations will contribute to the internet traffic jams. This is so because of Web 2.0 type applications are creating a crushing new burden of data on the networks. As companies push more content onto the internet, the networks at some point will reach capacity. Network neutrality regulations will accelerate these problems because flow of some data such as emails cannot be delayed in order to make space for priority data such as video. Heavy regulation may also create disincentives to invest in networks as these investments cannot be recouped (Kitsing 2011). A view of network operators along the similar lines was expressed in the Financial Times about the delay of the telecom package adoption in May 2009: "Telecom companies declined to comment publicly, but privately welcomed the delay to regulations that they have lobbied against for years. We never like uncertainty in the regulation, but doubt is better than some of the stuff that was in the package," one executive said. He added: "I still think most of it will go through, but we may have bought ourselves a year "(Pignal 2009). This is also consistent with my interview with a lobbyist for a large US multinational company in the EU (Interviews 17).

As the interests of content- and network providers seem diametrically opposed to each other, it is surprising that both of these groups ended up in supporting the prevailing minimalist provisions on network neutrality in the EU telecom package. European Telecom Network Operators' Association (ETNO), an organization representing interests of leading European telecom companies, expressed its public support to the final version of the package (Kiviniemi 2009). ETNO Director Michael Barthomelew told to the Wall Street Journal that telecom package's "new provisions to boost investment in superfast broadband networks should be quickly put into practice" (Kiviniemi 2009). This was echoed by BT Group PLC's president of public and government affairs Larry Stone who told to the Wall Street Journal that "his company strongly supports the EU's regulatory push for a more consistent European telecom market "allowing for more competition, innovation and consumer choice in the telecoms sector"" (Kiviniemi 2009). After two years of extensive lobbying and pushing their narrow agenda, it seems that this narrow self-interest became enlightened self-interest. Or it may be a realization that more favorable package is not feasible as expressed by a telecom executive in the Financial Times (cited above). It raises the question whether ETNO expressing revealed preferences of network providers or their real preferences.

Nevertheless, the simplistic characterization of the interests ignores the fact that network operators and content providers operate in the environment of mutual interdependence. Let me recall the Chapter Two which pointed out that internet and related services are network goods. Use of one good such as internet connection increases the use of other goods such as google search. In other words, content providers and network operators are selling complementary goods. An increase in demand for one good increases the demand for another good. Operators need content because this will increase demand for their network services and allow recouping investments in increasing the network capacity. Content-providers need increased capacity of networks because this allows them to create and sell even more data-intensive content. In the European context sellers of both of these goods have to be functionally separated which makes even more sense in characterizing the interaction mutual interdependence.

6.3.2 Estonian Government and Network Neutrality

The Estonian government view on network neutrality can be placed in this European context. The main office of Skype, peer-to-peer online phone service provider, was based in Estonia and Skype employed over 300 people in the years prior to the 2009 telecom package as was shown in Chapter Four. Estonia has set up a NATO Cooperative Cyber Defense Centre of Excellence in 2008 in response the 2007 cyber attacks that brought country's electronic communication networks to standstill. All of these factors make Estonia a critical case in understanding how ideas about network neutrality, institutional complexity of dealing with the EU level legislation and interests of powerful companies such as Skype interacted in the network neutrality debate and in the legislative efforts. Both Skype and Cyber Security Center are relatively small operations. The data about Skype is given in Chapter Five. The Center has 48 staff members from 16 countries- not all NATO members have joined the center and contribute to its efforts. However, both organizations carry much more significant symbolic meaning in the world of Estonian policy-making.

Starting with the interests, then the position of Skype is dominant in Estonian policy-making. The company is basically seen as a national treasure and its interests are considered at least in political rhetoric to be in sync with the interests of Estonia. Skype's country manager Sten Tamkivi was also an adviser to Estonian president Toomas Hendrik Ilves on ICT issues during the network neutrality debate. In other words, Skype can be seen also as an institutional entrepreneur trying to shape the rules of the game in Estonia in addition to its business activities in the peer-to-peer telephony.

Estonian government's position to see the interests of Skype and Estonia in sync ignored the fact that until September 2009 that the main shareholder of Skype was E-Bay, which had purchased the company from Danish-Estonian-Swedish founders in 2005 for 2.6 billion US dollars. E-Bay's and Skype interests in the network neutrality debate are consistent with the interests of other content providers such as Google. Interviews reveal that Skype supported tougher network neutrality regulations through its lobbying efforts both in Estonia and Brussels (Interviews 14-17).

Hence, it is not surprising that a short speech given by the Estonian Minister of Transport and Communication Juhan Parts at the EU Council of Ministers' meeting in November 2008 echoed rhetoric of content-providers such as eBay, Google and Skype according to an interview with a person with access to meeting transcripts (Interviews 17) After it became clear that the EU Council of Ministers and Parliament were not able to reach a compromise on the telecom package in May 2009 because of the copyright issue, the minister even expressed opinion that Estonia should support reopening the negotiations on other issues in the package (Interview 16)

Most interestingly, this view was never debated publicly and did not receive any public attention in Estonia. The public debate – or to be more precise - the lack of public debate on the net neutrality in Estonia and the EU in general created much less favorable environment for the legislation than in the US. While in the US the net neutrality has received a considerable attention in the media such as National Public Radio and even in Daily Show of Comedy Central, it is perceived as highly technical issue in Estonia and the EU. It would be fair to say on the basis of interviews that many experts working and investors in the field of telecommunications are not just familiar with the debate but had during the time of interviews in 2008 and 2009 never heard of the term “net neutrality”. Some of the ideas assembled under this concept may be, of course, familiar to them. In the US the debate has taken concrete political leanings where Democrats usually tend to support network neutrality regulations and most Republicans oppose it (Hart 2006). This is, of course, simplification as some Republicans have taken and still take a different position.

Nothing of that sort has emerged in Estonia and in Europe where most politicians have no position on the net neutrality. Hence, the issue seems to concern primarily lobbyists for particular interests and experts who have studied the issue. It was politically relatively unimportant issue – perhaps even a non-issue (Interviews 15 and 16). There are no important political actors who are willing to invest their political capital for focusing on this issue. The expression of supportive views for Skype position by the Estonian minister can be seen as a default position - an acceptance that Skype knows the issue and politicians don’t. Thus why not trust Skype. Therefore, it is also relatively easy to facilitate compromises as many political actors have not taken firm position on the issue. All of this is not helped by the fact that main supporters of the network neutrality legislation are American companies such as Google, E-Bay and Skype - even though the latter has significantly more employees in the EU than in the US. Nevertheless, it was still owned by E-Bay until September 2009 when its founders together with London and Silicon Valley-based venture capital firms purchased a majority stake in the company. In 2012 the company was sold to Microsoft. At the same time, network providers are usually European companies.

The partisan nature of the debate is also completely different. In comparison with the US supporters of network neutrality, Juhan Parts is from a center-right conservative party of Isamaa and Res Publica Liit (IRL), which was chaired by famous Estonian economic reformer

Mart Laar. He was one of the most important ministers in a center-right coalition government made up of market liberal Reform Party and above-mentioned conservative party during the adoption of new EU telecom package. This is further indicator that ideological lines in the network neutrality debate are not as clear-cut in the European countries as they are in the United States.

The low profile debate is a logical outcome in a way because the institutional framework in Estonia and European Union is different. As the leading EU regulatory experts Cave and Corcioni (2007) point out:

> "The net neutrality debate originated in the U.S. and is at least partly conditioned by the U.S. specific regulatory and market features. It is most importantly the retail ISPs, operating at the IP layer of the network, making prioritization decisions. In the U.S. it is much more likely that the ISP is affiliated to the network access provider than in Europe. This is because the degree of access regulation for Internet broadband in the U.S. is currently considerably lower than in Europe where often because of access obligations, the retail ISP is not the wholesale network provider. Effectively there have been opposite regulatory trends to access to broadband networks in the U.S. and Europe. U.S. access obligations have been largely removed, while since 1998 European National Regulatory Authorities (NRAs) and the European Commission have increasingly extended access obligations to broadband networks at different levels."
> (Cave and Corcioni 2007).

In other words, some important goals that are expected to be achieved by the specific network neutrality regulations in the US have already been implemented in the EU by other means. Hence, Estonian position expressed in favor of network neutrality legislation can be seen as political rhetoric.

The EU telecom package was discussed for several years and deadlines for adoption were postponed. In the end, it was supposed to be approved by the Council of Ministers and European Parliament by May 2009. However, the Council and Parliament were able to reach compromises on most issues – including the network neutrality provisions discussed above –

except the one concerning copyright. Council proposed tough provisions denying access to the internet to those who have violated copyrights online three times (so-called three-strikes rule), while Parliament saw the access to the internet as a basic human right as Estonia, which cannot be taken away without due judicial process. Elections to European Parliament took place in the summer of 2009 and new EU Commission was appointed and confirmed in the beginning of 2010 (Kitsing 2011). All of these developments increased uncertainty. The ETNO director Michael Barthomelew expresses the importance of reducing uncertainty. He told to the Wall Street Journal that the compromise reached on the telecom package "marks the end of a long period of uncertainty for the telecoms sector" (Kiviniemi 2009). The current minimalist network neutrality regulations were seen by Estonia and others as a better outcome than no new telecom package in the near term and potentially even worse telecom package in the longer term (Interview 16) . Hence, actors did not push for re-negotiations of any clauses in the telecom package after the elections. The main focus was on reaching the compromise on the copyright issue which was achieved with the new EU parliament and the package was adopted in the fall of 2009.

Furthermore, interview with a government official indicate that giving full-fledged and vocal support by the government for Skype's position was complicated because of the cyber security agenda (Interview 16). Tougher network neutrality regulations imply that management of electronic communication networks becomes less flexible. At the same time, great degree of flexibility is needed to respond effectively to cyber attacks. Some traffic must be blocked, delayed and so on. Hence, official Estonian position was thorn between these two sides. Therefore it is not surprising that Estonian government kept a low profile in this debate. According to the interviews, the network neutrality was not discussed in the government meetings where the telecom package was on the agenda (Interviews 16). There was almost no public debate on the issue.[46] Indeed, interviews reveal that even people with experience in the field of telecommunications were generally unaware of the concept of network neutrality.

The government policy concerning network neutrality demonstrates balancing among different vested interests. The institutional framework constrained vested interested and the emergence of minimalist net neutrality regulations in the EU which the end was supported by Estonia. The dynamics played out in the EU telecom package debate would have suggested that Estonia either would support its telecom companies if the regulatory capture would have been the case or supported content providers because of Skype has become an institution on its own in Estonia. Estonia Ministry of Economic Affairs and Communications who is also responsible for telecom sector regulation sided with the content providers in the beginning. If we place this outcome in the context of chapter 4, then it is quite different from Slovenia were the ministry is suspected in acting in the interest of incumbent telecom company.

Nevertheless, if we put Estonian government position and the interests of content-providers and network operators into the context of ideas and institutions, then it is obvious that both institutional and ideological environment were more in sync with that of network operators. Content providers had to argue for network neutrality regulations in an environment where general public was indifferent for their cause. Institutional nature of the EU was not supportive either as effective legislation of network neutrality demands much more uniformity and enforcement capacity of federal state than it is available in the current EU. In addition, support for their cause means more centralization, which is opposed by many member states regardless of how noble the cause might be. Nevertheless, the Estonian minister decided to express its public support for content-providers in the EU meeting.

[46] The author of this dissertation tried to encourage debate by publishing three op-eds in the leading Estonian language dailies Postimess and Äripäev as well in English in the Baltic Times in 2009. The author also gave an interview to the Estonian national TV evening news in 2009.

However, in the end Estonia supported the implementation of minimum quality requirements, which fall under responsibility of national telecom regulators rather than the EU. The main reason for this compromise was Estonia's cybersecurity agenda rather than the interests of telecom companies. As the minimum quality requirements are the main way to implement network neutrality regulations, it is natural to expect a high degree of variance what network neutrality means in practice in different EU countries, i.e. Estonian and Slovenian approaches may considerably differ. Even if the language concerning the network neutrality in the telecom package would have been more explicit and detailed, then implementation of these seemingly uniform provisions would have been probably fairly diverse as has been with the previous EU telecom regulations (Section 2.8).

In sum, the Estonian policy making demonstrates the institutional complexity of network neutrality regulations. In the case of network neutrality, the institutional complexity constrains actors – limits the entrepreneurial process of discovery in shaping institutions and policies. Even the presence of dominant content provider and their lobbying for network neutrality does not lead to uniform position and homogeneous policy outcomes. Furthermore, the lack of public debate and debate in government supports the broader points made that Estonia has either explicitly or implicitly tried to balance different interest and engaged in making general rules and regulations instead of trying to impose narrow sector-specific legislation in the telecom sector which would benefit particular interests. This case shows that government does not promote the use of ICT at any cost and policy entrepreneurship has serious constraints as a result of institutional complexity. The next section will tackle institutional complexity and policy heterogeneity in the context of government ventur capital scheme.

6.4 Government Venture Capital Investments in the ICT sector[47]

Chapter 4 and section 6.2 demonstrated that Estonian government has focused primarily on rule-making and not intervening directly in the ICT sector to encourage diffusion of internet. However, there is a perception, which was discussed in the beginning of this chapter and also in developments of concerning Skype that Estonian government has had a particularly smart policy for encouraging the birth of new innovative companies. Chapter Five argued that birth of Skype and internet banking had to do more with government nonintervention than intervention. However, there has been a fundamental policy shift from 2004 onwards. Estonian government actually tries to encourage directly emergence of new innovative companies. This has happened because the membership of the European Union means that EU structural funds are available for encouraging innovation and entrepreneurship in Estonia. Most of these funds have been spent in the form of grants. The impact of these grants has been characterized as "picking big winners and small losers" in a study by Vicente and Kitsing (2015) using propensity score matching. Most importantly, there has been a shift in thinking and policy-makers seem to believe that they can replicate success of Skype through direct policy measures. This is ironic because as it was pointed out in Chapter Five the emergence of Skype was accidental and spontaneous. It cannot be attributed to the direct policy measures.

This section will tackle equity injection by government in start-up companies. It will leave the question of grants aside as I have addressed it in other papers. The government venture capital scheme is a supply side measure to reduce constraints in availability of capital for new innovative ventures. Since these new venture will bring new technologies to the market, they can have positive externalities for some sectors or for the entire population as new reasons for using internet will emerge. It must be clarified, however, that the Estonian

[47] Earlier versions of this section have been presented at the Industry Studies Annual Conference in 2013 and at the Midwest Political Science Association Annual Meeting in 2014.

government tries to encourage the development of ICT sector implicitly by government venture capital scheme. The targeting of ICT sector is implicit because the Estonian Development Fund (EDF), a government venture capital fund set up in 2006, does not have to invest exclusively in the ICT sector. However, it has invested primarily in ICT companies because companies from other sectors do not often meet its criteria.

