THE ROLE OF ICT AND HIGH-GROWTH FIRMS: MICRO-LEVEL EVIDENCE ON JOB CREATION AND PRODUCTIVITY GROWTH

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ABSTRACT

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Abstract

In this thesis are analyzed high-growth firms' and information and communication technology's (ICT) contribution to job creation and labor productivity. Economic development has been weak in Finland for the last decade because of global financial crisis. Unemployment has risen to a high level and labor productivity growth has slowed down, and eventually stopped. In addition, there's been public discussion about job creation in Finland. This thesis aims to provide valuable information about the sources of economic growth in Finland based in empirical research.

In addition to economic growth theory, also theoretical background and earlier literature about high-growth firms is introduced. We also introduce firm lifecycles and different methods for productivity analysis, which are also applied in the empirical research of this thesis. Thesis includes also more specific review about labor markets and ICT in Finland.

In the main focus of this empirical research are high-growth firms and other continuing firms in different industry groups. Industries are divided into ICT-producing, ICT-using and non-ICT industries to study the impacts of ICT. Thesis also aims to provide information about the productivity impacts of creative destruction.

Key Words:
high-growth firm, job creation, aggregate labor productivity growth, creative destruction, information and communication technology

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Tiivistelmä

Tässä tutkielmassa analysoidaan kasvuyritysten sekä tieto- ja viestintäteknologian (ICT) kontribuutioita työpaikkojen luomiseen ja työn tuottavuuteen. Suomen talouden kehitys on ollut heikkoa viimeisen vuosikymmenen ajan globaalista finanssikriisistä johtuen. Työttömyys on noussut korkealle tasolle ja työn tuottavuuden kasvu hidastunut, ja lopulta pysähtynyt. Lisäksi on keskusteltu siitä, syntyykö Suomeen uusia työpaikkoja. Tässä tutkielmassa pyritään tarjoamaan empiiriseen tutkimukseen perustuvaa tietoa Suomen talouskasvun lähteistä.

Tutkielmassa esitetään kasvuteorian lisäksi kasvuyrittäjyyteen liittyvää teoriataustaa sekä aiempaa kirjallisuutta. Lisäksi esitellään yrityksen elinkaareen liittyvää teoriaa ja työn tuottavuuden tutkimiseen liittyviä menetelmiä, joita on myös sovellettu tutkielman empiirisessä tutkimuksessa. Tutkielma sisältää myös tarkemman katsauksen Suomen työmarkkinoiden tilanteeseen sekä ICT:n kehitykseen.

Empiirisen tutkimuksen kohteena ovat kasvuyritysten rinnalla muut havaintoperiodin ajan toimintaansa jatkaneet yritykset eri toimialaryhmissä. Toimialat on ryhmitelty ICT:tä tuottaviin, käyttäviin sekä ei-ICT toimialoihin ICT:n vaikutusten tutkimiseksi. Tavoitteena on myös tarjota informaatiota liittyen luovan tuhon tuottavuusvaikutuksiin.

Asiasanat:
kasvuyritys, työpaikkojen luominen, työn tuottavuuden aggregaattikasvu, luova tuho, tieto- ja viestintäteknologia

Säilytyspaikka
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1 INTRODUCTION

Entrepreneurship can be seen as a basis of all economic activity, and so on it has been in the center of public discussion in the past few years since the condition of Finnish economy has weakened significantly. Economic growth turned extremely negative in 2008 because of the global financial crisis and growth also remained slow because of the European debt crisis in the 2010s. Since that Finnish economy has had major problems with entrepreneurship and competitiveness. These factors have impact on economic growth.

Entrepreneurship is defined as a creation of new organizations as a response to observed demand in the market. Foundation of new firms creates new jobs, and lack of enthusiasm to entrepreneurship can lead to serious problems with employment in economy. Not all founded firms survive long in the market, but those that do usually grow over time by employment or productivity or both. Firms can privately owned or public. Successfulness between firms and industries vary over time, but some firms grow more rapidly than others. These are called high-growth firms. Even though we are discovered such a firm group, there are not much that we know about their lifecycle or contribution to the Finnish economy.

High-growth firm is, according to definition by OECD, a firm that has average annualized growth rate of employment over 20 % for three-year period. High-growth firm also has to have ten or more employees at the beginning of this period. Because of the rapid growth of these firms, they have a major impact on job creation and productivity. High-growth firms contribute to the economic growth by impacts on job creation and productivity growth. (Audretsch, 2012.)

A lot of study is related to the growth patterns and firm lifecycles but no general conclusion has been made about the determinants of high-growth firms. Some attention has been given to industries, firm size, firm age, technology and entrepreneurship, and it seems that all these factors mentioned are affecting on high growth. In the long-term economic growth technology is in a key role. Therefore high-growth firms in industries related to the newest technologies are extremely important to the economy. Information and communication technology has provided very important contribution to productivity and its contribution to firms' productivity and growth is also significant.

1.1 Economic growth

According to Kuznets (1973) economic growth means economy's capability to increase its long-run supply of diverse goods and services to its population. Economic growth has usually been defined as a growth in the output of the whole economy, and it has usually been measured as a percentage change in gross domestic product (GDP). GDP counts all the output carried by all firms, non-profit institutions, government bodies and households in the whole economy in a given year regardless what kind of goods are produced, provided that the production happens in that economy's area (Lequiller & Blades, 2014, 15-16). More accurate way to present economic growth is GDP per capita or worker, which makes growth rates comparable between countries. Changes in GDP can be nominal or real. Real changes in GDP have been deflated with some price index and it takes inflation into account. Both employment and productivity impact on economic growth, and in fact, economic growth is defined as a sum of net employment growth and productivity growth.

Many factors have impact on economic growth. In the long run technological development is the key factor of economic growth. Applying new technologies improves productivity that has impact on economic growth. Technological development has impact also on employment. Most important are technological developments so called general purpose technologies that can be applied in many industries. Use of these technologies offers an opportunity for economy to improve its productivity. For example, development of information and communication technology improved greatly the productivity in large scale of industries but also created entirely new industries (ICT-producing industries) so that the impacts can be seen in net employment growth and productivity growth.

History knows many theories about economic growth and different kinds of factors that have impact on it. The best known theories are Solow-Swan model, endogenous growth theory, Schumpeterian growth theory and Kremer's theory which states that population growth leads to increase in technological development. All these theories are presenting the factors that have impact on economic growth.