The EDF was founded by the Estonian Parliament in 2006 with the purpose investing public funds in and offering management support for early stage research and development intensive companies. Differently from other government agencies, the EDF does not operate under the executive branch, i.e. it is not an agency under some ministry, but reports directly to the legislative branch – the *Riigikogu.* Nevertheless, in its ever day business the Ministry of Economic Affairs and Communications has some supervisory duties concerning the EDF. Both Ministers of Finance and Economic Affairs and Communications are members of the Supervisory Board of the fund. Other members include parliamentarians and independent experts. The EDF mandate is to take minority stakes ranging between 10-49 per cent in companies on the equal terms with its private sector co-investors. The time horizon for investments is 3-5 years. It is also important to point out that the EDF invests funds of Estonian taxpayers, not EU structural funds. The EDF model was created as a result of extensive study of Sitra, a similar organization in Finland. The space does not allow to discuss it here whether Sitra has been a success or not. However, it is crucial to point out in the context of smart specialization literature in Chapter 2 that Finland and Estonia have had different development trajectories. Hence, the notion that you can transfer one model of organizing government venture capital to another country is an example of simplistic policy-making. There is also variance in time which is crucial for understanding how institutions constrain agency (Pierson 2004). Sitra was founded in 1967 while the EDF in 2006. The 1960s in Finland are different from the 2000s in Estonia. The following discussion is based on data obtained from the Estonian Business Registry on the EDF investments, network analysis of digital ecosystem created by the EDF and 9 semi-structured interviews - with 6 portfolio companies, with a high level EDF officer and two outside investors (Appendix 1, Interviews 22-26, 28 and 32-34).

6.4.1 The EDF Portfolio

Since 2008 the EDF has directly co-invested with private investors in 18 start-ups either directly as the EDF or since 2012 through its Smartcap fund, an investment vehicle of the EDF. By July 2013, EDF had made 18 investments in seed and start-up phase totaling 8.7 million euros. Of these investments 10 have been made in ICT companies amounting to more than 5 million euros. Table 6.4 highlights these ICT investments. Hence, either intentionally or unintentionally the EDF has been giving public support to the ICT sector in comparison with other sectors. The following table gives an overview of the EDF portfolio in the area of ICT.

So far the EDF has only exited from three companies. The first exit was the Modesat Communications in September 2012, a telecom company, which was acquired by NASDAQ listed Xilinx (Anderson, 2012). In this company, the EDF investment totaled 750 000 euros as of May 2012. The terms of the deal have not been publicly disclosed. Hence, the return on investment is not known. On the basis of indirect sources and interviews, it can be estimated that the sale price of Modesat share exceeded the initial investment but not significantly and the exit can be considered successful from the point of view of financial return. The second exit took place in September 2014 when a US 3D printing company Stratasys acquire GrabCAD, a collaborative product development software creator which makes it possible for engineers to share CAD files. The terms of transaction were not disclosed but Forbes reports that it was worth about 100 million dollars (Chowdhry 2014).

Table 6.4: The EDF/Smartcap investments in ICT companies by size, year and phase.

Company	Investment size in euros[48]	Year of initial investment	Investment phase
NOW!Innovations	950 000	2011	Start-up
Modesat Communications	750 000	2010	Start-up
United Dogs and Cats	479 337	2009	Start-up
Massi Miliano (fits.me)	960 000	2009	Start-up
Realeyes	320 000	2011	Seed
GrabCAD	127 800	2010	Seed
Inner Circle	88 000	2010	Seed
Sportlyzer	95 800	2010	Seed
Defendec	1 200 000	2012	Start-up
WeatherMe	250 000	2012	Start-up

Source: Created by author with data from Arengufond (2013).

The third exit took place in July 2015 when the leading Japanese e-commerce company Rakuten purchased fits.me (legal name Massi Miliano in the Table 6.4), a company that develops virtual fitting rooms meaning that it helps customers to visualize online whether items they purchase from e-commerce sites will fit them properly or not (Lunden and Lomas 2015). Again, the terms of transaction has not been disclosed. All these exists have been ICT companies. By considering only exits, the EDF investments have success. Three exits out of

[48] The investment size is based on publicly available data, which may be inaccurate and not be up to date because there is a significant time lag between the investments and the time, when this information becomes publicly available.

total 18 portfolio companies can be considered quite a good outcome in venture capital. Certainly, it is not clear how much has the EDF earned from these exists but they have certainly exceeded the initial investment.

So far it can be also confirmed that three EDF investments have failed. Two of these were ICT companies. The business models of two social network companies the United Cats and Dogs and Inner Circle did not materialize. EDF suffered a loss of all initial investment (Tänavsuu 2010; Poom 2012, Interviews 21, 22 and 25). The total loss of 1.2 million euros is about 14 percent of the EDF portfolio as of July 2013. Hence, it can be concluded that the exit from remaining 5 ICT businesses remains uncertain. According to semi-structured interview results optimistic projection would be that exit should take place in 4-5 years after initial investment and more realistic projection is 7 years. If this assumption is correct, then it is too early to expect exits by 2015 as the EDF invested in first two companies in 2008 (one of which has gone bankrupt) and remaining 16 investments were made in 2009-2012. The EDF estimates that the value of its portfolio is 11 million euros. Of the remaining 12 investments, the EDF has revalued 4 investments below the initial investment value. This implies that the four additional investments are likely to fail including some ICT companies.

However, there is no objective way to confirm the accuracy of the EDF valuation of its portfolio. The standard valuation techniques of companies do apply in the case of start-ups. Their values may fluctuate significantly depending on the subjective interpretation of key stake holders. For instance, CEO of one ICT company pointed out that the valuation of his company can be 10-12 million euros but it is too early to say and it is highly subjective depending on what perspective the potential buyer might have. According to another CEO of ICT company the value of their company is approximately four million euros. Nevertheless, it is impossible to evaluate the true value of the company as the exit remains uncertain. It should be pointed out that during the interviews valuation offered by EDF did not match often the valuations given by the management teams of portfolio companies. Ultimately, the value of company will be discovered when the exit takes place and the exits will take place in the case of most portfolio companies if they are successful in raising funds in next financing rounds. Even though interviews were conducted in 2012 and 2013, the portfolio companies already insisted then that the most likely exit strategy is acquisition by large IT company rather than IPO in the case of Estonian start-ups. One owner and manager of portfolio company said that "the exit should take place within 5 years from the initial investment as this is the investment horizon of the investors" (Interviews 23). According to CEO of one company which has recently been acquired, "there is no certain date when the exit must take place but usually exits take 5 years". He was not willing to discuss details when potential exit may take place and what is the valuation of the company (Interviews 21). However, interviews with investors, entrepreneurs and experts highlight that the main purpose of government venture capital is to develop the venture capital ecosystem and generate positive externalities of its investments. Hence, the main focus of this case will be on the impact of EDF on the ecosystem.

6.4.2 Market Failures, Externalities and Ecosystem

The main purpose of government venture capital is to develop the venture capital ecosystem and generate positive externalities of its investments. The literature on venture capital has emphasized the role of government venture capital can play in minimizing the impact of market failures. Some scholars have pointed out that private sector may undersupply venture capital because of asymmetric information. Hence, it is possible to speak of market failure resulting from the information asymmetry where government funding could potentially reduce the negative impact (Brander et al 2010). Other scholars have emphasized market failure stemming from insufficient incentives of private investor to supply funds to innovation and research and development-intensive companies. This is caused by the inability of these companies to capture positive externalities of their investment. If there is a reason to believe that innovation is underprovided, then government intervention can reduce negative effects of this market failure (Kortum and Lerner, 2000; Hsu, 2006). This section analyzes the impact of the Estonian Development fund on the basis on these theoretical premises. In addition, to semi-structured interviews and descriptive statistics it relies on the online network analysis. The purpose of network analysis was map the digital networks of the EDF, which offers one way to demonstrate its role in the broader venture capital landscape.

The Estonian venture capital ecosystem is characterized by few, small but proud funds. In addition, to state-backed Estonian Development Fund only one or two well-structured private venture capital funds exist. The following figure 6.4 gives an overview of venture capital and private equity market by highlighting the distribution of investments on the basis of geography and investment phase of 18 investors and their 120 portfolio companies.

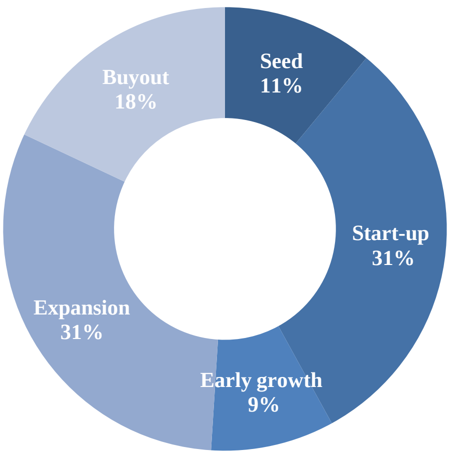

Figure 6.4: The characteristics of the Estonian private equity and venture capital market in 2012 on the basis of EstVCA (2012).

One of the most active investor has been Ambient Sound Investment (ASI), which invests funds of Estonian co-founders of Skype and does not raise money from outside investors. The bottom-line is that existing funds and investors do a relatively small number of deals and are not well diversified and scalable (Jostov and Sonts, 2012).

The Figure 6.5 shows a map a broader venture capital online ecosystem in Estonia through online network analysis as developed by Rogers (2013). 15 urls of full members of Estonian Venture Capital Association (EstVCA) were entered to the harvester of issuecrawler.net. 8 members of EstVCA are included in the output map below given in the figure 6.5. The EDF (arengufond.ee) is certainly in the central position of the network.

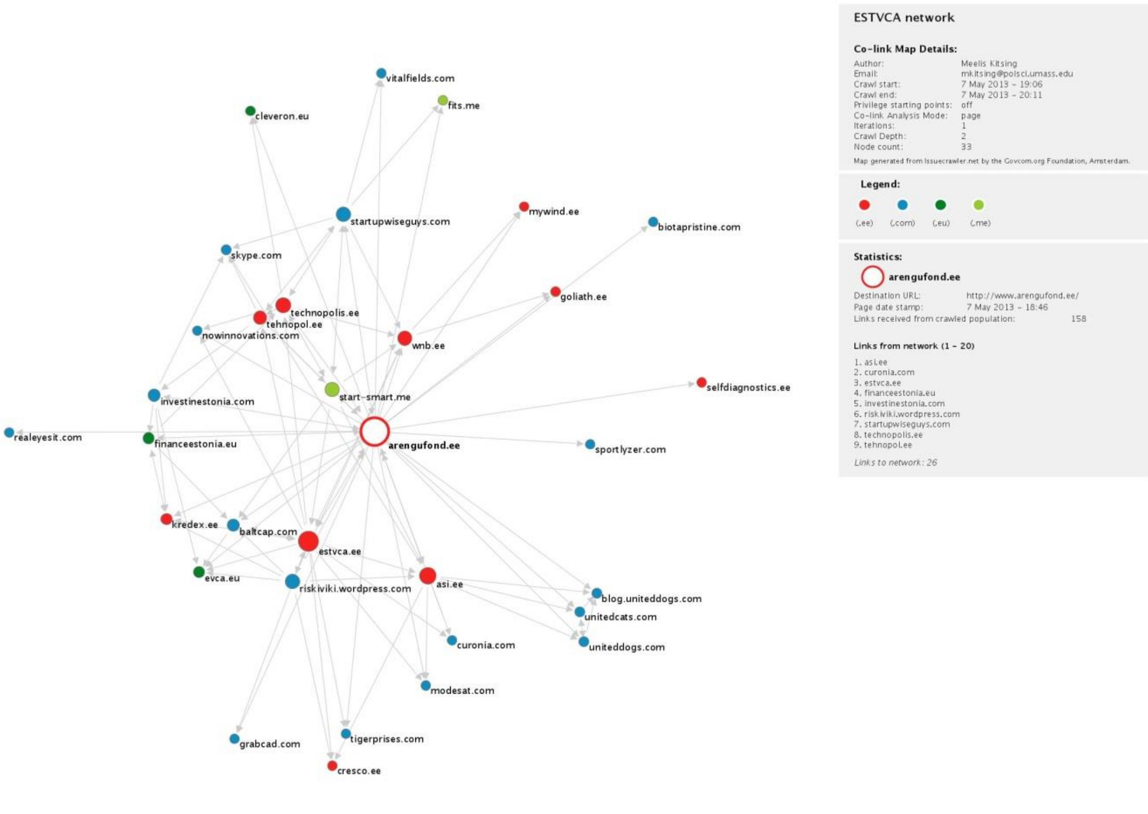

Figure 6.5: The Estonian venture capital network with inlinks and outlinks (May 7, 2013).[49]

[49] Data entered by the author, map produced by issucrawler.net.

However, EstVCA itself as well as private sector investors such as asi.ee and wnb.ee play focal role in the network as many nodes connect to them. As the network nodes are quite evenly distributed (many firms connect to each other as well as to the EDF), then this network can be characterized as moderately centralized. The network includes also 14 portfolio companies of the EDF. It is surprising that it does not include 7 members of EstVCA. However, it does include most active co-investors of the EDF such as asi.ee and wnb.ee.

The network analysis revealed that the EDF is an important focal point among its portfolio companies as well as in a broader venture capital ecosystem in Estonia. This finding has been confirmed also by interviews (Interview 22-26 and 32-34). The analysis of EstVCA members revealed that the EDF plays a central role in the broader venture capital networks. However, its centrality is moderate as many companies in the network are linked directly to each other. Hence, this network is less centralized than portfolio network, which signals maturity and tight contacts among the network members. The network analysis does not only allow to grasp the links in the ecosystem but to assess the potential performance of portfolio. Following Hochberg et al (2007) the strong network links of the EDF could suggest that the potential performance of EDF portfolio could be better than the performance of venture capital firm with weaker ties. At the same time, it should be kept in mind that most co-investors of the EDF are relatively inexperienced investors as is the EDF itself. Hence, the portfolio performance may still turn out to be inferior despite strong network ties.

Most importantly, the central role of EDF played in the venture capital ecosystem is not necessarily a positive outcome. First, it may suggest that the ecosystem is not able to function without government intervention and is too dependent on government. Second, the development of a venture capital ecosystem is not an end in itself. Rather it is a means to contribute to broader economic development. Thus the potential externalities of the EDF are explored below.

6.4.2.1 Asymmetric Information

Thus, it is crucial to analyze the externalities of EDF investments and its impact on negative effects of perceived and real market failures. One theory in Section 6.4.2 suggested that the government venture capital is necessary for overcoming market failures stemming from asymmetric information. However, all interviews with co-investors and outside investors did not confirm this. Rather several investors argued that they are quite familiar with potential companies in the pipeline and here the EDF does not add value in solving information asymmetry by matching investors and start-ups. According to one outside investor the EDF requires non-disclose agreement (NDA) before showing its pipeline to potential investors. This was viewed by this investor as unnecessary requirement as the companies in the EDF pipeline approach potential investors independently as well and the NDA requirement creates just additional complications (Interview 28). At the same time, a co-investor of EDF told that he has never been asked for the NDA and he is familiar with the companies in the pipeline anyway (Interview 34). The EDF confirmed that they had treated potential investors differently but this is not the case anymore (Interview 25).