In Solow model economic growth is explained with labor and capital stock. The model also includes a technological term as a most important economic growth explaining factor. Technological progress leads to productivity growth. In Solow model technological progress is assumed to be exogenous. Exogenous models are aiming to find steady state equilibrium where investments equal depreciation of capital stock. According to Solow, economic growth can be studied with production function, which can be presented for labor, capital stock and technological development. Studying economic growth with Solow-Swan model and production function results that in the long run economic growth is driven by technological development. (Solow, 1957.)

In endogenous growth model the technological development factor that has impact on economic growth is being explained inside the model. When technological development is explained inside the model it offers an opportunity to study factors that have impact on it. In a key role for technology are for example human capital, and research and development. Endogenous growth model emphasizes the importance of technological development. The model focuses on the ways how agents in economy can cause technological development by innovations and R&D. The difference to Solow's exogenous model is that technological development is explained inside the model (Helpman, 1991).

An alternative model for economic growth is Schumpeterian model. In this endogenous model growth is driven by random, quality-improving innovations. Schumpeterian growth theory also emphasizes the effect of quality of entrepreneurship as a source of economic growth. Schumpeterian growth theory is closely related to the innovative competition of firms and the concept of creative destruction in which products and services, that no longer have demand on the current market, exit and make room for new products and services (Aghion & Howitt, 1990).

Knowing the factors that have impact on economic growth will help when analyzing economy. Although labor matter in economic growth's point of view, even more important are the innovations that drive technological development which makes it possible for economy to improve its productivity. High-growth firms' contribution to the job creation and productivity growth in ICT-intensive and non-ICT industries are therefore interesting points.

Studying labor markets and employment is a central target in economic research. According to economic growth theory, job creation has a major impact on economic growth. In labor markets happens job creation and destruction constantly. New firms in the market create jobs, and when some of them exit the market jobs are destroyed. The difference between gross job creation and gross job destruction is called net employment growth. Net employment growth is positive (negative) when gross job creation is higher (lower) than gross job destruction. Job creation can be seen as a very important component of economy. Positive net growth in jobs decreases unemployment that has negative effect on economic growth in the long run. Job creation can also be seen as a measurement of firm growth in study of industrial organizations. Research considering firm dynamics has a long history that has seen a lot of literature focusing on different theories of firm growth. One of the most known is Law of proportionate effect introduced by Robert Gibrat in 1931. This law is also known as Gibrat's Law.

There's a lot of literature about job creation in different kinds of firms and a common perception is that small firms create most of the jobs. Also a lot of literature is about impacts of firm's age to the job creation in firms. Results show that firms' age is a lot more significant factor than the size of firm (Haltiwanger, Jarmin & Miranda, 2013). Some empirical evidence is also found (Samuels, 1965) that large firms grow faster and therefore create more jobs. These conclusions must be read carefully because of possible biases occurring in the results. Large firms may seem to grow faster because of mergers and takeovers, and small firms because of unsuitable data or regression-to-the-mean bias.

In long-term economic growth productivity growth that is driven by R&D, innovations and technological development is the most important component. Productivity is a measurement of production's efficiency and the productivity changes can be expressed in relative or absolute terms. Practically productivity can be measured simply by output per input, for example physical output per work input.

Using Solow's exogenous growth theory it's possible to analyze productivity even more. In the model, that Robert Solow has presented, he uses production function, which is a formal presentation about the relationship between production, technology, capital stock and labor. By dividing it with labor results labor productivity and its components. Therefore labor productivity consists of the capital intensity and technology. Because we can't grow the capital intensity limitlessly in the long run, the technology is the most important factor for labor productivity. (Solow, 1957.)

The importance of productivity and its growth gives motivation to develop economy so that the productivity growth is maximized. Because labor productivity is based on technological term, it is technology that is important to develop. That is done with R&D and innovations. Also education is important component considering this since it increases the human capital. In Solow model education and knowing is considered as a human capital. According to Solow model this is also noticeable thing.

Productivity development does not happen simply by one way but rather through several components. During past few decades economists have developed a group of different methods. These productivity decompositions divide changes in aggregate productivity into components that gives an opportunity to study more accurately the sources of productivity changes.

1.2 Information and communication technology

Economic growth theory introduced before emphasizes the importance of technological development. Any technological improvements are important for productivity but history knows many technologies that can be applied to more than just one industry and therefore be used in even larger scale of industries. These technologies are called general purpose technologies (GPT). Newest general purpose technology that has developed greatly during past few decades is commonly known as information and communications technology. Some other GPTs that are commonly known are, for example, steam engine, electricity, railways and internet. Information and communication technology (ICT) is defined as an extended version of information technology. ICT contains in addition to information technology also an integration of telecommunications, computers, software and other systems that users can use to store, transmit and manipulate information.

Technological developments run the long-term economic growth through productivity growth. Therefore also ICT has had positive impact on the development of economies. ICT has enabled fast information transmission, which improves firms' possibilities to increase their production. ICT has also become important part of education, healthcare and other public organizations. Rapid growth of usage of ICT led to creation of ICT-producing industries that became big part of Finnish economy. Results of this general purpose technology showed in productivity growth but also in net employment growth, especially in Finland.

In Finland ICT has had major impact economically. The ICT sector is relatively one of the largest in the world. High production and manufacturing in the past and highly advanced use of ICT have improved productivity in Finland in the past few decades, but in the past ten years productivity growth has stopped and even gone negative at some years. Advanced use of ICT in production gives firms an opportunity to grow. Use of technology can therefore be one determinant for high-growth firms.

1.3 Goals and motivation

In this thesis we analyze the high-growth firms' impact on job creation and labor productivity as a change in three-year periods. Our goal is to find out how ICT effects on high-growth firms and how high-growth firms in different industries contribute to these components of economic growth. Earlier literature contains some literature about determinants of high-growth firms. Using the definition given by OECD we can analyze the relationship between high-growth firms and ICT. Using the firms' average employment instead of employment at the beginning also helps with the regression-to-the-mean bias that many earlier studies have suffered from. The target is to compare these different kinds of high-growth firms to other firms in the market and analyze the differences in job creation and aggregate labor productivity growth, noticing also the effect of ICT. Industries are divided into three groups: ICT-producing industries, industries using ICT and non-ICT industries. The last one is also divided into manufacturing and non-manufacturing.

Weak and at some years even negative economic growth in Finland for the last decade gives a motivation to study impacts of high-growth firms. Economic growth is one of the most important goals in economy. Economic growth can be seen as a change in standards of living so it is a measurement for welfare. These points give us a motivation to reach for positive economic growth in addition to the fact that our population grows all the time. Economic growth measured by change in GDP can be problematic since it does not count everything. For example, homework or externalities are not been counted to GDP. Because of these reasons GDP should not be considered as an absolute measurement of welfare but rather as an indicator.

1.4 Progression of thesis

This thesis proceeds as follows. In the second chapter is introduced the essential theories about high-growth firms and dynamics of firm. Besides defining high-growth firm and its determinants we introduce Gibrat's law, which is a theory about firm growth. Gibrat's Law can be seen as a relevant background theory since it's a presentation about firm growth, which has usually been measured in net job growth. We also look into theory of firm's lifecycle and the different phases of it. At the end of second chapter are also introduced productivity decompositions that are relevant method when studying productivity.

In the third chapter is provided more background literature about job creation and productivity. We will discuss about different kinds of results and impacts. Chapter three also includes an overview of productivity and employment in Finland and development of ICT.

In chapter four is introduced the data and methods that are used in the empirical study of this thesis. More accurately is introduced the modified Diewert-Fox productivity decomposition that is used to analyze industries and firms in this thesis. Also some tables concerning the firm groups and industries are provided to give accurate picture of the data of this empirical analysis.

Fifth chapter is about the results of our empirical study. In chapter five is presented the results of modified Diewert-Fox decompositions in tables 7 - 10. Decomposition has been applied to four industry groups for five three-year periods. Analysis of the results has been done in two ways, firm-level and between industry groups. Some attention is also focused on reliability of results. Conclusions of the thesis are reported in the sixth chapter. This includes short discussion about the results and some conclusions. Also some possible themes and targets for future research are provided.

2 THEORETICAL FRAMEWORK

2.1 High-growth firms

Generally high-growth firm or "gazelle" has been defined as a firm that has high growth rates. However, there is no official definition for high-growth firm. Most of the studies focusing on this group of firms are based on definition made by OECD. According to OECD, all firms that have average annualized employment growth rate greater than 20 % over three-year period, and ten or more employees at the beginning of this period are high-growth firms. If the annualized employment growth rate is more than 100% it is called explosive or exponential growth. (Audretsch, 2012). There are also a large number of other different kinds of definitions used in the earlier literature, which can be problematic when one is trying to compare the results.

High-growth firms create a significant amount of jobs by definition. According to their capability to create jobs, they are in key role for employment creation and therefore also for economic growth, even though high-growth firms are a very small group among all firms (Audretsch, 2012). Earlier literature (Haltiwanger et al., 2013) has pointed out empirically, that smaller firms have higher growth rates than others, which has led to the general perception that high-growth firms are small firms. This is when firm growth is being measured by employment growth. Not necessarily all high-growth firms are new but rather larger and more mature firms (Audretsch, 2012). Therefore, high-growth firms can also be found among larger firms'. Haltiwanger et al. (2013) studied different kinds of firms and their capability to create jobs. According to their results small businesses have higher job creation rate than other firms, but a lot more significant influence on job creation had the firm's age. After controlling the age of the firm, the negative relationship between firm's growth rate and size of the firm disappeared. (Haltiwanger et al., 2013.)

Amount of high-growth firms' has not been limited to any specific industry or geographic region, and empirically has been shown that high-growth firms can be found in every industry or area (Audretsch, 2012). The industry may still have some effect on the growth rates of firms and the effect of high-growth firms' can be more significant in some industries than others. According to literature considering the subject of firm's life cycle and industry evolution, small firms' have better advantage for growth in high technology industries (Audretsch, 2012).

2.1.1 Determinants of high-growth firm

Since we are interested in high-growth firms, it is important to recognize the characteristics behind them. Earlier literature is focusing on the firm-specific points that could reveal important information about this small group of firms.

Most common target of these earlier studies has been the relationship between firm size or age, and firm growth. According to the results of earlier studies, age of the firm has been more important factor. Other factors that have also been under serious consideration are industry, structure of the firm, innovations, R&D and organization's hierarchy and management.

According to the OECD's Working paper by Audretsch (2012), even though there are some uncertainties about high-growth firms' characteristics, a set of results have occurred in most of the studies:

1) *Growth rates are higher for smaller enterprises*

2) *Growth rates are higher for younger enterprises*

3) *Growth rates are even higher for small and young enterprises in knowledge-intensive industries*

Finland's Ministry of Employment and the Economy has also made some research concerning high-growth firms and entrepreneurship in Finland. In their Growth Enterprise Review from year 2011 they list some determinants that are common for high-growth firms'. Determinants from both sources are stating the same. According to the Ministry of Employment and the Economy's report high-growth firms:

- *are younger and smaller*
- *are focused on service sector*
- *are less international*
- *are publicly supported*
- *can be found around Finland*
- *are more knowledge intensity based*

Moreno and Casillas (2000) have also defined high-growth firms (or like they call them, gazelles) and their characteristics. They don't use the OECD's definition but they note that high-growth firms experience strong growth in their size and that it happens in a very short period, four or five years. Moreno and Casillas state that strong growth can happen two ways. First is that the firm with high growth is a new enterprise. In this case the firm is searching for the minimum size that it can survive with. These firms usually come up to get advantage from new technology that other firms have not detected. The second case is the already existing enterprises. In this case the high growth is usually a result to the changes in strategies, actions, behavior etc. The figure below describes the different characteristics. (Moreno & Casillas, 2000.)

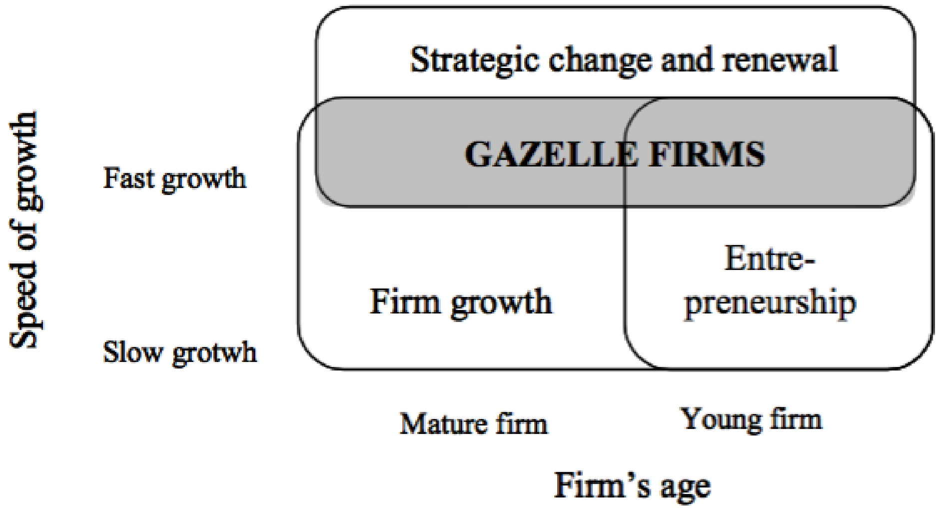

FIGURE 1 Characteristics which effect on high-growth firms. Fast growth depends on firm renewal and changes in strategies. Small and large firms have different sources of growth. (Moreno & Casillas, 2000.)