Some technology companies in the EDF portfolio pointed out that the EDF has brought important contacts and contributes to finding potential investor. However, majority of portfolio companies complained about the EDF not helping them in finding new investors and not being sufficiently connected to potential investors. Most companies interviewed also saw the EDF as a financial investor rather than hands-on VC, which brings specific knowledge and expertise to the sector. In addition, most companies did see the EDF as too bureaucratic in comparison with private sector investors. One founder and former CEO pointed out that the EDF decision-making took too long and contracts were too lengthy and overly detailed. He told that negotiations took 4 months and the EDF approach was narrow-minded as they did not take a longer term perspective (Interview 34). The EDF did not have experience and network that other venture capital firms could provide (he compared the experience with the EDF with his new venture which by 2012 had raised USD 700 000 in Silicon Valley).

According to another manager, the EDF has primarily provided oversight over finances. The EDF has accepted management strategies and not intervened in the core business. However, he pointed out it is impossible to have a good quality investment team in such small fund such as the EDF. “The minimum requirement would 50-100 million euros under management for hiring a highly professional investment team,” said one manager (Interview 23). His assessment is that the EDF’s legal competence is very strong, but negotiations take too long, fund is not effective in making quick decisions, decision-making process is too formal and not very clear always. “The mandate of EDF representative is not always clear. You need to take 2-3 steps to figure it out but only 1-2 steps with private investors,” he said. The EDF required very detailed final accounts dating several years back as a part of due diligence, which was difficult for the company as the previous management had not kept them and it required additional time and substantial work (Interview 23).

Some portfolio companies offered more moderate criticism. According to another CEO, they had the first contacts with the EDF in the summer of 2010 and made some presentations, but started serious negotiations in December 2010 and it was completed by the beginning of 2011. “In the beginning, the requirements of the EDF were too complex and bureaucratic, but it was possible to simplify them,” he said (Interview 21). One company saw clear benefits. The CEO of a small company where the EDF has 20 % stake, pointed out that the EDF provides advice and legal assistance in drafting contracts and so on. The CEO considered this really important for him as the company is relatively small and cannot afford such services (Interview 33).

6.4.2.2 Underinvestment in Innovation

The first part of this Chapter revealed that Estonian government has been a moderate investor in innovation. Section 6.4.2 suggested that private sector investors may undersupply capital to innovative new start-ups because they cannot capture positive externalities of innovation. Government provision of venture capital does not just benefit these companies but leads to positive externalities of innovation and thus benefits broader economic development by minimizing negative effects of this market failure.

Most companies pointed out that they did not have any alternative sources of financing to the EDF. Two companies had alternative options but they considered terms offered by the EDF better. In the case of one company, alternative options were not even explored. According to one CEO they needed investment for product development and the investments have allowed company to grow faster. Alternative options would have been to raise money from the UK and the USA. These options would have taken longer than raising the capital from the EDF. "If the EDF would not have injected capital, then the company would have found other options," he said According to him, they have talked with 100 investors in order to find suitable options for fund-raising (Interview 24).

Another CEO and founder argued that the EDF has fulfilled important gap in the market as in 2006 only one serious private venture capital firm existed in the Estonian market. According to him, his company did not have any real alternatives to the EDF investment and mobile parking solutions would seem too utopian for investors outside of Estonia. He argued that his company needs to raise additional equity capital of 1-2 million euros but there are not sufficient funds available. Additional capital would be necessary to secure sustainability of his team, which should be 2-3 times larger. The new equity injection would enable the company to be competitive in the mobile parking business, which has market size of 50 billion euros in the US and EU.

According to CEO of company with a recent successful exit, they did not have any realistic alternatives for the EDF investment. It is difficult for an Estonian company to raise money, particularly if it is very research intensive. He said that research and development expenditure is 70 percent of all the funds company has raised so far. He argued that the company could not have made necessary investments without this equity injection. Patent applications alone take 4-5 years to handle and this means investors have to take a long time horizon. However, this execute saw the EDF role as a passive financial investor rather than active hands-on investor. “There is no need for active involvement in the company as they do not have experience and there is no necessity for that,” he said (Interview 21).

For instance, CEO and owner of another company said that the EDF has been instrumental in developing the company from the early days and alternative sources of financing have not been available to his venture. Only realistic alternative could have been bootstrapping, which was not very likely as he already had to live off his wife’s maternity leave money when he founded the company (Interview 33).

However, the lack of funding itself cannot be a market failure. Otherwise, all areas of life can be seen as full of market failure as there is often lack of funds. The market failure is underinvestment in innovative companies, which would create economy-wide positive externalities and enhance economic development. Thus, it should be explored whether the EDF investment has created these desired externalities.

6.4.2.3 Capturing Positive Externalities

The key to understanding the impact of EDF is question whether Estonia is able to capture positive externalities of investments. Certainly, some Estonian entrepreneurs will get richer once their exits from companies ~~will~~ materialize. However, much more is at stake. Section 2.4 pointed out on the basis of smart specialization literature that the diffusion of ICTs has increased differences among core regions and periphery. This is because ICTs are complements to knowledge-intensive activities which also require face-to-face interactions but they are substitutes for activities which can be routinized (McCann and Ortega 2013, 4). Hence, public policies aimed at encouraging internet diffusion can be self-defeating if they do not factor in local informal institutions, knowledge, skills and geographical specificity and ensure that positive externalities of diffusion process is internalized by local actors rather than by outsiders.

Whether the EDF investments lead to positive externalities which will benefit Estonian economy is far from certain. The innovative activities have to materialize in terms of increased revenue, particularly increased export revenue as the domestic market is very small. The cumulative export revenue of whole portfolio for the years 2008-2012 amounted to 20 million euros while the entire export revenue of Estonian companies was 48 billion euros during the same five years. Similarly, 131 employees in the EDF portfolio companies is miniscule considering that entire workforce is about 600,000 or even that of Skype which exceeds 400. Obviously, some of the portfolio companies may achieve significantly higher revenue and create jobs in the future. Hence, it may be too early to assess the externalities on these grounds. Only three portfolio companies – two of them ICT companies NOW!Innovation and GrabCAD - were profitable in 2012. All other 15 companies made losses. The portfolio companies employed 131 people in 2012. The 131 employees implies that the EDF alone had invested 68,700 euros per each employee in its portfolio company by 2013 (not counting the equal co-investments by private sector venture capitalists). The average gross salary was 1400 euros in the portfolio companies in 2012. In comparison, the Estonian average salary was about 900 euros in 2012.

Alternatively, we could assess the likelihood that potential externalities would occur in Estonia. The current limited evidence seems to suggest that more successful portfolio companies usually create positive externalities, but they are not captured in Estonia. At the same time, less successful portfolio companies generate negative externalities in Estonia. For instance, one successful exit did not generate positive externalities to the Estonian economy. Modesat was taken over by US- based company and its business operations are located in the US now. GrabCAD has moved its headquarters to Boston and has more employees there than in its office in Tallinn, Estonia. Fits.me has moved its headquarters to London. Other investments which can be considered relatively successful by the abilities of companies to raise new funds signal similar trends. RealEyes does not employ anybody in Estonia. Its operations take place in London, UK, Boston, US, Budapest, Hungary and Minsk, Byelorussia. NOW!Innovations have significant operations outside of Estonia.

EDF impact in generating externalities cannot also be seen in isolation. Considerable amount of EDF portfolio companies have also received grants from the Enterprise Estonia, a government agency for business support, and KredEx[50], a government agency for financial services. At least two companies out of 18 have used services of KredEx, grants from Enterprise Estonia and equity injections from the EDF. About half of the EDF portfolio companies have received also grants from the Enterprise Estonia. Thus, it is not possible to distinguish the exact role that EDF has played in generating positive externalities in comparison with other agencies. And of course, sometimes these externalities have not been positive.

For instance, fits.me has attracted total of 1.5 million euros in equity investments and R&D grants from the Estonian government agencies. The role of EDF is that of passive financial investor. Certainly, there has been positive externalities of these investments has the company cooperates closely with two largest universities in Estonia. However, the performance of the company cannot be assessed on the basis of publicly available data because they have not consolidated their accounts to Estonia.

[50] The clients of KredEx cannot be publicly disclosed because they are protected by bank secrecy.

6.4.2.4 Portfolio Performance and Public Interest

There is a constant challenge to find a proper balance between portfolio performance and a broader public interest. The EDF has to invest into Estonia-based companies, which was seen by many experts as unnecessary restriction as it limits the potential investment targets and hinders portfolio performance (Interviews 22-26, 28). One venture capitalist argued that there should not be any geographical restrictions (Interview 26). “What is Estonia?, ” he asked during interview. “Define Estonia!,” he added. “Let’s take Hardi Meybaum (founder of GrabCAD) as an example who has headquartered his company in Boston. Is Hardi Meybaum Estonia?,” he asked. He argued that we should not limit our definition of Estonia to geography in the 21 Century. He pointed out that Estonians can never make major breakthroughs in the world and be world-class professionals if their approach is too Estonia-centric. “Hardi Meybaum with other founders will always seek and keep their roots in Estonia,” he argued.

At the same time, the political masters of the EDF see requirement to invest in Estonia-based companies as a crucial building block for its operations. Some portfolio companies and investors agree that the main aim of EDF should be enhancing public benefits. One CEO pointed out that EDF’s goal is to maximize profits, but it should consider broader public goals. “In the end, any return on investment would be marginal from the point of view of Estonian economy. What really matters is creating success stories and fulfill gap in the venture capital market,” he said. He argued that the EDF should not focus too much technology-centric companies because they are acquired early by other companies. The EDF should invest more in sales-oriented companies, where new companies create brands, which allows have positive impact on the broader image of Estonia (Interview 23).

In reality, the EDF has found ways to reduce the requirement to invest in Estonia to formality. For instance, RealEyes does not have an office in Estonia and does not have any employees in Estonia. The Company was founded in UK in 2006. In 2009, company was officially registered in Estonia and shares of UK based corporation were sold to the Estonian entity in order to receive research and development grant of 770 000 euros from the Enterprise Estonia, a government's agency that distributes EU structural funds for encouraging entrepreneurship and innovation. The EDF invested 120,000 euros as a seed investment in 2011, which was matched by Bellus (now Caplia Invest) owned by Rolf Relander and Rikard Relander, who are also co-investor in several other EDF portfolio companies. By June 2012, the EDF has invested additional 200 000 euros which has been matched by Kaplia Invest, which means total equity injection of 640 000 euros. As of August 2012, the EDF share was 12.5 percent while founders owned 60 percent of the equity. Similarly, as was pointed out above, several other companies have moved significant parts of their business operations outside Estonia. For instance, fits.me has offices in Munich, Germany, Paris, France, New York, USA and Auckland, New Zealand. In order to stay competitive, it is natural for them to move to well-established ecosystems. Obviously, this is not just an issue in Estonia and peripheral EU countries. Even well established and wealthy US regions such as Atlanta have not managed to keep its new promising companies from moving to Silicon Valley and Boston (Breznitz and Taylor 2011).

Thus, the tension between portfolio performance and public interest is not a temporary issue, which can be solved by clever design but rather it is a permanent feature of the government venture capital scheme. Unless, of course, the definition of public interest would be radically altered – e.g. investments in the companies could be seen as marketing cost with the aim of promoting Estonia abroad.

6.4.2.5 Private Equity and Transparency

Imperfect data and insufficient transparency make measurement of positive externalities difficult. A considerable proportion of the EDF portfolio companies have not consolidated their financial data and hence the Estonian Business Registry does not provide accurate overview of their operations. Some companies also like to inflate their revenues and other financial data. For instance, Fits.me reported to the Estonian media in 2013 that its annual sales revenue increased to almost 2 million euros in 2012 from 22,869 euros in 2011. The annual report available in the business registry shows this to be true. However, the company did not tell to the media that actually over 1.9 million euros was for the services sold to Fits.me's UK-based holding company. Hence, it was a transaction between related parties, which is shown on its annual report as revenue for sales (Estonian Business Registry 2015).

Similarly, it is difficult to assess the EDF performance if the information disclosed to the public is limited. As was pointed out before, it is difficult to assess the value of its portfolio, when even detailed information about successful exits cannot be disclosed. These tensions concerning data availability and broader transparency are not temporary problems which can be easily solved. Rather, the tensions stem from fundamental contradictions inherent to the government venture capital scheme. The important element of venture capital success is its private nature. It is a form of private equity. This allows making quick and focused decisions with limited public scrutiny. As the representative of EDF said in the interview "These investment decisions concern private legal persons who are not public sector institutions and therefore making information public would actually harm them" (Interview 25) However, the distribution of public money by nature has to be public and come with certain degree of transparency. Hence, it is natural to scrutinize companies receiving money from public purse and organizations distributing the public funds. If the success of venture capital scheme depends on information asymmetry, then public scrutiny may become an important obstacle. But if government distributes money, then it cannot be free of public scrutiny.

6.4.2.6 Entrepreneurial Discovery and Rent-seeking

The discussion above on market failures and externalities pointed out some fundamental issues relating to the broader political economy of government venture capital. Government wants to have a cake and eat it at the same time by demanding both stellar portfolio performance and positive externalities for the benefit of broader economic development. Public demands strong scrutiny while the beauty of venture capital is in its private nature. In other words, government wants EDF to be entrepreneurial and through the process of entrepreneurial discovery to find new ventures. At the same time, these decision should be made in the public interest. However, there is considerable institutional complexity involved because government rules interact with formal and informal rules of venture capital. There is also considerable heterogeneity in policy design and outcomes. If the parliament is responsible for the EDF, who is really responsible? All 101 members or only members of governing coalition? How many exits is sufficient to decide that the EDF performance has been positive? How do we decide that positive externalities created by EDF are sufficient? All these questions do not have clear answers and hence, they create ambiguity and uncertainty.

In this context entrepreneurial discovery and investment of public funds can become easily coupled with potential rent-seeking. There is a risk in the venture capital scheme, which seems to point towards a classic outcome where benefits are privatized and costs socialized. A straight-forward rent-seeking is difficult to explore on the basis of semi-structured interviews and descriptive statistics. Some perspectives suggest that government venture capital may crowd out private investments and government may want to pick successful companies which do not need its funds instead of companies which struggle in raising funds. Cumming and MacIntosh (2006) have shown that government venture capital tends to “crowd out” private investments. This fits well with the reasoning offered by Wallsten (2000) that government officials may not tackle market failures but select companies, which are likely to be successful rather than businesses that actually cannot raise private sector funds and need government support. There is no evidence that the EDF has crowded out private investments. Interviews confirm the opposite (Interviews 22-26 and 32-34). Particularly, as the EDF started to invest in 2008-2009 when the financial crisis reached Estonia. The capital was scarce and terms of credit were tightened. The Estonian GDP had a cumulative drop of 20 per cent in the years 2008-2009. The EDF has not invested in Transferwise which is valued over one billion dollars and is the most successful of recent start-ups. This financial technology start-up was founded in London by two Estonians (one of them first employee of Skype) but has a significat presence in Estonia. Interview with the EDF officer shows that they regret not investing in Transferwise.