Moreno and Casillas also determine the process of growth in their article. According to them the high-growth is a process between the firm and its environment. In this process the external changes and firm’s internal changes are joined together and they offer an opportunity to rapid growth. External changes can be such as technological development, changes in the market or industrial characteristics. Internal changes can be for example ownership changes or organizational changes. So the summary of changes inside and outside the firm is the process of growth. (Moreno & Casillas, 2000.)

In the figure 2 is presented the model that describes the growth process. According to Moreno and Casillas the changes in the external and internal factors are first perceived by the managers. This leads to changes in the organizations behavior, strategies and structure for example. Eventually these changes will lead to high-growth. The changes in external and internal factors can also lead directly to changes in the organization or to the growth. (Moreno & Casillas, 2000.)

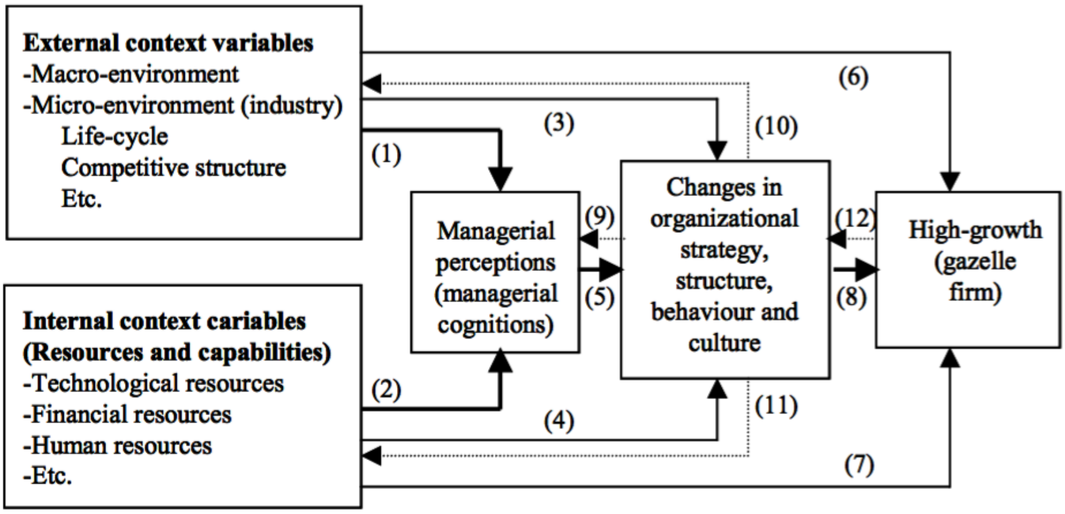

FIGURE 2 Determinants of high growth and the growth process. (Moreno & Casillas, 2000.)

Most of the earlier literature is focusing on the relationship between firm size and growth. Mainly the conclusion is all the same in every study: smaller firms' have higher growth rates. Haltiwanger et al. (2013) state that they find some evidence for that smaller firms create the most of the jobs. Also some other studies (Mansfield, 1962; Evans, 1987b) get results that smaller firms have higher growth rates. Samuels (1965) tested Gibrat's Law with sample of 400 companies during 1951-1960. He used company's net assets as a measurement for the size. As a result he got, even after noticing the regression-to-the-mean bias that large firms grow faster. Davis et al. (1995) highlighted the problems in research about job creation and firm growth. They criticized earlier literature's results and conclusions because of the data and methods being used. According to the results Davis et al. (1995) presented there are no strong relationship between firm growth rates and firm size. This background literature is presented more accurately further.

Some earlier literature is also made about high-growth firms in Finland. Deschryvere (2008) studied, which firms add the most employment in Finland. According to the statistics Deschryvere presents in his analysis, there were 750 high-growth firms in Finland in 2006. This is approximately 5% of the firms that have 10 or more employees. When subtracting the inorganic growth of the firms there remain still 642 firms. Inorganic growth in this context means firms' growth by acquisitions and mergers. Deschryvere also emphasizes the importance of creative destruction as a growth of the firm. (Deschryvere, 2008.)

Deschryvere (2008) concludes that only 65% of the jobs high-growth firms created were organic growth. The 750 high-growth firms in Finland that year created 89% of the aggregate growth. Those 642 that were growing organically were responsible for 58% of the aggregate growth. (Deschryvere, 2008.)

According to the Growth Enterprise Review 2011 by Ministry of Employment and the Economy about 70% of high-growth firms in Finland are in service sector. Most of these are in knowledge-intensive services. Least high-growth firms are in mid-level low technology manufacturing, mining industry and energy maintenance. These shares between industries have stayed quite constant over time, so the variance is reasonably small. (Ministry of Employment and the Economy, 2011.)

One point of view to the high-growth firms' determinants is entrepreneurship. Some literature is focusing on the characteristics of entrepreneurship, which has been linked to the performance of the firm. Several studies (Baum, Locke & Smith, 2001; Baum & Locke, 2004) highlight the personal characteristics that have impact on venture growth. Baum et al. (2001) tested if individual, environmental and organizational domains have impact on venture growth. The goal was to find factors that can predict performance. Their results contained a large set of different personal characteristics and their effects on firm performance. For example, entrepreneur's traits had a large impact on performance directly and indirectly. Traits' direct effect was quite poor but indirect effect through competencies, for example, was significant. Also specific motivation, competitive strategies and specific competencies were found important factors. Closely related study by Baum et al. (2004) support these results. According to their results the variables of entrepreneur's traits, skill and motivation categories had direct and indirect effects on predictions of venture growth. Growth Enterprise Review from Ministry of Employment and the Economy states that high-growth firm's employees are highly educated on average. More than half of the high-growth firms in Finland have employees that have master's degree or equivalent education (Ministry of Employment and the Economy, 2001). These point presented above are significant when talking about high-growth firms' determinants.

History knows several studies that are focused on innovations and R&D when interested in firms' growth and productivity. Hölzl and Friesenbichler (2010) have studied what kind of differences high-growth firms' have in different countries when looking into the behavior related to innovations and R&D. They made a research in 16 EU countries. To do so, they defined frontier economies in terms of average relative GDP levels and average R&D intensities. According to their results, there's a difference in high-growth firms in frontier economies and countries that have a distance to the frontier. High-growth firms seem to be more R&D-intensive in countries that are near the frontier. Results also show that for non-frontier countries the results are not statistically significant. Ministry of Employment and the Economy state in their review (2011) that half of high-growth firms in Finland have got some kind of public support.