The EDF portfolio performance suggests that EDF has picked more losers than winners. There has been three successful exits so far. Three investments have failed and four investments have been revalued downwards. This would suggest that the current evidence supports more “traditional” political economy hypotheses that governments do not manage to pick winners even if they try very hard. Losers simply have stronger incentives to pick governments than governments’ incentives to pick winners. Nevertheless, on the basis of evidence it cannot be concluded that the government venture capital scheme is more likely to pick losers than winners. We have to see venture capital in a broader context. Majority of investments by private sector venture capitalist fail as well. A large number of failures is expected among the venture capitalist as long as some investments earn them extraordinary returns. Uncertainty surrounding venture capital investing suggests that even if governments may perceive some companies as clear winners and pick them, the companies may turn out to be losers because investors have to face unknown unknowns in decision-making. For instance, the EDF picked social networking start-up Inner Circle as its portfolio companies, which was backed by one of the most well-known Estonian venture capitalist Allan

Martinson. The decision-making was quick and the Chairman of EDF supervisory board became co-investor in the venture. However, the venture struggled to find a proper business model and eventually failed despite of excellent management team and strong financial backing (Interviews 22-26).

There is limited evidence of other type of potential rent-seeking. Estonian business newspaper Äripäev has brought attention to the case of Inner Circle, where Chairman of the EDF supervisory board and other interested parties were shareholders (Tahlfeld 2010). The Estonian media reported in 2012 that unnecessarily exclusive and excessive office space was rented by the former management team of the EDF. The EDF paid annually 85,000 euros for 500 square meters in one of the most exclusive office buildings in central Tallinn (Smutov 2012). This is the price of most expensive office space in Tallinn but the EDF could have rented 30-50 percent cheaper space in a less exclusive office building in central Tallinn. Considering that the EDF had about 20 employees, there was 25 square meters of office space per each employee. Obviously, the EDF should have also been more economical with the use of space, which could have generated additional savings. Furthermore, Tõnis Arro, CEO of EDF was fired in 2014, for using EDF funds to cover his personal expenses.

However, the rent-seeking may also take place indirectly as agents may not be always the best guardians of principal's assets. In the case of one failed investment private co-investor said that he invested his own money, while the EDF and other co-investor Ambient Sound Investment are investing other people's money, which may also impact their incentives. According to this investor, the board did not execute sufficient control over the company. The CEO was an excellent sales man and was able convince board members that everything is going fine even if numbers showed otherwise. This investor argued that the main reason for the failure of the company was misallocation of resources. "They spent almost 4000 euros on servers per month," he said. CEO paid himself and other employees high salaries, which is out of line with start-ups. Too many people were hired who were given dubious and fancy job titles. He concluded that his decision to invest in the company was clearly a mistake and he must have suffered “a temporary loss of mind”, when he made this decision (Interview 22).

6.4.3 Entrepreneurial Discovery and Institutional Complexity in the Case of EDF

The main purpose of paper was to assess the broader impact of the EDF on the ICT ecosystem and how institutional complexity constrained entrepreneurial discovery and created heterogeneous policy outcomes. Online network analysis and semi-structured interviews showed the central role of EDF in the venture capital ecosystem of Estonia. This is consistent with previous qualitative studies based on semi-structured interviews that have suggested a crucial role of the EDF in getting venture capital networks started in Estonia (Nightingale and Reid 2010; Jostov and Sonts 2012). The broad venture capital ecosystem network is modestly centralized where network nodes connect to the EDF as well as to other members of networks. One of the portfolio companies - accelerator Startup WiseGuys - has become a focal point in this network in less than a year. Certainly, the analysis of online networks gives only a partial understanding of the EDF role as the offline world may not match online world. Nevertheless, it is a crucial factor – especially as many EDF portfolio companies are social network and ICT companies.

While the EDF has contributed significantly for the creation of the ecosystem, it is not sufficient for capturing positive externalities. The findings suggest that the 18 EDF portfolio companies , including 10 ICT companies, are small and insignificant from a broader perspective of the Estonian economy. By tackling market failures and externalities of government venture capital scheme, the case highlights policy dilemmas stemming from institutional complexity. First, the research demonstrates that government’s aim to increase the EDF portfolio performance and concurrently create positive externalities for local economy are in conflict with each in the government venture capital scheme. The portfolio performance can be increased by removing requirements for investing such as to invest only in the Estonian companies. But this would enhance already existing trend where successful companies are eager to leave peripheral economy of Tallinn, Estonia, for the better ecosystem in Boston, London and other areas. Second, the principles of venture capital investing and public accountability of government expenditures are also mutually exclusive. By definition venture capital is a form of private equity, where most benefits stem from its private nature. At the same time, government expenditure has to be public and transparent. Information asymmetries concerning the losses and exits of the EDF portfolio companies work against the principles of accountability and transparency. Third, the case offers evidence of how entrepreneurial discovery process can become rent-seeking and negative externalities of government intervention. The EDF comes across as a passive financial investor rather than hands on venture capital fund and is seen as too bureaucratic and inflexible in comparison with the private sector funds. However, lengthy formalities and inflexibility may also stem from the fact that the EDF is an institutional investor while its co-investors are less institutionalized and not comfortable with high degrees of complexity.

6.5 Conclusion

Even though often Estonian government's ICT specific initiatives receive a lot of attention and Estonia government is seen as a unified strategic actor in encouraging the use of internet throughout society and providing numerous online services, these factor are not critically important for the diffusion of internet. As the discussion above demonstrated even semi-successful of these initiatives are at best false positives. Wrong conclusions are drawn on the basis of these cases. First, even though numerous strategy documents for information society exist, the implementation mechanisms of ICT policies are relative decentralized.. With the decentralization have come benefits as well as costs. On the one hand, Estonian system has delivered innovation in the form of groundbreaking initiatives (internet voting, ID card and digital signatures as discussed in Chapter Five) as a result of entrepreneurial discovery in different government agencies. On the other hand, the system has costs such as incompatibility of certain solutions and delays in implementation as well as lack of financial benefits that come with economies of scale and scope in centralized systems. Hence, the relative successes and failures (or the outcomes) of government initiatives have been quite heterogeneous by nature rather than homogeneous. As Estonia is often seen as an ICT success story it is often assumed that policy design and outcomes have been homogeneous.

Second, many initiatives have been launched already after the significant take off of internet in 2000. Thus, they have actually been a reaction to the availability of internet and benefited the further use of internet rather than been crucial for the internet diffusion in the early years. The internet diffusion has been outcome of a path-dependent process in Estonia where crucial critical juncture took place in 1996 when internet banking was launched. All following steps have in one way or another built on the success of internet banking. However, perception of Estonia abroad as an ICT innovator and some successes at home have created mental models for key policy-makers and other actors where they aim to replicate earlier and accidental success by deliberate design. Some of these attempts have been fruitful but as this Chapter tried to demonstrate outcomes have been heterogeneous at best. Let me re-call the Chapter Two that policy-makers may actually not understand causal mechanisms and draw wrong policy lessons.

As it was emphasized throughout the description, Estonia does not have sector-specific approach to ICT. Either explicitly or implicitly ICT is seen as priority by government institutions and members of society at large. Many government initiatives have been and are small in its significance for the take-up of internet and they have indirect impact through political rhetoric rather than direct impact. The implicit and informal elements of internet diffusion are more fundamental than formal strategy documents. This also makes it more challenging to compare and copy directly the Estonian initiatives and solutions in contextually different. Therefore, it is important to locate specifically the drivers of internet diffusion beyond reliance on formal strategy documents. The beginning of this Chapter highlighted that many other countries in the world look to Estonia for guidance on building a path to an information society. However, the understanding of causal mechanism behind Estonia's achievements is often superficial. For this reason, it is important to understand the formal and informal institutions that actually build internet diffusion. It is crucial to separate the ICT projects and other activities that are more peripheral to the country's success. Especially, as sometimes these projects are false positives. This chapter took also a hard look at the actual successes of Estonia in the ICT domains and note some significant weaknesses, troubling long-term trends and project failures. In other words, Estonia offers opportunities to learn from both its successes and failures but its model must not be automatically copied and universally transferred to other countries. As it has been emphasized throughout this dissertation, different countries follow different development trajectories and there is no one size fits all model for encouraging internet diffusion which is ahistorical and aspatial.

CHAPTER 7

CONCLUSION

The purpose of this study was to describe and explain how the internet diffuses in different institutional contexts. Let me recall that dissertation asked three questions. The first question was following: *How do Estonia and Slovenia differ in the outcomes of internet diffusion?* The second research question of this dissertation was the following: *How have the entrepreneurial discovery processes and internet diffusion intertwined in Estonia?* The third research question of this dissertation was the following: *How has institutional complexity constrained entrepreneurial discovery processes and internet diffusion in Estonia?* These questions corresponded to each individual chapter. In this concluding chapter I will offer overview of findings which is followed by discussion of methodological limitations and policy implications.

7.1 Overview of Findings

In order to examine two similar countries and their developmental paths with respect to internet diffusion, Chapter Four offered a comparative descriptive analysis of Estonia and Slovenia from 1991 to present. It demonstrated that there is significant variance in the internet diffusion between Estonia and Slovenia when measured by both eleven variables in the last year of data availability as well as over time. Most importantly, Estonia has performed better in internet diffusion outcomes than Slovenia when measured statically in one point of time as well as dynamically over time. Estonian internet users have been able to use better quality and higher speed internet for longer time-period than Slovenian users. The more regular use, better supply of internet and demand for more sophisticated services have interacted more favorably in the Estonian case and contributed to both better intensive and extensive diffusion the internet.

The comparative analysis of Chapter Four also shows clearly that the national wealth as has been suggested by some scholars cannot explain the variance between internet diffusion in Estonia and Slovenia. Estonia has been and is considerable poorer than Slovenia as the data on per capita GDP demonstrated. Furthermore, Estonia is considerably less equal than Slovenia as the data on the Gini coefficient demonstrated. In spite of lower per capita GDP and higher inequality, internet has diffused more among Estonian population and among different population segments by income in Estonia than in Slovenia. Thus, the propositions based on wealth and/or distribution of wealth as an explanation for the internet diffusion can be rejected as a crucial factor in the variance between internet diffusion in Estonia and Slovenia. Furthermore, Chapter 4 also shows that there is no considerable variance in human capital in the form of ICT skills between Estonia and Slovenia. The dissertation does not aim to generalize to entire world and hence, it is plausible that national wealth hypothesis and/or human capital hypothesis fail to be rejected on the basis of different sample of countries. As it is a descriptive study, then I do not entertain the possibility of causality. However, the wealth-based hypothesis can be rejected by a simple logic on the basis of descriptive statistics in the case of this comparison.

An examination of institutional developments that investigates formal institutional arrangements – in other words, the thick description -- shows that most important have been institutional changes carried out by the Estonian government in the 1990s and the early 2000s. Interviews showed that both Estonia and Slovenia had vibrant IT communities in the 1990s but mere existence of an IT community is not sufficient for influencing government decisions if entrepreneurial discovery processes are seriously hindered by institutional complexity. Precisely, the interaction between telecom-specific rules of the game and the broader institutional framework is fundamental for understanding the reasons for the different outcomes in the internet diffusion. This is so because it reduces conflicts among different institutional logic. Estonia had broadly liberal institutional framework for economic governance after radical reforms in the 1990s. Opening up telecom market for competition was consistent with these general changes in the rules of the game. All these institutional changes were also consistent with the EU legislation in both letter and spirit. At the same time, Slovenia introduced a form of managed capitalism after gradual reforms in the 1990s. Government was reluctant to open up telecom sector for competition and did so under the EU pressure. Government is still the main owner of incumbent telecom company and to present day this issue creates tensions with the EU. Even if Slovenia may follow EU regulation is letter, it does not do so in spirit as the interviews revealed.

Most importantly, mutual reinforcement of general and sector-specific formal institutions and timing of institutional change offers an explanation how high quality and high speed internet has spread widely in the Estonian society and how distribution of internet among users with different socio-economic backgrounds is more equal in market liberal Estonia than egalitarian social democratic corporatist Slovenia. The rules created greater openness in Estonia than in Slovenia. Telecom sector liberalization provided a critical juncture, which enabled a path that led entrepreneurs to supply high quality fast internet. The telecom sector liberalization and encouragement of competition is a fundamental difference between Estonia and Slovenia. It fits nicely with previous empirical works which has emphasized the importance of telecom liberalization and competition which is discussed in Chapter Two (Dasgupta et al 2001; Guillen and Suarez 2005; Caselli and Coleman 2001).

However, the telecom sector liberalization and encouragement of competition is not sufficient on its own for internet diffusion. Chapter Five shows that this supply of telecom services interacted with other forms entrepreneurship in an ecosystem that produced the provision of innovative online services by both public and private sector. The institutional changes unleashed the process of entrepreneurial discovery and experimentation with different ICT services as documented in Chapter Five. As an example of this ecosystem, Chapter Five discussed how innovative peer-to-peer telecom service provider Skype emerged in Estonia in 2003 and it was sold for 2.6 billion dollars to eBay in 2005.

Most important of these was the online identification method provided by the leading banks and accepted as a platform by government for building online services. We can attribute this acceptance of innovation by government as an example of a mental model that sought out and leveraged innovations for the public good. The banking system with innovative internet solutions was one of the unintended outcomes of market liberal reforms carried out by the Estonian governments in the 1990s. It was accidental but it set-forth a path-dependent process where interests of government and banks were incentive compatible. In the 2000s, both government and banks built on the foundation and gradually started to **substitute** the old online identification methods with national ID card. Certainly, this adoption was possible because of government's rule-making, which made the ownership of ID card mandatory and by doing so contributed the emergence of new sophisticated online services.

Nevertheless, government did not make the use of ID card online mandatory per se rather certain government services had higher transaction costs when accessed without the ID card. The emphasis is on the rule-making by the government in contributing to the intensity of internet diffusion rather than specific initiatives and policies. Certainly, this rule-making was not rational, top-down process which was able to foresee outcomes. Rather, it was learning-by-doing, experimental. Some of the experiments worked out well as Chapter Five documented on the basis of online tax declaration, ID card and internet voting. Other government initiatives and policies were by design and outcomes more heterogeneous as shown in Chapter Six.

Institutional complexity, bounded rationality, uncertainty and policy heterogeneity documented through various case studies in Chapters Five and Six do suggest that the reason why Estonia has the higher penetration rate of internet in comparison with Slovenia is not because of some master plan drawn out to achieve this particular rate adopted by the government. Although various strategy papers expressing grandiose visions for promoting the internet did exist, these plans were a reaction to already existing phenomena and an attempt by politicians as rational agents to capitalize on success; they were not the cause of Estonia's rapid internet diffusion. As the thick description on Estonia showed many government initiatives targeted at the ICT sector and use of internet were not existent in the early years of internet diffusion. Chapter Six showed that differently from other CEE countries Estonia did not have a comprehensive ICT strategy before the emergence of internet banking, introduction of online tax declarations and other crucial initiatives. Chapter Four also discussed that differently from Slovenia Estonia did not have a special ministry dedicated for ICT. Skype emerged in 2003 in Estonia but government initiatives for imitating Skype's success in the case of other start-ups materialized in 2008 in the form of government venture capital investment. Once government initiatives such as government venture capital have been implemented, the allocation of government expenditure to them has not been significant and these initiatives have not created serious positive externalities for innovation and internet diffusion as shown in Chapter Six.

The main role of Estonian government as a catalyst for innovation and internet diffusion has been in the form of general rule-making rather than contributing to the internet diffusion by specific initiatives and government programs. In the 1990s the Estonian government followed the advice of its local IT community by unifying the public sector IT systems through X-Road and increasing IT use in public sector administration because it fit well with reforms aimed at making government more efficient and reducing the size of government in the economy. Most importantly, it was a technologically decentralized and cost-effective approach which aimed to make different legacy systems to connect to each other.

The Estonian government did not increase a public sector spending on R&D and did not engage in industrial policies for IT promotion, however. The government online services to the general public emerged gradually and were heterogeneous reflecting the different priorities of different agencies. Overall, the government approach to the ICT use remained quite decentralized not only technologically but also institutionally as Estonian did not aim to create any new ministry responsible for the ICT as Slovenia did in the early 2000s.

Hence, analysis of the impact of institutions has to go beyond the consideration of formal institutions. This is challenging to do because formal institutional changes are documented and informal institutional changes have to be interpreted indirectly. Nevertheless, the interaction between formal and informal institutions is fundamental for understanding effective institutional changes. Chapter Five discussed the case of Skype, which cannot be understood solely on the basis of formal institutions. The existence of bohemian-libertarian ecosystem in Estonia enabled various entrepreneurial discovery processed to take place and allowed experimentation with various forms of ICT ventures. Indeed, the Skype founders' early venture called Kazaa made them the fugitives of US justice system because their peer-to-peer technology was primarily used for illegal file sharing. However, Estonian government stayed aside and did not intervene.

Entrepreneurial discovery process can take many different forms and exist in both public and private sectors. Chapter Five showed how on the basis of private sector initiatives in internet banking public sector online services can be offered. This is a positive case of entrepreneurial discovery benefiting public good. However, Chapter Six offered some insights on basis of interviews how entrepreneurial discovery process can become affiliated with rent-seeking on the basis of government venture capital, where risks are socialized and benefits privatized. Institutional complexity stemming from different institutional logic of venture capital and public sector governance creates perverse incentives for agents. Thus benefits for public good are unclear.

By emphasizing the institutional framework and how it conditions entrepreneurial discovery, the dissertation has demonstrated that the institutional context matters and there are many tacit elements in understanding the process of internet diffusion. This highlights the fact that practices on the ground are not captured by nominal variables. In a large N-study based of limited variables the differences between the telecom sector regulation as well as the role played by the entrepreneurial discovery in creating online identification methods would be not understood. Their role of critical junctures of for the extensive and intensive diffusion of internet in Estonia would be ignored. The path-dependent nature of these developments would not be captured. Internet is tacit as it is used differently in different political, social and economic context. Many factors explaining differences in Internet use are also tacit as they are not easily measurable.

7.2 Limitations of the Study

Certainly, this study comes with several limitations stemming from its descriptive nature, small population and sample (population equals sample), limited comparisons and imperfect data. The limitations of data and self-selection biases inherent in using semi-structured interviews reveal several obstacles for analysis. This is a fundamental issue that cannot be solved by more publicly available data and more interviews with actors whose interests are at stake. Only time may allow overcoming these barriers because only over time agents involved in decision-making may become more open about the past decisions. Even more importantly, the institutional changes are challenging to address because of path-dependency on previous decisions and lack of proper counterfactuals. Second, measurement difficulties are empirical.

As the number of experts, high level officials, ministries and other very important persons is small in Estonia and Slovenia, then significant portion of information cannot be aggregated and published without revealing sensitive information, which people do not want to reveal in public. The interviews were coded in order to encourage more openness in interviews but this may not be always useful and people are reluctant to discuss important issues even on the unpublished record. In addition, public information sources such as business registries do not always have comparable data on different countries.

However, the future research can be certainly improved by incorporating more theoretical insights on process-tracing, policy entrepreneurship and institutionalism as well as improved methodological approaches in the form of network analysis and collection of more data.

7.3 Policy Implications

The cases come with specific characteristics and these characteristic mean that findings may not be relevant for all countries but it may be relevant for small countries or countries. Obviously, this is not just a methodological issue but creates substantial issues for policy-makers as they try to learn as they go and would like to learn from the Estonian "best practices". Hence, this particularist version of history of internet diffusion in Estonia is limited in its lessons that policy-makers can draw. The purpose of dissertation was to understand the processes rather than give simplistic "take-aways" as lessons. The particularist emphasis itself signals that there is no take away. Governments cannot create unintended path-dependencies by design which would benefit them. The rationale for policy intervention is crucially different from the emphasis on institutional complexity in the dissertation. Policy-makers assume institutional complexity away and use simplistic deterministic mental models for making their case. Often policymakers aim is to make long-term commitment of public funds with limited accountability, transparency and ability to track the performance of programs aimed at bridging digital divide and justify the public investments in the broader public discourse.

Even if government schemes are able to establish incentive structure that would make decision-making processes incentive compatible and establish the best possible public investment model, the performance of government initiatives are difficult to measure. First, partially these measurement difficulties are conceptual. The government interventions are surrounded by uncertainty in fast-changing technological environment. Politicians and government officials may want certainty and short-term result, which may lead to the adoption of superficial projects - some of which may be successful and others not - as the Estonian experience demonstrates. Success is relative and its measurement overdetermined, which means in the end it is not known whether an initiative materialized accidentally or because of deliberate actions.

However, one of the key lessons from the dissertation is that the process of entrepreneurial discovery should be encouraged also in the public sector. Usually, government officials are not seen as entrepreneurial and entrepreneurs and government bureaucrats are seen mutually exclusive. However, the Estonian experience suggests that it does not have to be so. It certainly comes with caveats. Entrepreneurial discover process should not become rent-seeking. There is a fundamental difference between the two. Former is about creating new value, new products and services. The latter is about redistributing existing resources.

Another important message from the Estonian experience is that reduction of institutional complexity has to be a priority for government because it reduces constraints on entrepreneurial discovery in both private and public sectors. The key to reduction is understanding of different institutional logic and how creation of new formal rules of the game may interact with existing formal and informal rules. This requires more institutional analysis, which have incorporate insights from political science scholars.

APPENDIX A

KEY TERMS AND CONCEPTS

This appendix defines key terms and concepts used in the dissertation in alphabetical order.

Entrepreneurial discovery – this dissertation relies on broad definition of entrepreneurial discovery. It is Schumpeterian approach where entrepreneurs are risk-takers and innovators who find ways to break old routines and establish new ones. Entrepreneur is not an ordinary business person or employee in a corporation. The latter tends to follow routines and is not motivated to break the routines. Entrepreneurs engage in constant process innovation as well as improve existing products and bring new products to the market place. This approach to entrepreneurial discovery also includes what in smart specialization literature McCann and Ortega-Argiles (2013a) call an entrepreneurial process of discovery. This process means involvement of entrepreneurs in policy-making process and consideration of their insight in early stages of policy design, which allows identification of new domains for technological development as well as re-designing public policies through constant feedback mechanism between entrepreneurs and policy-makers. The involvement of entrepreneurs in policy-making concerning ICTs and other technologies is crucial because successful innovation policy has to be aware of developments in real economy. The degree of embeddedness and relatedness of domain increases the impact of innovation developments across different activities and sectors. It has to be pointed out that smart specialization literature defines entrepreneurs very broadly: public universities and research institutes can be entrepreneurial and part of the process. It is not impossible that policy makers can be entrepreneurial. Hence, the entrepreneurial discovery is not only limited to private sector, but can also take place in public sector as well as in the non-governmental sector.

Epistemological nature of technology means that diffusion an use of technology takes place within the social frameworks of knowledge. Our previous knowledge and beliefs affect how we use technology. At the same time, technological change affects how we think and our thinking about thinking. It is circular process but technological change does not have unifirm impact. We perceive technology differently depending who we are. Braman (2012) see information policy as epistemology policy. She argues that epistemology affects perceptual entity, i.e. how we perceive technology, it affects how material and social world are experienced, translation of experiences into facts and which facts are are discussed in social groups and lead to consensually understood truth (Braman 2012, 137)

Institutions are “the rules of the game in a society or, more formally, the humanly devised constraints that shape human interaction” (Pierson 2004, 27). Institutions consist both formal and informal institutions. The former is understood as laws, regulations, constitutions and other rules made by government and/or international governmental organizations. The latter is defined as social norms, culture and other nonformalized rules of the game shaping the behavior of agents. It also includes social networks and social capital.

Institutional complexity – refers to the interactions of formal and informal institutions as well as interactions of formal institutions on different levels of government regulations. This implies that broad rules governing macroeconomic environment may conflict with regulations on micro level. There is considerable literature on institutional complexity and one way to define it is “incompatible prescriptions from multiple institutional logics” (Greenwood, Raynard et al. 2011, 317). Different institutions, their interactions, conflicts and institutional logics (see it defined below) creates institutional complexity. Usually, it can be assumed that greater institutional complexity implies greater constraints on agency. However, it does not have to be so. Some entrepreneurs and policy entrepreneurs may be well equipped for navigating in institutional complexity and achieving desired outcomes.

They may benefit from complexity and it may create absolute or comparative advantages for them.

Institutional logic - may stem from laws and regulations imposed by government in the case of formal institutions as well as socially constructed historical patterns of behavior, mental models of agents, habits, assumptions, expectations, values, culture and other rules, which may constrain or enable individuals and groups of individuals in their behavior and define social reality for them. Institutional logic may operate on community level as long as community members share the same beliefs. On a macro level, community may be a nation. Different nationalities may share the same beliefs about themselves and other nations. On a micro level, such abstract community as a nation may consist many different communities, which may follow different institutional logic. These communities may have different understanding of the same issue depending on their beliefs, knowledge and other factors (Smets, Morris et al., 2012; Thornton, Ocacio et al. 2012). For instance, nation as a community may be proud of IT developments in their country. They may experience the differences in quality and availability of services when spending time abroad or read about it in the newspapers. Within a nation IT community may also share the view about overall progress but may be more critical of recent developments finding that the government is not investing enough in IT development. Within IT community open source community may have a different view finding that government has overinvested in proprietary software solution and should rely on open source solutions instead.

Internet diffusion - There is no uniform definition of internet diffusion in the literature. Often scholars use the terms internet diffusion, penetration, adoption, connecitivity, access, use and digital divide interexchangably to describe the same phenomena. For example, the Internet Encyclopedia offers the following definition: “diffusion of an innovation is a macro process concerned with the spread of the innovation from its source to the public” (Dholakia et al 2004). The adoption is defined as “… a micro process that focuses on the stages through which an individual passes when deciding to accept or reject the innovation” (Dholakia et al 2004). However, individual decisions to adopt or not to adopt the Internet have clearly consequences on macro level. And diffusion on macro level impacts individual decisions on micro level to adopt the internet. In practice, it is not possible to draw clear lines between adoption and diffusion as these processes are mutually interdependent. Micro and macro processes interact. Often macro outcomes are simply aggregates of multiple micro processes. Adoption of internet by groups of individuals such as students or businesses in manufacturing sector, for instance, increases diffusion of internet on per capita basis on macro level. Indeed, the same encyclopedia talks about “adoption and diffusion patterns of internet” without clearly distinguishing between the two (Dholakia et al 2004). Essentially, adoption, use, penetration and diffusion of Internet describe the same phenomena.

Path-dependence – this dissertation uses following definition: “At every step along the way there were choices political and economic - that provided real alternatives. Path dependence is a way to narrow conceptually the choice set and link decision making through time” (Pierson 2004, 52). It is not a story of inevitability in which the past neatly predicts the future. Rather than assuming causal independence through time, it assumes that events are normally "path dependent," that is, that what has happened at an earlier point in time will affect the possible outcomes of a sequence of events occurring at a later point in time (Pierson 2004, 20).

Policy heterogeneity – implies that public policies often have heterogeneous context and design. Knoepfel et al (2011) argue that if implementation of public policy falls under several ministries, or several departments within one ministry, then policy context is heterogeneous. If policy is implemented by one unit at the same ministry, then it is homogeneous. They give defense policy as an example of homogeneous administrative context while policies dealing with natural disasters are heterogeneous (Knoepfel et al 2011, 186-187). Nevertheless, it is difficult to imagine completely homogeneous policy context – even in the case of defense policy different ministries are involved as stakeholders. For instance, the implementation of defense policy depends on taxation which means trade-offs have to be made among ministries and in society. Hence, it is a question of degree of heterogeneity and homogeneity. Most importantly, ICT policies have high degree of heterogeneity by administrative context as well as design. ICT is by nature horizontal dependent on physical infrastructure as well as humans skills in different administrative units and in society as well. Knoepfel et al (2011) approach seems also narrow considering nature of public policy implementation in general and ICT policies in particular. Even if policy context and design is homogeneous, then the impact of public policies can be heterogeneous. This may stem from unintended consequences, interactions of government regulations with informal rules as discussed under institutional complexity. It is similar to competitive heterogeneity affiliated by scholars such as Harold Demzets (1973) and Michael Porter (1980) in strategic management and industrial economics, which examines why industries do not converge on one single model of operations. In international economics policy heterogeneity is used to highlight regulatory differences between countries (Kox and Lejour 2005). However, there might be also regulatory differences within countries or among the group of countries such as EU, which formally have adopted same regulations. It is a fact of life that regulations may conflict with each other and may be implemented differently by policymakers.

APPENDIX B

OVERVIEW OF ESTONIA AND SLOVENIA

Estonia

Estonia per capita GDP was almost 20 000 in current US dollars in 2014 which is below the EU average of 36 000 dollars (World Bank 2015). In 1995 Estonian per capita GDP was 3000 in current US dollars. After the collapse of the Soviet Union in 1991, Estonia experienced rapid decline in the Gross Domestic Product (GDP) in combination with high levels of inflation. GDP in 1992 decreased by 14.2 percent and the annual rate of inflation was 1.076 percent. However, Estonia's economic misfortune turned around relatively quickly. By 1995 rapid GDP growth became characteristic to this economy. For instance, Estonia reached 11.7 percent growth in 1997. Since 1998, the inflation rate has been limited to single digits. Within a few years Estonia had oriented its economy to the Western markets to such a degree that even the 1998 financial crisis in Russia had relatively small consequences in Estonia – GDP dropped 0.3 percent in 1999 and the growth was restored to positive figures by 2000 (International Monetary Fund 2009). In retrospect, the Russian crisis and collapse of markets in the East helped to cool down an overheating economy and strengthen economic integration with Western markets. Most importantly, Estonia experienced some of the most spectacular GDP growth rates in Europe in the second half of the 1990s and early years of the decade. The rate of growth was more than seven percent for each year between 2000 and 2007, and indeed, reached 11.4 percent in 2007.

Estonia’s total GDP was 26 billion in current US dollars in 2014 while it was slightly over 4 billion US dollars in 1995 (World Bank 2015). Estonian labor productivity based on hours worked was slighlty over 60 percent of the EU average in 2013 (Eurostat 2015). However, it was only 41 percent of the EU average in 2000 which signals significant progress over the decade. Estonian population is 1.3 million people of whom 32 percent lives in rural areas (World Bank 2015). Estonia is one of the most attractive destinations for inward FDI in Europe as well as in the Central and Eastern Europe. Inward FDI to GDP ratio was 84.5 percent in 2012 (Eurostat 2015). Only Bulgaria with almost 94 percent had better outcome in the CEE.