Using data that covers all firms in Sweden in years 1993-2006, Bjuggren and Daunfeldt (2010) analyzed if the ownership of the firm has any impact on the firm being a high-growth firm. According to their results the larger firms were more likely high-growth firms if growth was measured as an absolute growth. When growth was measured in relative terms, like it usually is in this literature, smaller and younger firms got higher growth rates. They also find some evidence about how ownership and changes in ownership impact on firm being a high-growth firm. Family-owned firms were less likely to be high-growth firms so changing the ownership to some else private-owning increased the probability for the firm to grow more rapidly. (Bjuggren & Daunfeldt, 2010.)

In this section is presented several determinants for high-growth firms that have been studied earlier. All of these can be seen as relevant factors when considering the differences between high-growth firms and other firms. In this thesis we are empirically interested in size, growth, productivity and especially industry (ICT-intensive or non-ICT) but it is important to be aware of all the factors that have effect on this small but important group of firms.

2.1.2 Myths and incorrect perceptions

In some earlier literature there are some conclusions that are not necessarily offering the truth about entrepreneurship or high-growth firms or they may just be misleading for some reason and not entirely false.

Some articles and reports published suggest that there's an absence in high-growth entrepreneurship in Finland even though in Finland R&D investments per capita are very high. This phenomenon called "Finnish paradox" is actually in conflict with other sources of information, which state that preconditions for high-growth entrepreneurship are good in Finland. This is not the only "myth" concerning this group of firms: general perception is that high-growth firms are small firms and young firms, which is not necessarily true. In the third chapter we discuss more about this.

In his article Autio (2009) discusses about absence of high-growth firms in Finland and seeks weaknesses from Finland's innovation policy system. At the beginning he summarizes high-growth entrepreneurship with some stylized facts that are presented below.

1) *High-growth entrepreneurs deliver disproportionate economic impact relative to their numbers*

2) *High-growth entrepreneurs are rare*

3) *High-growth entrepreneurship is not limited to technology sector*

4) *High-growth entrepreneurs tend to be highly innovative*

5) *Achieving high growth can take a long time*

6) *High growth entrepreneurs differ from ordinary entrepreneurs in terms of their demographic characteristics*

Stylized facts presented above are summarizing findings from earlier literature. Autio has tested these stylized facts presented above with data from the Global Entrepreneurship Monitor to compare Finland against other countries. In Finland, where the R&D investments per capita are very high, there should be no absence in high-growth entrepreneurship. One should however notice that entrepreneurship characteristics are only one factor effecting on high-growth firms, as we told earlier, so not only innovativeness is having an impact on these firms.

Autio (2009) concludes in his article that high-growth entrepreneurship activities lag in Finland when comparing to other countries in Europe and Scandinavia. The results also show that high-growth firms are less common in Finland so that we actually have absence in high-growth entrepreneurship. Finland's performance for high-growth entrepreneurship is about half of the amount that can be considered as a normal European level. According to Autio the statistical difference between Finland and other countries cannot be explained even with industry structures. In Sweden high-growth entrepreneurship performance has been almost twice as much as in Finland, and we can presume that the industry structure in Sweden is quite the same as in Finland. (Autio, 2009.)

Autio calls this inconsistent situation with a name "Finnish paradox". Finland has a very high R&D investment rate and remarkable education system. Also high level of technology, and political and financial support to the entrepreneurship should lead to different kind of results that Autio's research presents. Autio also discusses about few reasons why high-growth entrepreneurship in Finland seems to be problematic. There can be issues with data being used, cultural differences that are not noticed in this research, insufficient experience and crowding out effects. The definition for high-growth firm that Autio used also differs from the most commonly used OECD's definition. Noticing these facts one should pay really attention to these conclusions about Finland's high-growth entrepreneurship performance because there are other sources, which state that the situation in Finland is totally opposite.

The results presented above are surprising when looking into the Ministry of Employment and the Economy's Growth Enterprise Review from year 2012. In Ministry report there is statistical information about Finland from years 2007-2010. During that time period there was 668 high-growth firms in Finland which is 4.4 % of the firms that have continued in the market and have at least ten employees. The average employment of high-growth firm was 116 which is a lot more than in the previous report from Ministry where it was reported being 74. In total high-growth firms created 51 542 jobs during that time which are half of all the jobs created in the period. (Ministry of Employment and the Economy, 2012.)

Considering the results that Autio (2009) had there's a lot differences in these statistics. Autio states that Finland is one of the worst countries for entrepreneurship in Europe but in Ministry of Employment and the Economy's report is told that Finland is 11th on ranking for the best countries for running business and 39th on ranking to start a new firm which means that all the preconditions for high-growth entrepreneurship are good. Some of these differences can be explained with the different definition used: Ministry's report is based on OECD's definition and Autio uses a definition that includes all firms that have ambition to grow and also potential to realize that ambition. The past definition can be very problematic when doing empirical study on this subject and when comparing the results. Measuring high-growth firms with potential to grow is causing bias because even though many firms have potential they won't grow. Addition to that there may be many firms that show no potential and have high-growth rates. Data issues or cultural differences may also cause some of the difference but still the conclusions made are so different that not these alone are enough to explain it.

2.2 Gibrat's Law

For better understanding of firm-level dynamics and job creation it is important to know what factors have impact on job creation in firms and firm growth. Study of industrial organizations has a long history and one of the main questions has been relationship between firm growth and size. Gibrat's Law, or Law of proportional effect, is a theory about relationship between firm's size and firm's growth presented by Robert Gibrat. Gibrat's Law is considered as a first formal model of dynamics of the firm size (Sutton, 1997). This theory made by Gibrat has also been used to analyze city growth.

According to Gibrat's Law the proportional growth rate of the firm is independent of the firm's absolute size. In other words, all firms in the same industry should grow at the same growth rate (Sutton, 1997). This implies that after controlling the industry, growth rate should not be affected by any other variable. Mansfield (1962) describes the law slightly differently. According to Gibrat's Law the probability of a given proportionate growth (positive or negative) during some period is the same for all firms in given industry regardless of the size of the firms. For example, a firm with sales of 100 million is as likely to double its sales as firm with sales of 100 thousand (Mansfield, 1962).

Gibrat's Law can be problematic because growing can happen in two ways, organic or inorganic. Organic growth means that firm grows by expanding its actions and creating more jobs. Inorganic growth means that firms, for example, buys other firms or merger happens, so that net growth of employment is actually zero, the jobs only move to another firm.