Estonian general government debt to GDP ratio was 10.6 percent in 2014 while it was 3.7 percent in 2007. The increase was modest considering that Estonian GDP decreased cumulatively by almost 20 percent in 2008 and 2009 which made it the third-deepest recession in the EU (International Monetary Fund 2009). Estonian government pursued conservative fiscal policy throughout crisis and aimed to keep budget balanced. the government implemented contractionary economic policies in response to the current crisis. Throughout the economic depression, Estonia has remained a beacon of fiscal prudence, keeping the public sector debt at the lowest level in Europe and one of the lowest levels in the world. Estonia has not issued and does not issue government bonds, thereby essentially making this country the “Anti-Greece,” to use a term recently coined in a Financial Times editorial (Financial Times 2010). As Estonia is a small open economy and rapid credit expansion had boosted domestic consumption after entrance to the European Union (EU) in 2004, then it is not surprising that the country was hit hard by the recent financial crisis. Significant export markets disappeared and the domestic housing bubble deflated

The overall government budget surplus was 0.6 in 2014 while it was 1.8 percent in 2003 (Eurostat 2015). Even during severe recession in 2008 and 2009 government deficits did not reach 3 percent of GDP which is maximum allowed by the EU Maastricht criteria. Throughout the so-called boom years the government ran constant budget surpluses and built up emergency reserves, moves that also helped to respond to the crisis without any external assistance. Instead of external devaluation by changing the exchange rate of the Estonian kroon to the euro, the government kept the peg and opted for internal devaluation, resulting in wage cuts averaging twenty percent. Estonia joined the eurozone in 2011, when many experts started to question the viability of euro as a currency in the long run.

Slovenia

Slovenia became independent from Yugoslavia in 1991 and was the wealthiest of Central and Eastern European countries which joined the European Union in 2004. Slovenia's population is about 2 million and Slovenian make up roughly 80 percent of this population. Other ethnic groups include Serbs, Croats, Bosniaks and many others. 50 percent of population lives in rural areas. Population density is 101 inhabitants per square kilometer. Total area of country is 20,273 square kilometers. Slovenia per capita GDP was 24 000 in current US dollars in 2014 which is below the EU average of 36 000 dollars. In 1995, Slovenia's per capita GDP was almost 11 000 in current US dollars (World Bank 2015). This signals that Slovenia's transition from market socialism to market economy has been relatively gradual over the past decades without significant ups and downs.

Slovenia's total GDP was 49 billion in current US dollars in 2014 while it was 21 billion in 1995. Slovenia's labor productivity was 86 percent of the EU average in 2013 and it was 76 percent in 2000 (Eurostat 2015). Slovenia's general government debt to GDP ratio was 81 percent in 2014 while before the economic and financial crisis at 23 percent in 2007. In 2003 Slovenia's debt to GDP ratio was close 27 percent which indicates that government debt had been gradually reduced. This clearly indicates that Slovenia has suffered in the crisis and followed relatively loose fiscal policies by trying to stimulate economy by public sector spending. Furthermore, Slovenia's current debt level exceeds 60 percent allowed by the Maastricht Treaty. Slovenia joined the eurozone in 2007 and made a commitment to follow Maastricht criteria concerning government debt level and deficits.

However, Slovenian government has run excessive deficits since 2009 which have been significantly higher than 3 percent to GDP ratio allowed by Maastricht treaty. In 2014 Slovenia's public sector deficit was 5 percent and in 2013 15 percent. However, before the country joined the euro, the annual deficits stayed within 1-2 percent and never exceeded 3 percent (Eurostat 2015). Because of excessive macroeconomic imbalances, Slovenian economy has been under close scrutiny of the European Commission. In Spring 2015 EU Council warned that Slovenia's government macroeconomic policies do not meet the criteria of EU Stability and Growth Pact. It also sätted that Slovenia's business environment is constrained by excessive regulations which do not facilitate the growht and government has been slow in privitizing state assets such as state owned banks.

Constraints in the business environment of Slovenia are well demonstrated by looking at FDI statistics. Slovenia was one of the most attractive destinations for FDI in Central and Eastern Europe (CEE) in the late 1980s throughout the mid-1990s. However, according to the current FDI to Gross Domestic Product (GDP) ratio, Slovenia lags behind other countries in the region. Inward FDI to GDP ratio was 33.2 percent which is the worst outcome among the CEE countries who joined the EU in 2004 and 2007 (Eurostat 2015). One key difference with other CEE countries is that FDI in Slovenian telecom sector is nonexistent. Throughout the years, Slovenia has engaged in selective protection against certain types of FDI. Most inward FDI is directed into the manufacturing sector, including industrial output such as paper, paper products, machinery and equipment, rubber and plastic products, chemicals and chemical products, and motor vehicles (OECD 2002, 10). Most of these products play an important role in Slovenia's export structure. According to the Organization for Economic Cooperation and

Development (OECD), foreign investors were attracted to Slovenia because of individual companies rather than specific industries (OECD 2002, 10). In addition, FDI is concentrated on a small number of large multinational companies (MNEs) of European origin. This characteristic indicates that Slovenia has been well integrated with the economic clusters in Europe (Biegelbauer et al 2001).

APPENDIX C

LIST OF SEMISTRUCTURED INTERVIEWS

No	Position	Company	Date	Place	Method
1	Minister	government	Jan 6, 2003	Ljubljana	in person
2	high official	government	Jan 7, 2003	Ljubljana	In person
3	owner	IT company	Jan 7, 2003	Ljubljana	In person
4	official	parliament	Jan 8, 2003	Ljubljana	In person
5	researcher	University	Jan 8, 2003	Ljubljana	In person
6	activist	social movement	Jan 9, 2003	Ljubljana	In person
7	expert	ICT company	Jan 9, 2003	Ljubljana	In person
8	regulator	government	Jun 7, 2012	Ljubljana	In person
9	researcher	university	Jun 7, 2012	Ljubljana	In person
10	executive	telecom	Jun 7, 2012	Ljubljana	In person
11	professor	university	Jun 8, 2012	Maribor	In person
12	expert	university	Jun 6, 2012	Ljubljana	In person
13	owner	IT company	Jun 6, 2012	Ljubljana	In person
14	executive	ICT company	Dec 3, 2008	Tallinn	In person
15	journalist	TV	May 5, 2009	Tallinn	In person
16	official	government	May 7, 2009	Tallinn	In person
17	lobbyist	telecom	March 4, 2009	DC	In person
18	former banker	bank	Sept 25, 2011	Tallinn	In person
19	official	government	Dec 3, 2011	Tallinn	In person
20	high official	government	Dec 5, 2011	Tallinn	In person
21	CEO/owner	ICT company	September 4, 2012	Tallinn	In person
22	regulator	government	Sept 5, 2012	Tallinn	In person
22	Investor/owner	social network	September 7, 2012	Tallinn	In person
23	CEO/owner	ICT company	September 3, 2012	Tallinn	In person
24	CEO/owner	ICT company	Aug 23, 2012	Tallinn	In person
25	executive	government	Sept 20, 2013	Tallinn	In person
26	investor	ICT	August 13, 2013	Tallinn	In person
27	expert	university	August 8, 2013	Tallinn	In person
28	former banker	banking	August 21, 2013	Tallinn	In person
29	official	government	August 13, 2013	Tallinn	In person
30	former CEO	large ICT company	August 23 2013	Tallinn	In person

31	executive	telecom	August 29, 2013	Tallinn	In person
32	former banker	banking	August 21, 2013	Tallinn	In person
33	CEO/owner	IT company	August 17, 2012	Tartu	In person
34	former CEO/owner	social network	August 13, 2012	Tallinn	In person

APPENDIX D
DETAILED DATA FOR FIGURES

1.

Internet users (per 100 people)

Year	Estonia	Europe & Central Asia (all income levels)	European Union	Slovenia	World
1990		0.048	0.069		0.05
1991			0.172		
1992	0.065	0.262	0.31		
1993	0.301	0.317	0.434	0.41	0.254
1994	1.16	0.564	0.827	1.07	0.45
1995	2.779	1.022	1.582	2.9	0.781
1996	3.525	1.84	2.806	5.07	1.33
1997	5.706	3.355	5.119	7.59	2.047
1998	10.796	5.428	8.421	10.1	3.147
1999	14.501	9.227	14.574	12.61	4.641
2000	28.577	13.158	20.539	15.11	6.747
2001	31.527	16.38	25.287	30.18	8.069
2002	41.52	23.019	35.109	27.84	10.551
2003	45.32	28.324	41.792	31.85	12.245
2004	53.2	32.318	46.793	40.81	14.141
2005	61.45	35.187	50.933	46.81	15.775
2006	63.51	38.051	54.513	54.01	17.599
2007	66.19	43.652	60.253	56.74	20.58
2008	70.58	47.355	64.156	58	23.27
2009	72.5	50.745	67.189	64	25.842
2010	74.1	56.518	70.951	70	29.581
2011	76.5	60.283	73.17	69	32.623
2012	79	63.177	75.281	70	35.571

Source: United Nations

2.

Internet users (per 100 people)

Year	Bulgaria	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovak Republic	Slovenia
1991				0.003			0.005			
1992			0.065	0.048			0.052			
1993	0.002	0.58	0.301	0.193			0.13	0.004	0.13	0.41
1994	0.02	1.26	1.16	0.484			0.389	0.026	0.32	1.07
1995	0.12	1.45	2.779	0.677			0.648	0.075	0.52	2.9
1996	0.725	1.94	3.525	0.969	0.813	0.28	1.295	0.222	0.78	5.07
1997	1.22	2.92	5.706	1.942	2.053	0.98	2.073	0.445	1.17	7.59
1998	1.845	3.9	10.796	3.895	3.315	1.97	4.102	2.238	2.69	10.1
1999	2.908	6.83	14.501	5.858	4.387	2.92	5.456	2.698	5.44	12.61
2000	5.371	9.78	28.577	7	6.319	6.43	7.285	3.614	9.43	15.11
2001	7.612	14.7	31.527	14.529	7.219	7.18	9.901	4.539	12.53	30.18
2002	9.08	23.93	41.52	16.67	21.94	17.69	21.15	6.58	40.14	27.84
2003	12.04	34.3	45.32	21.63	26.98	25.91	24.87	8.9	43.04	31.85
2004	18.13	35.5	53.2	27.74	38.58	31.23	32.53	15	52.89	40.81
2005	19.97	35.27	61.45	38.97	46	36.22	38.81	21.5	55.19	46.81
2006	27.09	47.93	63.51	47.06	53.63	43.9	44.58	24.66	56.08	54.01
2007	33.64	51.93	66.19	53.3	59.17	49.9	48.6	28.3	61.8	56.74
2008	39.67	62.97	70.58	61	63.41	55.22	53.13	32.42	66.05	58
2009	45	64.43	72.5	62	66.84	59.76	58.97	36.6	70	64
2010	46.23	68.82	74.1	65	68.42	62.12	62.32	39.93	75.71	70
2011	51	72.97	76.5	70	71.68	65.05	64.88	44.02	74.44	69
2012	55.148	75	79	72	74	68	65	50	80	70

Source: United Nations

3.

Households with Internet access at home

Units: % of households with at least one member aged 16 to 74

Year	Bulgaria	Czech Republic	Estonia	European Union (27 countries)	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia
2002						3	4	11			
2003		15					6	14			
2004	10	19	31	41	14	15	12	26	6	23	47
2005		19	39	48	22	31	16	30		23	48
2006	17	29	46	49	32	42	35	36	14	27	54
2007	19	35	53	55	38	51	44	41	22	46	58
2008	25	46	58	60	48	53	51	48	30	58	59
2009	30	54	63	66	55	58	60	59	38	62	64
2010	33	61	68	70	60	60	61	63	42	67	68
2011	45	67	71	73	65	64	60	67	47	71	73
2012	51	65	75	76	69	69	60	70	54	75	74
2013	54	73	80	79	71	72	65	72	58	78	76

Source: Eurostat

4.

Households with broadband access

Units: Percentage of households with Internet access at home

Year	Bulgaria	Czech Republic	Estonia	European Union (27 countries)	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia
2003		10					27				
2004	39	23	66	33	41	37	32	32		15	22
2005		27	77	48	49	46	73	51		31	40
2006	59	57	80	62	68	53	56	60	37	43	62
2007	81	80	90	77	86	63	77	72	36	57	76
2008	82	79	94	80	87	75	84	80	45	61	84
2009	88	90	98	86	93	87	83	87	62	67	88
2010	79	89	95	87	86	88	88	90	54	73	91
2011	88	95	94	92	93	93	93	92	65	78	92
2012	100	96	99	95	99	98	99	95	94	96	99
2013	100	96	99	97	99	98	99	96	97	90	98

Source: Eurostat

5.

Enterprises with fixed broadband access

Units: % of enterprises with at least 10 persons employed in the given NACE sectors. NACE Rev 2 since 2009 (break in series in 2009)

Year	Bulgaria	Czech Republic	Estonia	European Union (27 countries)	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia
2003		20									
2004	28	38	68	46		45	50	28	7	25	62
2005	32	52	67	62	48	48	57	43		48	74
2006	57	69	76	73	61	59	57	46	31	61	75
2007	61	77	78	77	70	57	53	53	37	76	79
2008	62	79	88	81	72	62	56	59	44	79	84
2009	68	77	86	82	74	61	57	58	40	78	85
2010	61	85	87	84	78	66	78	66	49	71	85
2011	68	87	90	87	84	82	87	73	54	76	92
2012	76	91	94	90	85	86	95	77		90	97
2013	78	95	94	90	85	91	96	77	61	87	96

Source: Eurostat

6.

Individuals regularly using the internet

Units: % of individuals aged 16 to 74

	Females, 16 to 74 years old		Males, 16 to 74 years old	
Year	**Estonia**	**Slovenia**	**Estonia**	**Slovenia**
2004	44	31	45	36
2005	50	39	55	42
2006	55	42	56	51
2007	59	48	58	50
2008	62	51	61	53
2009	68	57	65	59
2010	71	62	70	67
2011	73	61	72	68
2012	74	62	75	68
2013	77	66	77	71
2014	81	68	82	68

Source: Eurostat

7.

Individuals regularly using the internet

Units: % of individuals aged 16 to 74

	Individuals aged 25 to 54 with low formal education		Individuals aged 55 to 74 with low formal education		Individuals, 65 to 74 years old	
Year	**Estonia**	**Slovenia**	**Estonia**	**Slovenia**	**Estonia**	**Slovenia**
2004	25		0		7	
2005				0		
2006	30	11		1		5
2007	38	15		2	11	6
2008	43	18		3	15	4
2009	51	32	6	2	12	6
2010	65	36	13	1	20	11
2011	64	30	11	4	21	12
2012	60	35	10	4	24	15
2013	68	34	13	9	29	22
2014	81	39	21	10	41	21

Source: Eurostat

8.