Gibrat's Law can be presented in mathematical form:

$$size_{i,t} = (1 + \epsilon)size_{i,t-1} \qquad (1),$$

where $size_{i,t}$ is firm's i size at the period t, and ϵ is stochastic process that effects on firm's size, in other words it's the proportional effect. (Audretsch, 2012.)

There is at least three ways to formulate Gibrat's Law depending on how one treats the exiting firms and the comprehensiveness of the law. First, Gibrat's Law holds for all firms including those that exit the market. Second, it holds for all firms that survive. This second formulation does not account exiting firms at all. Third, law holds for all firms exceeding some minimum efficient size in industry. Below this specified size unit costs rise sharply and above unit costs vary very slightly. (Mansfield, 1962.)

A lot of research has been done focusing on whether the law holds or not, Gibrat's Law has got a lot of attention for itself in the field of economics. Several earlier literature (Mansfield, 1962; Samuels, 1965) contains empirical evidence about that Gibrat's Law does not hold. However, there are also results (Simon & Bonini, 1958) whereby we can not totally reject the Gibrat's Law. Results mentioned before have many reasons to different conclusions according to earlier literature, and Davis, Haltiwanger & Schuh (1995) state that some of the conclusions in that literature are incorrect.

2.2.1 Empirical testing issues

Davis, Haltiwanger and Schuh studied the relationship between firm growth and firm size, and criticized the methods and data being used in earlier literature when studied firm growth. Common result in firm-growth analysis is that small firms create most of the jobs and in their article Davis et al. (1995) evaluate the empirical basis of these studies. According to Davis et al. (1995) the general problem in the earlier literature is the data being used to study firm dynamics. Besides that, they notice a couple of empirical factors that are causing bias in firm dynamics analysis. Such biases are size distribution fallacy and regression fallacy. Noticing these is a requirement for a correct research of firm dynamics.

Davis et al. (1995) state in their article that using unsuitable data while studying firm dynamics can lead to false conclusions. For example, they have mentioned a database used in some earlier studies called Dun and Bradstreet Market Identifier (DMI). DMI-database statistics about unemployment differentiate from Bureau of Labour Statistics, which is a mark of that the DMI-database is not necessarily trustworthy. Davis et al. also state that the database is not following all the events of labor market accurately. Such events like births and deaths of firms. To get correct result one should use longitudinal data which means data that contains observations about the employers from more than one period (Davis et al., 1995). To get correct results when analyzing firm dynamics one should be aware of the data used and also how to deal with it. Also use of longitudinal data is required because changes in firm-level dynamics (like almost in everything) vary over time, and that over-time-vary effect is in firm dynamics the thing we are interested in.

The second thing to notice is the possible regression fallacy. According to Davis et al. many studies that are using longitudinal data are suffering from regression-to-the-mean bias. This regression fallacy arises when the variables are extremely high or low at the first period and at the second period they tend to get closer their long-run average. Firms that are large in the beginning of the observation period will be tended to contract and firms that are smaller in the beginning tend to grow. This can create an illusion that smaller firms are outperforming the larger ones. This bias arises when one is (in this context) arranging the firms every year again into categories and comparing the initial size to the size at the base year. This leads to moving firms from category to another.

Using average firm sizes can help to avoid the problem with the bias. (Davis et al., 1995.)

The third problem in the research of job creation has been size distribution fallacy. This bias arises when firms are being categorized by their size and they change the category during the observation period which can lead to distorted results. Firms are moving from category to another because the job flows are big enough. To get correct results one should notice the problem with size categories. Davis et al. state that many of the results referring that small businesses create most jobs are because of this kind of bias. (Davis et al., 1995.)

2.2.2 Empirical results

Gibrat's Law and the effectiveness of it have been studied from many aspects since 1950's. General object of interest were, what kind of firms create most of the jobs. Results in earlier studies differ a lot from each other. Some say that Gibrat's Law holds and others state that it does not. A lot of earlier literature (Simon & Bonini, 1958; Mansfield, 1962; Samuels, 1965; Davis et al., 1995; Haltiwanger et al., 2013) is trying to figure out the relationship between firm size and firm growth. General perception is that small firms create most of the jobs. Also the ways of testing Gibrat's law vary a lot.

Mansfield (1962) presented three different ways to formulate Gibrat's law depending on if the exiting firms are accounted. First, Gibrat's law holds for all firms in industry. Second, Gibrat's law holds for firms that survive in the market. Third, law holds for firms that exceed the minimum efficient size in industry. All these different formulas have been tested, and the results show that Gibrat's law does not hold. The first formulation, which accounts all firms of industry, does not hold because firm's probability to survive in the market is not independent of its size. (Mansfield, 1962.)

TABLE 1 Observed value of χ^2 criterion, estimated slope of regression and ratio of variances of growth rates of large and small firms. (Mansfield, 1962.)

Item	Steel				Petroleum				Tires	
	1916–1926	1926–1935	1935–1945	1945–1954	1921–1927	1927–1937	1937–1947	1947–1957	1937–1945	1945–1952
χ^2 criterion:										
Including deaths	9.0	17.0[b]	22.5[b]	7.8	29.2[b]	44.9[b]	25.6[b]	42.7[b]	9.3	22.9[b]
Excluding deaths	7.1	3.3	9.5[b]	3.4	2.8	22.1[b]	17.7[b]	8.9	6.3	6.6[b]
Degrees of freedom (χ^2 tests):										
Including deaths	6	6	6	6	6	6	6	6	6	4
Excluding deaths	4	4	4	4	4	4	4	4	4	2
Estimated slope:[c]										
Excluding deaths	.88[b]	.99	.92[b]	1.00	.94	.88[b]	.99	.94	.97	.97
Large firms only	.94	.96	1.00	.98	.99	.98	.93	1.10	1.07	.89
Standard error of slope:										
Excluding deaths	.05	.04	.03	.04	.05	.04	.03	.04	.05	.04
Large firms only	.16	.16	.07	.06	.24	.14	.07	.07	.10	.05
Number of firms:										
Excluding deaths	72	66	64	69	128	116	156	106	34	31
Large firms only	7	9	11	12	7	11	16	17	11	12
Ratio of variances of growth rates of large and small firms:[d]										
Excluding deaths	8.96[b]	.80	37.40[b]	5.06[b]	43.27[b]	19.25[b]	63.56[b]	147.1[b]	16.16[b]	.31
Large firms only	.63	161.00[b]	.90	8.50[b]	3.50	7.75[b]	4.00[b]	3.6[b]	39.25[b]	8.67

Table 1 above shows the empirical results for χ^2 criteria and the slopes of the regression of the growth. We can see from the table 1 that all values for χ^2 criteria are over the confidence level of .05 which means that the results are not statistically significant. According to this the Gibrat's law does not hold. (Mansfield, 1962.)

The second formulate that was adopted by Hart and Prais (1956) does not account the exiting firms. The results for firms that survived in the market are also being reported in the table 1. χ^2-values with excluding deaths are much smaller but still not nearly all are under the limit of .05. Either these are not all statistically significant. (Mansfield, 1962.)

The third formulate that was introduced by Simon and Bonini (1958) accounts only firms that exceed the minimum efficient size of industry. Again there is the problem if or not to include the exiting firms. In Mansfield's (1962) article this has been empirically tested with regression. The results of the regression are being shown in the table 1 also. The slopes of the regression are quite close to 1, so this formulate is quite consistent with the Gibrat's law. (Mansfield, 1962.)

Samuels (1965) studied Gibrat's Law and job creation using ten-year period. The data he used contained only about 400 observations from different kind of firms. He only used data that contained firms which had been existing in the beginning of the period and were still alive at the end of it so that he didn't notice at all the births and deaths of firms in his study. Samuels also used a different kind of measurement to measure firm size: net assets. This might have also affected to his results. In the results Samuels reported average proportional growth rates for firm size categories. The largest firms had clearly the highest average growth rate. According to Samuels's results the average proportional growth rate decreases with the firm size category. Samuels also tested the regression-to-the-mean bias in his study and even after that the result remained. However, there are other possible explanations why large firms grow faster. For example mergers and takeovers can lead to biased results. (Samuels, 1965.)

Davis et al. (1995) studied job creation in manufacturing sector at the U.S. in the 1972-1988. Their results were following: in large firms and establishments the job creation and destruction was the highest. Even though the small firms have very high gross job creation rates, they also have high gross job destruction rates. Davis et al. didn't find any strong relationship between employers size and growth rate. The job durability were much higher in the large firms to new and already existing jobs so the job durability and firm size have a positive relationship. The results presented by Davis et al. are strongly against the general perception that small firms create most of the jobs.

In their results Haltiwanger et al. (2013) state, that they find some evidence to support that small firms create most jobs. So, according to results the small firms have the highest growth rate. However, Haltiwanger et al. also state that even more significant factor is the firm's age. In their study they controlled the age of the firm when the negative relationship between firm size and firm growth rate disappeared. So the age of the firm is more significant factor than the size of the firm. According to the results small firms' job destruction rates are high because of the exit mechanism. In five years approximately 40% of the jobs that small firms create are destroyed. Although for the young firms that survive, the growth rates are higher than older counterparts in the market. (Haltiwanger et al., 2013.)

According to the results presented before, we can't make any conclusion if the Gibrat's Law works or not. Haltiwanger et al. (2013) got results that smaller firms have higher growth rates but there is also empirical evidence about large firms' higher growth rates. In Mansfield article (1962) he uses three formulations of Gibrat's law and tests them. In two of them Gibrat's law does not hold but se last one is quite consistent with Gibrat's law. Davis et al. (1995) have also discussed about the relationship between firm size and job creation. According to them there are no strong relationship between firm size and growth. Haltiwanger et al. (2013) stated that age of the firm is more significant factor than the size of the firm.

There are probably many of factors that have impact on this. First of all the researches have been done in different kinds of times so that the economical situations have been different and the economic system may even be different in some parts. Secondly they are using totally different kinds of data, which can lead to different results. Also the data Samuels used is quite small. Samuels states in his article that one reason for Gibrat's Law not to hold is the acquisition of firms.

2.3 Firm lifecycle and creative destruction

Firm's lifecycle contains several different steps in firm's life beginning from the entry and continuing after that with growth and development of the firm. Changes in the current market can be analyzed by several different kinds of components when we are interested in dynamics of the firm. For example, changes in job creation or average productivity in some industry can be analyzed with entry and exit mechanisms. Also reallocation of resources and productivity growth occurs when low productivity firms exit from the market.

Firm's lifecycle is closely related to the job creation and firm growth, and so on also to the Gibrat's Law and creative destruction. The different components and phases of firm's lifecycle are result of creative destruction. Also the phase where firm is considered as high-growth firm can be seen as a step in firm's lifecycle, because none of the firms is going to have high-growth its entire life.

Figure 3 illustrates the creative destruction and firm lifecycle. In figure 3 is presented firms in some industry. The points in the figure describes the firms in the industry. Bigger points are bigger firms. The lines between points describe firms' productivity development, and the dotted line describes the industry's productivity.

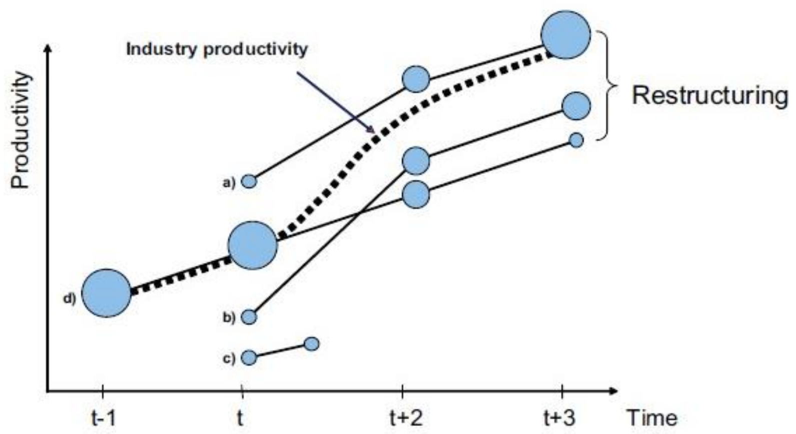

FIGURE 3 Firm's lifecycle. In the figure one can see the changes in productivity and size of firms, and therefore also in productivity of an industry. (Hyytinen & Maliranta, 2013.)

2.3.1 Entry

Entry mechanism is used to describe the effect of the market entry of new firms'. Entry mechanism is usually a component that has a positive effect on gross job creation but also it has a negative effect on industry's average productivity if the new firms' productivity is lower than their already existing incumbents' (Hyytinen & Maliranta, 2013).

When entering the market, new firms are competing from market shares and trying to provide viable products, which will usually lead to growth. Also the strategy that firm uses when entering the market has a major impact on firm's survival. On one hand, the firm can use a production technology that is already used in the market by older and larger firms. This is the more safe way to start and it will probably lead to higher rate of survival but lower productivity. On the other hand the entering firm can use more innovative and new technologies. This is more risky way to enter the market and start a firm, but it has a potential to lead higher productivity and therefore higher growth rates in the future. (Maliranta, 2014.)