Households with Internet access at home

Units: % of households with at least one member aged 16 to 74

Year	Estonia		European Union (27 countries)		Slovenia	
	Households living in densely-populated area (at least 500 inhabitants/Km2)	Households living in sparsely populated area (less than 100 inhabitants/Km2)	Households living in densely-populated area (at least 500 inhabitants/Km2)	Households living in sparsely populated area (less than 100 inhabitants/Km2)	Households living in densely-populated area (at least 500 inhabitants/Km2)	Households living in sparsely populated area (less than 100 inhabitants/Km2)
2004	41	26	46	31	44	43
2005	45	32	52	40	53	45
2006	52	39	53	40	65	51
2007	58	47	59	45	62	53
2008	62	54	65	51	62	56
2009	70	56	70	57	68	60
2010	71	64	74	60	68	63
2011	76	66	77	65	75	71
2012	81	69	80	68	79	69

Source: Eurostat

9.

Households with Internet access at home

Units: % of households with at least one member aged 16 to 74

Year	Estonia				Slovenia			
	Number of households with income in first quartile	Number of households with income in fourth quartile	Number of households with income in second quartile	Number of households with income in third quartile	Number of households with income in first quartile	Number of households with income in fourth quartile	Number of households with income in second quartile	Number of households with income in third quartile
2005						78	34	58
2006					18	82	43	67
2007					26	86	51	70
2008	24	86	61	78	23	91	39	67
2009	32	93	61	80	31	90	49	74
2010	41	94	69	83	29	96	57	81
2011	46	91	72	88	41	98	70	86
2012	46	96	72	89	37	97	68	87
2013	56	89	84	92	41	99	74	87

Source: Eurostat

10.

Broadband penetration rate

Information society indicator: Broadband penetration rate (%)

Month	Bulgaria	Czech Republic	Estonia	European Union (27 countries)	Hungary	Latvia	Lithuania	Poland	Slovakia	Slovenia
Jul 2004		0.7	7.6		2.2	1.5	2.5	0.5	0.4	3.8
Oct 2004		1.1	8.6		2.9	2.4	3.1	1.6	0.6	5.3
Jan 2005		1.6	10.3		3.6	2.4	3.7	3.3	1	5.9
Jul 2005		4.3	11.1		4.5	3.7	5	1.9	1.5	7.8
Jan 2006		6.3	13.3		6.2	5.7	6.9	2.7	2.6	9.8
Jul 2006		8.4	16.6		7.5	6.8	8.4	3.9	4	11.4
Jan 2007	4.5	10.6	18.4	16.2	9.9	10.6	10.6	5.2	5.2	13.9
Jul 2007	5.7	12.2	20	18.2	11.6	11.6	12.7	6.8	6.9	15.3
Jan 2008	7.6	14.6	22.2	20.2	14.2	15	15	8.4	8.8	17.3
Jul 2008	9.5	15.8	23.6	21.7	15.7	16.3	16.1	9.6	9.6	19.1
Jan 2009	11.2	16.9	24.6	22.7	16.4	17.5	17.6	11.7	10.9	21
Jul 2009	11.9	17.8	26.3	23.9	17.2	17.5	18.2	12.8	14.3	22.1
Jan 2010	13	19.1	26	24.7	18.8	19.4	19	13.5	14.8	22.7
Jul 2010	13.9	20.4	26	25.7	19.7	18.8	19.6	14.9	15.5	23.6
Jan 2011	15	21.5	26.7	26.5	20.6	19.5	21.1	16	16.4	24.1

Source: Eurostat

11

Mobile broadband - coverage

Information society indicator: MBB_3GCOV **Units:** Percentage of total population

Year	Estonia	European Union (27 countries)	Slovenia
2008	62	74.4	74
2009	77	82	76.5
2010	90	89.9	80

Source: Eurostat

12

Mobile broadband - coverage

Information society indicator: Advanced 3G mobile broadband coverage (from 2011) **Unit of measure:** Percentage of households

Year	Estonia	European Union (27 countries)	Slovenia
2011	87	94.7	95.6
2012	87	96.3	96.2
2013	99.9	97.1	99.1

Source: Eurostat

13.

Global broadband performance

Units: Kilobits per second

	Estonia		Slovenia	
Month	**Download speed**	**Upload speed**	**Download speed**	**Upload speed**
Jan 2008	3 526.703	953.778	4 213.077	2 066.966
Feb 2008	3 048.97	704.629	4 608.024	2 337.749
Mar 2008	3 737.343	935.371	5 081.735	2 497.089
Apr 2008	3 779.141	974.99	5 122.929	2 558.458
May 2008	3 987.27	1 090.521	5 335.159	2 572.331
Jun 2008	4 008.82	945.228	5 747.981	2 773.871
Jul 2008	3 831.598	982.7	6 181.419	2 894.663
Aug 2008	3 938.325	1 028.579	6 086.811	2 978.15
Sep 2008	4 922.327	1 745.782	6 403.448	3 108.241
Oct 2008	5 827.482	2 102.072	6 742.813	3 304.87
Nov 2008	5 646.662	1 824.164	6 375.46	3 098.726
Dec 2008	5 909.1	1 849.769	6 471.653	3 156.132
Jan 2009	5 465.732	1 717.982	5 945.276	2 865.884
Feb 2009	6 099.581	2 003.295	6 155.706	2 858.287
Mar 2009	6 042.354	1 898.083	6 257.484	2 828.788
Apr 2009	6 530.399	2 076.451	6 851.744	3 125.984
May 2009	6 587.683	2 058.713	7 060.535	3 111.113
Jun 2009	6 008.659	1 862.771	7 085.82	3 384.86
Jul 2009	5 724.511	1 879.226	6 781.935	3 230.374
Aug 2009	6 039.724	1 917.016	7 048.353	3 671.465
Sep 2009	6 879.451	2 046.887	8 174.214	4 128.053
Oct 2009	9 166.014	2 956.037	8 053.375	4 247.091
Nov 2009	11 248.98	3 830.198	7 718.501	3 829.808
Dec 2009	11 364.408	3 910.471	7 789.351	3 560.926
Jan 2010	10 772.818	3 889.867	7 481.479	3 489.977
Feb 2010	10 847.182	3 798.896	7 410.915	3 478.302
Mar 2010	10 308.092	3 506.681	7 633.361	3 399.593
Apr 2010	10 511.64	3 463.21	7 703.557	3 583.651
May 2010	11 703.205	3 543.243	7 564.339	3 778.012
Jun 2010	9 360.294	2 844.097	7 525.336	4 085.856
Jul 2010	8 323.59	2 543.02	7 784.595	2 937.442
Aug 2010	7 711.93	2 426.299	7 742.989	1 637.488
Sep 2010	10 244.832	2 632.507	7 334.18	2 755.753
Oct 2010	12 006.87	3 088.588	7 504.163	3 484.077
Nov 2010	13 384.64	3 042.387	7 370.222	3 150.112
Dec 2010	12 904.113	3 210.929	7 360.221	3 254.451
Jan 2011	11 997.776	3 415.081	7 670.578	3 800.905
Feb 2011	14 078.762	4 035.865	8 125.581	3 962.672
Mar 2011	14 435.054	4 159.314	8 797.227	4 335.023
Apr 2011	13 157.787	4 016.239	8 303.653	4 292.876
May 2011	12 903.708	4 447.527	8 007.848	4 079.352
Jun 2011	11 758.266	4 141.315	7 199.595	3 382.916
Jul 2011	9 505.621	3 380.875	7 287.301	3 302.972
Aug 2011	9 364.425	3 242.619	7 895.805	3 926.433
Sep 2011	11 626.119	4 298.628	8 268.089	4 462.16
Oct 2011	13 669.82	5 517.858	8 685.833	4 671.134
Nov 2011	17 268.459	6 235.43	9 399.145	4 686.844
Dec 2011	31 895.103	14 986.154	9 583.524	4 836.748
Jan 2012	45 052.778	24 274.871	9 818.072	4 834.858
Feb 2012	33 458.553	17 714.355	10 091.987	5 006.954
Mar 2012	14 616.202	5 077.325	10 188.005	5 222.539
Apr 2012	14 329.038	4 858.352	10 286.886	5 370.061
May 2012	15 321.633	5 397.788	10 440.196	5 091.429
Jun 2012	14 769.928	5 136.19	11 235.579	5 413.89
Jul 2012	13 753.139	4 632.814	11 819.478	5 162.435
Aug 2012	13 741.53	4 558.171	11 690.726	5 234.73
Sep 2012	15 172.97	5 448.883	11 314.818	5 169.708
Oct 2012	16 458.853	5 722.639	11 651.733	5 258.43
Nov 2012	17 044.083	6 026.182	11 397.59	5 198.126
Dec 2012	17 021.71	6 556.214	11 841.341	5 456.581
Jan 2013	16 492.029	5 862.968	11 598.691	5 221.04
Feb 2013	17 415.213	6 410.199	11 610.431	5 251.056
Mar 2013	17 357.912	6 388.868	11 977.634	5 623.453
Apr 2013	17 641.274	6 393.234	12 391.459	5 964.251
May 2013	18 035.033	6 756.24	12 924.835	6 285.938
Jun 2013	17 421.989	6 383.754	13 632.428	6 283.068
Jul 2013	16 265.786	5 884.457	13 939.243	6 097.248
Aug 2013	18 410.391	6 207.602	13 658.909	5 920.688
Sep 2013	25 492.581	8 626.936	14 464.251	6 071.058
Oct 2013	24 010.388	9 380.237	14 906.038	6 431.129
Nov 2013	22 575.074	9 301.012	14 792.243	6 467.338
Dec 2013	24 359.962	11 511.279	14 656.712	6 383.143
Jan 2014	23 921.706	13 047.143	14 250.848	5 946.656
Feb 2014	24 123.026	13 152.091	14 528.215	5 977.323
Mar 2014	24 071.199	12 976.984	14 641.31	6 000.379

Source: Ookla

14.

GDP per capita, PPP (constant 2005 international $)

Units: Constant 2005 international $

Year	Estonia	European Union	OECD members	Slovenia
1993	7 427.316	20 382.639	23 354.054	14 621.062
1994	7 463.241	20 936.045	23 905.443	15 417.824
1995	7 938.073	21 502.077	24 345.448	15 975.982
1996	8 530.55	21 920.024	24 925.354	16 569.1
1997	9 641.097	22 514.297	25 651.347	17 413.884
1998	10 397.018	23 142.158	26 158.341	18 065.328
1999	10 410.392	23 767.738	26 844.264	19 013.832
2000	11 430.479	24 652.5	27 736.588	19 766.263
2001	12 200.093	25 124.664	27 879.972	20 315.297
2002	13 057.53	25 398.983	28 135.077	21 066.612
2003	14 132.918	25 706.927	28 530.764	21 670.804
2004	15 089.323	26 301.789	29 276.364	22 610.22
2005	16 485.087	26 795.459	29 890.823	23 475.573
2006	18 219.704	27 638.767	30 606.391	24 769.631
2007	19 638.818	28 454.816	31 204.807	26 323.734
2008	18 852.557	28 517.447	31 044.245	27 225.48
2009	16 216.027	27 152.761	29 747.895	24 819.944
2010	16 652.009	27 620.22	30 442.227	25 052.856
2011	18 270.094	28 001.589	30 816.518	25 175.873
2012	19 070.406	27 998.494	31 185.536	24 494.977

Source: World Bank

15.

GDP per capita, PPP (constant 2005 international $)

Units: Constant 2005 international $

Year	Bulgaria	Czech Republic	Estonia	Hungary	Latvia	Lithuania	Poland	Romania	Slovenia
1993	6 475.911	14 401.191	7 427.316	11 158.44	5 920.836	7 809.478	8 017.22	6 426.057	14 621.062
1994	6 616.073	14 814.814	7 463.241	11 503.031	6 152.624	7 095.876	8 423.76	6 690.906	15 417.824
1995	6 835.684	15 746.155	7 938.073	11 690.636	6 182.015	7 385.969	8 997.15	7 184.489	15 975.982
1996	6 250.571	16 480.149	8 530.55	11 729.575	6 489.05	7 828.054	9 551.21	7 494.07	16 569.1
1997	6 185.257	16 357.269	9 641.097	12 120.774	7 096.913	8 475.044	10 221.34	7 057.011	17 413.884
1998	6 529.37	16 334.138	10 397.018	12 643.894	7 502.494	9 187.909	10 726.69	6 732.968	18 065.328
1999	6 695.047	16 625.414	10 410.392	13 085.22	7 919.241	9 154.019	11 212.92	6 662.623	19 013.832
2000	7 111.702	17 369.935	11 430.479	13 673.575	8 548.779	9 518.306	11 753.35	6 811.349	19 766.263
2001	7 548.886	17 975.353	12 200.093	14 213.732	9 356.46	10 243.492	11 958.98	7 299.382	20 315.297
2002	8 056.177	18 397.151	13 057.53	14 896.576	10 078.477	11 034.785	12 137.23	7 808.424	21 066.612
2003	8 548.057	19 095.485	14 132.918	15 514.532	10 908.632	12 264.705	12 615.11	8 270.329	21 670.804
2004	9 170.471	19 995.019	15 089.323	16 294.837	11 985.347	13 314.946	13 297.14	9 076.562	22 610.22
2005	9 809.398	21 315.667	16 485.087	16 974.56	13 399.92	14 589.46	13 784.16	9 524.461	23 475.573
2006	10 502.48	22 750.418	18 219.704	17 663.569	15 177.748	15 987.167	14 651.85	10 416.162	24 769.631
2007	11 402.241	23 915.221	19 638.818	17 711.246	16 828.919	17 770.124	15 654.52	11 232.898	26 323.734
2008	12 194.476	24 452.697	18 852.557	17 900.928	16 285.024	18 479.419	16 454.81	12 319.586	27 225.48
2009	11 598.265	23 217.923	16 216.027	16 709.776	13 583.475	15 931.148	16 706.76	11 578.061	24 819.944
2010	11 721.565	23 722.028	16 652.009	16 958.295	13 821.51	16 485.148	17 372.27	11 537.592	25 052.856
2011	12 009.314	24 103.555	18 270.094	17 278.519	14 821.472	17 873.397	17 980.78	11 862.189	25 175.873
2012	12 175.709	23 824.069	19 070.406	17 072.727	15 756.779	18 784.976	18 306.9	11 946.123	24 494.977

Source: World Bank

16.

Gini coefficient of equivalised disposable income

Year	Estonia	European Union (27 countries)	New Member States (12 countries)	Slovenia
2000	36			22
2001	35			22
2002	35			22
2003	34			22
2004	37.4		37.4	
2005	34.1	30.6	33.2	23.8
2006	33.1	30.3	33	23.7
2007	33.4	30.6	31.8	23.2
2008	30.9	30.9	31.3	23.4
2009	31.4	30.5	30.7	22.7
2010	31.3	30.5	30.2	23.8
2011	31.9	30.8	30.5	23.8
2012	32.5	30.6	30.3	23.7

Source: Eurostat

17.

Internet users (per 100 people)

Year	Armenia	Azerbaijan	Belarus	Estonia	Georgia	Kazakhstan	Kyrgyz Republic	Latvia	Lithuania	Moldova	Russian Federation	Tajikistan	Turkmenistan	Ukraine	Uzbekistan
1992				0.065							0.001				
1993				0.301							0.013			0.001	
1994	0.009	0.001	0	1.16		0.001				0.001	0.054			0.014	
1995	0.053	0.002	0.003	2.779	0.01	0.011				0.003	0.148			0.043	0.002
1996	0.095	0.006	0.029	3.525	0.04	0.032		0.813	0.28	0.005	0.27			0.099	0.004
1997	0.112	0.025	0.049	5.706	0.06	0.065		2.053	0.98	0.028	0.473			0.199	0.011
1998	0.129	0.037	0.074	10.796	0.1	0.131	0.073	3.315	1.97	0.261	0.813			0.301	0.021
1999	0.971	0.099	0.495	14.501	0.42	0.464	0.205	4.387	2.92	0.601	1.019	0.03	0.045	0.405	0.031
2000	1.3	0.148	1.86	28.577	0.48	0.669	1.041	6.319	6.43	1.283	1.977	0.05	0.133	0.716	0.484
2001	1.631	0.306	4.301	31.527	0.99	1.006	3.003	7.219	7.18	1.488	2.944	0.05	0.175	1.239	0.598
2002	1.96	5	8.951	41.52	1.59	1.675	2.999	21.94	17.69	3.787	4.128	0.06	0.302	1.874	1.082
2003	4.575			45.32	2.56	2	3.909	26.98	25.91	7.408	8.299	0.06	0.425	3.148	1.913
2004	4.899			53.2	3.89	2.65	5.09	38.58	31.23	10.629	12.859	0.08	0.754	3.489	2.594
2005	5.253	8.03		61.45	6.08	2.962	10.534	46	36.22	14.63	15.227	0.3	0.997	3.75	3.344
2006	5.632	11.992	16.2	63.51	7.53	3.268	12.307	53.63	43.9	19.621	18.023	3.77	1.32	4.506	6.388
2007	6.021	14.54	19.7	66.19	8.26	4.02	14.03	59.17	49.9	20.45	24.66	7.2	1.406	6.55	7.491
2008	6.21	17.08	23	70.58	10.01	11	15.7	63.41	55.22	23.39	26.83	8.78	1.75	11	9.08
2009	15.3	27.4	27.43	72.5	20.07	18.2	17	66.84	59.76	27.5	29	10.07	1.95	17.9	17.058
2010	25	46	31.8	74.1	26.9	31.6	18.4	68.42	62.12	32.3	43	11.55	3	23.3	20
2011	32	50	39.6	76.5	36.56	50.6	20	71.68	65.05	38	49	13.03	5	28.708	30.2
2012	39.161	54.2	46.906	79	45.5	53.316	21.724	74	68	43.37	53.275	14.51	7.196	33.7	36.521

Source: United Nations

18.

Internet users (per 100 people)

Year	Denmark	Estonia	Finland	High income	High income: nonOECD	High income: OECD	Norway	OECD members	Sweden	Upper middle income
1990	0.1		0.4	0.231		0.287	0.71	0.247	0.58	
1991	0.19		1.4	0.467		0.48	1.41	0.434	1.16	
1992	0.39	0.065	1.89	0.627	0.065	0.738	2.22	0.668	1.5	
1993	0.58	0.301	2.57	0.875	0.124	1.024	2.78	0.882	1.72	0.01
1994	1.34	1.16	4.92	1.756	0.251	2.066	4.15	1.778	3.41	0.022
1995	3.83	2.779	13.9	3.238	0.383	3.899	6.42	3.35	5.1	0.05
1996	5.71	3.525	16.78	5.91	0.802	7.134	18.25	6.123	9.04	0.119
1997	11.38	5.706	19.46	9.333	1.806	11.135	20.42	9.583	23.73	0.253
1998	22.67	10.796	25.45	14.035	3.08	16.649	22.56	14.346	33.47	0.614
1999	30.59	14.501	32.3	20.265	4.623	23.986	40	20.72	41.43	1.322
2000	39.17	28.577	37.25	27.273	6.861	32.112	52	27.967	45.69	2.575
2001	42.96	31.527	43.11	32.746	9.228	38.3	64	33.506	51.77	3.708
2002	64.25	41.52	62.43	40.349	12.295	47.085	72.84	41.624	70.57	6.126
2003	76.26	45.32	69.22	45.047	16.501	51.88	78.13	45.832	79.13	7.881
2004	80.93	53.2	72.39	50.184	20.528	57.268	77.69	50.636	83.89	9.757
2005	82.74	61.45	74.48	53.784	23.194	60.942	81.99	54.243	84.83	11.356
2006	86.65	63.51	79.66	56.492	27.126	63.37	82.55	56.694	87.76	13.879
2007	85.03	66.19	80.78	62.054	33.521	68.753	86.93	61.968	82.01	18.418
2008	85.02	70.58	83.67	64.14	36.508	70.649	90.57	64.007	90	23.272
2009	86.84	72.5	82.49	65.509	39.3	71.7	92.08	65.405	91	28.369
2010	88.72	74.1	86.89	69.685	49.094	74.557	93.39	68.431	90	33.241
2011	90	76.5	89.37	72.708	54.546	77.009	93.97	71.052	94	37.425
2012	93	79	91	75.333	59.072	79.181	95	73.302	94	41.506

Source: United Nations

19.

Broadband and connectivity - households

Geopolitical entity (reporting): Estonia **Units:** Percentage of households

	Household Internet connection type: broadband			Households with Internet access			Households without access to Internet at home, because the access costs are too high (telephone, etc.)		
Year	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children
2004	20	29	12	31	46	17			
2005	30		25	39		32	36	32	38
2006	37		29	46	69	37	34		42
2007	48	71	39	53	78	44			
2008	54	81	44	58	87	47	21		27
2009	62	89	52	63	90	52			
2010	64	87	56	68	92	59	17		
2011	66	87	59	71	93	63	17	4	21
2012	74	95	67	75	96	67	14		18
2013	79	97	72	80	98	74	11		14

Source: Eurostat

20.

Broadband and connectivity - households

Geopolitical entity (reporting): Estonia **Units:** Percentage of households

	Household Internet connection type: broadband			Households with Internet access			Households without access to Internet at home, because the equipment costs are too high		
Year	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children
2004	20	29	12	31	46	17			
2005	30		25	39		32	39	33	41
2006	37		29	46	69	37	37		43
2007	48	71	39	53	78	44			
2008	54	81	44	58	87	47	24		30
2009	62	89	52	63	90	52			
2010	64	87	56	68	92	59	19		24
2011	66	87	59	71	93	63	19	5	23
2012	74	95	67	75	96	67	16	3	21
2013	79	97	72	80	98	74	12		17

Source: Eurostat

21.

Individuals using the Internet for Internet banking

Individual type: All Individuals **Units:** % of individuals aged 16 to 74

Year	Bulgaria	Czech Republic	Estonia	European Union (27 countries)	Hungary	Latvia	Lithuania	Poland	Romania	Slovakia	Slovenia
2003		3					3				
2004	1	5	35	16	3	12	7	4	0	10	9
2005		5	45	19	6	16	10	6		10	12
2006	1	10	48	21	8	22	15	9	1	13	16
2007	2	12	53	25	12	28	21	13	2	15	19
2008	2	14	55	29	13	39	27	17	2	24	21
2009	2	18	62	33	16	42	32	21	2	26	24
2010	2	23	65	36	19	47	37	25	3	33	29
2011	3	30	68	37	21	53	40	27	4	34	31
2012	4	34	68	40	26	47	43	32	3	40	28
2013	5	41	73	42	26	55	46	32	4	39	32

Source: Eurostat

22.

Broadband and connectivity - households

Geopolitical entity (reporting): Estonia **Units:** Percentage of households

Year	Household Internet connection type: broadband			Households with Internet access			Households without access to Internet at home, because access not needed (content is not useful, not interesting, etc.)	
	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children	Total	All types without dependent children
2004	20	29	12	31	46	17		
2005	30		25	39		32	28	36
2006	37		29	46	69	37	29	37
2007	48	71	39	53	78	44		
2008	54	81	44	58	87	47	20	27
2009	62	89	52	63	90	52		
2010	64	87	56	68	92	59	13	
2011	66	87	59	71	93	63	15	20
2012	74	95	67	75	96	67	15	20
2013	79	97	72	80	98	74	11	15

Source: Eurostat

23.

Broadband and connectivity - households

Geopolitical entity (reporting): Estonia **Units:** Percentage of households

Year	Household Internet connection type: broadband			Households with Internet access			Households without access to Internet at home, because of lack of skills		Households without access to Internet at home, because of privacy or security concerns	
	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children	Total	All types without dependent children	Total	All types without dependent children
2004	20	29	12	31	46	17				
2005	30		25	39		32	26	31	2	
2006	37		29	46	69	37	31	38	3	
2007	48	71	39	53	78	44				
2008	54	81	44	58	87	47	26	34	2	
2009	62	89	52	63	90	52				
2010	64	87	56	68	92	59	19	26	2	
2011	66	87	59	71	93	63	19	25	2	3
2012	74	95	67	75	96	67	17	23	2	3
2013	79	97	72	80	98	74	14	19	2	3

Source: Eurostat

24

Internet users (per 100 people)

Year	Austria	Croatia	Germany	High income	High income: nonOECD	High income: OECD	Italy	OECD members	Slovenia	Switzerland	Upper middle income
1990	0.13		0.126	0.231		0.287	0.018	0.247		0.6	
1991	0.259		0.25	0.467		0.48	0.035	0.434		1.2	
1992	0.643		0.435	0.627	0.065	0.738	0.07	0.668		1.8	
1993	0.765	0.097	0.464	0.875	0.124	1.024	0.122	0.882	0.41	2.2	0.01
1994	1.393	0.268	0.923	1.756	0.251	2.066	0.192	1.778	1.07	2.7	0.022
1995	1.89	0.514	1.838	3.238	0.383	3.899	0.524	3.35	2.9	3.6	0.05
1996	6.909	0.859	3.055	5.91	0.802	7.134	1.023	6.123	5.07	4.5	0.119
1997	9.534	1.73	6.711	9.333	1.806	11.135	2.277	9.583	7.59	15.1	0.253
1998	15.421	3.273	9.878	14.035	3.08	16.649	4.559	14.346	10.1	24.8	0.614
1999	23.044	4.405	20.846	20.265	4.623	23.986	14.378	20.72	12.61	34	1.322
2000	33.73	6.645	30.216	27.273	6.861	32.112	23.111	27.967	15.11	47.1	2.575
2001	39.185	11.559	31.651	32.746	9.228	38.3	27.222	33.506	30.18	55.1	3.708
2002	36.56	17.76	48.82	40.349	12.295	47.085	28.04	41.624	27.84	61.4	6.126
2003	42.7	22.75	55.9	45.047	16.501	51.88	29.04	45.832	31.85	65.1	7.881
2004	54.28	30.91	64.73	50.184	20.528	57.268	33.24	50.636	40.81	67.8	9.757
2005	58	33.14	68.71	53.784	23.194	60.942	35	54.243	46.81	70.1	11.356
2006	63.6	37.98	72.16	56.492	27.126	63.37	37.99	56.694	54.01	75.7	13.879
2007	69.37	41.44	75.16	62.054	33.521	68.753	40.79	61.968	56.74	77.2	18.418
2008	72.87	44.24	78	64.14	36.508	70.649	44.53	64.007	58	79.2	23.272
2009	73.45	50.58	79	65.509	39.3	71.7	48.83	65.405	64	81.3	28.369
2010	75.17	56.55	82	69.685	49.094	74.557	53.68	68.431	70	83.9	33.241
2011	79.8	59.64	83	72.708	54.546	77.009	56.8	71.052	69	85.2	37.425
2012	81	63	84	75.333	59.072	79.181	58	73.302	70	85.2	41.506

Source: United Nations

25.

Broadband and connectivity - households

Geopolitical entity (reporting): Slovenia **Units:** Percentage of households

	Household Internet connection type: broadband			Households with Internet access			Households without access to Internet at home, because the access costs are too high (telephone, etc.)		
Year	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children
2004	10	15		47		28			
2005	19			48			19		
2006	34	50	28	54	75	47	17	10	19
2007	44	57	37	58	77	48			
2008	50	73	41	59	85	50	13	4	17
2009	56	78	48	64	85	56			
2010	62	84	53	68	92	59	13	3	17
2011	67	87	60	73	93	65	14		17
2012	73	94	66	74	95	66	12		16
2013	74	94	67	76	96	69	12		16

Source: Eurostat

27.

Broadband and connectivity - households

Geopolitical entity (reporting): Slovenia **Units:** Percentage of households

Year	Household Internet connection type: broadband			Households with Internet access			Households without access to Internet at home, because the equipment costs are too high		
	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children
2004	10	15		47		28			
2005	19			48			21		
2006	34	50	28	54	75	47	17	9	20
2007	44	57	37	58	77	48			
2008	50	73	41	59	85	50	14	4	18
2009	56	78	48	64	85	56			
2010	62	84	53	68	92	59	14	3	18
2011	67	87	60	73	93	65	13		17
2012	73	94	66	74	95	66	14		18
2013	74	94	67	76	96	69	13		16

Source: Eurostat

28.

Broadband and connectivity - households

Geopolitical entity (reporting): Slovenia **Units:** Percentage of households

Year	Household Internet connection type: broadband			Households with Internet access			Households without access to Internet at home, because access not needed (content is not useful, not interesting, etc.)		
	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children	Total	All types with dependent children	All types without dependent children
2004	10	15		47		28			
2005	19			48			29		37
2006	34	50	28	54	75	47	28	11	34
2007	44	57	37	58	77	48			
2008	50	73	41	59	85	50	25	6	32
2009	56	78	48	64	85	56			
2010	62	84	53	68	92	59	21	2	28
2011	67	87	60	73	93	65	17		22
2012	73	94	66	74	95	66	18		24
2013	74	94	67	76	96	69	19		25

Source: Eurostat

29.

Broadband and connectivity - households

Geopolitical entity (reporting): Slovenia **Units:** Percentage of households

	Household Internet connection type: broadband			Households with Internet access			Households without access to Internet at home, because of lack of skills			Households without access to Internet at home, because of privacy or security concerns		
Year	**Total**	**All types with dependent children**	**All types without dependent children**	**Total**	**All types with dependent children**	**All types without dependent children**	**Total**	**All types with dependent children**	**All types without dependent children**	**Total**	**All types with dependent children**	**All types without dependent children**
2004	10	15		47		28						
2005	19			48			22					
2006	34	50	28	54	75	47	16	4	21	4	1	4
2007	44	57	37	58	77	48						
2008	50	73	41	59	85	50	16	3	21	4	1	5
2009	56	78	48	64	85	56						
2010	62	84	53	68	92	59	18	2	25	5	1	6
2011	67	87	60	73	93	65	17		23	7		9
2012	73	94	66	74	95	66	15		20	7		10
2013	74	94	67	76	96	69	15		21	6		8

Source: Eurostat

APPENDIX E

NETWORK ANALYSIS

Network analysis of EstVCA full members on May 7, 2013, with following 15 urls:

http://www.arengufond.ee
http://www.asi.ee
http://www.baltcap.ee
http://www.cresco.ee
http://www.danskecapital.ee
http://www.essentiacapital.com
http://www.estban.ee
http://www.estvca.ee
http://www.masainvest.com
http://www.mtvp.ee
http://www.pioneer.ee
http://www.redgatecapital.eu
http://www.smartcap.ee
http://www.swedbank.ee/private/investor/funds/funds/hai
http://www.unitedpartners.ee

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