In the figure 3, entry mechanism can be seen at the time t when new firms (points a, b and c) occur. The bigger point (d) describes older and larger firm in the market. The firms are in different positions in the figure, which means that they have different productivities when they enter market. This means that c is from the very beginning a low productivity firm and therefore c has higher probability to exit the market later.

Geroski (1995) studied the entry mechanism. In his article he highlighted seven "stylized facts" about entry that summarize some already known information about the mechanism. Just simply studying the data has provided the following Stylized facts:

- *Entry is common. Large number of firms enter most markets in most years*
- *Although there is a very large cross-section variation in entry, differences in entry between industries do not persist for very long*
- *Entry and exit rates are highly positively correlated*
- *The survival rate of most entrants is low, and even successful entrants may take more than a decade to achieve a size comparable to the average incumbent*
- *De novo entry is more common but less successful than entry by diversification*
- *Entry rates vary over time, coming in waves which often peak early in the life of many markets*
- *Costs of adjustment seem to penalize large-scale initial entry and very rapid post-entry penetration rates*

Geroski (1995) also states that so called de novo entry which means entrants that are starting from very beginning are more common that firms with entry by diversification. According to Geroski the entry is easy but the survival is not, so the incumbents' response to the entry is usually rather selective. This is a bit in conflict with other earlier literature (Klapper et al, 2006) that states it is not easy to enter the market.

There is also a lot of other earlier literature referring to the entry mechanism. Many of this earlier literature are focusing on factors that have impact on entry, and what kinds of firms do enter the market. General result in these studies is, that new firms in the market are small (Caves, 1998). There is also empirical evidence showing that the probability of survival after entry is significantly lower for small firms (Agarwal & Audretsch, 2001). There can be several reasons why market entry is difficult. For example, entry regulation for new firms and industries by government and the possibilities in new firm's operating environment can complicate the entry (Klapper et al., 2006).

2.3.2 Exit

After entry mechanism many of new firms at the market exit because of low productivity. This is simply called an exit mechanism, which describes the changes at the market when some of the firms exit. Studies have shown that entry and exit mechanism are strongly positively correlated (Geroski, 1995).

Exit mechanism causes gross job destruction when firms exit from the market. It also has a positive effect on average productivity of industry because weaker, low productivity firms exit (Hyytinen & Maliranta, 2013). Low productivity firms exit is consequence to the market selection, which can be result from innovation-based competition or in other words technological development (Hyytinen & Maliranta, 2013).

In the figure 3 exit mechanism can be seen in the time after t. Firm c which has the lowest productivity but also the lowest productivity growth (in this figure productivity growth is presented as a slope of the line) exits the market soon after entry.

A set of several different variables is being used in research of firm exit. Such variables are for example minimum efficient scale (MES), industry growth, profitability, capital requirements, R&D, firm size and age of firm. Minimum efficient scale is defined as a minimum output level where firm is making use of economy scales. If firms' output level is lower than MES it is not working at optimal level. Industry growth is expected to have negative effect on exit rates. This can be because of growing demand, which offers opportunities to newly founded firms. Many studies suggest that high profits in some industry have negative relationship on exit. This may not be the best variable when studying exit rates after there is some literature that no such relationship appears. R&D is also a lot studied component of exit rates. Some evidence is about that R&D is a barrier to the exit but also some evidence pointing that industries with high R&D are uncertain. Some has reported negative and on the other hand some has reported positive relationship between exit and R&D, so one should be cautious when using R&D as a measurement. Firm size and age are probably the most studied variables when referring to the survival and exit rates. According to some earlier literature's results the probability of exit and firm size has a negative relationship, which means that smaller firms' have a higher probability for exit (Tsionas & Papadogonas, 2006).

Tsionas et al. (2006) made a research about technical efficiency and exit rates. An inefficient firm cannot survive in the market in the long run because of the strong competition in the markets. They found important positive relationship between inefficiency and exit rates so the inefficient firms are more likely to exit the market.

After gathering this information from earlier literature it is easy to say that a lot of variables have impact on exit but we are not sure about them. Earlier literature contains a lot of conflicts about the variables' effects. Although there is something we can say about exit. Age and size are significant variables: exit rates decrease by firm's age and size. Most important for exit rates must be productivity, which has many components effecting on it. Low productivity firms cannot compete with others in the market so they are forced to exit.

2.3.3 Reallocation of resources

Exit of low productivity firms' causes arise in the average productivity and a reallocation of resources, which leads to higher productivity of industry. In this context the resources can mean either actual resources or market shares released by exiting firms. As a result the continuing firms grow at the exiting firms' expense. The reallocation can also happen without the exit, so that the market shares inside an industry change. This means that some firms grow at the expense of others. When reallocation happens in the market the workers and resources allocate to the more productive firms and their productivity grows. (Hyytinen & Maliranta, 2013.)

Hyytinen and Maliranta (2013) studied the productivity evolution of industries. They divided the productivity growth into these four components (entry, exit, reallocation and productivity). According to their results, the between component (which represents reallocation of resources) vary a lot with firm age. Young rapidly growing firms' contribution to the between component is negative. That means their contribution to the productivity via reallocation is negative. This could be because even though they grow, their productivity is still low. For middle-aged firms the between component was positive which implicates that this age-group is fast-growing and have high labor productivity. (Hyytinen & Maliranta, 2013.)

In the figure 3, reallocation can be seen as a change in the firms' (points') size. Firm c exits the market so there are market shares for other firms to take. Other firms will grow at expense of firm c. Also firm b has a higher productivity growth (the slope of b) than firm d or firm a so it grows faster. Firms a and b grow (the points grow) and the firm d shrink (point shrinks). When some firms grow at the expense of others, the workers move to higher productive firm. Also market shares move between firms.

2.3.4 Productivity growth

Productivity growth within firms can be considered as a fourth component when studying the dynamics of the firm. Productivity growth of an industry means growth in average productivity of firms in that industry, and productivity growth of a firm means growth in average labor productivity. Surviving firms' productivity grow when they develop their operations and when the low productivity firms exit from the market and their market shares will be shared to continuing firms.

Firm's development can happen in many ways. Developing the production by R&D support, new working models, approaches and experimentation and also management in firms are important sources of productivity growth (Bloom et al., 2016). Productivity growth can also reflect firm's catching up potential (Hyytinen & Maliranta, 2013).

According to Hyytinen & Maliranta (2013) the firm's productivity growth (or so called within component) is the most important factor in the industry's productivity growth. When compared to the effects that reallocation of resources, the within component got much higher positive values in their research. The within component also varies a lot between industries.

To maximize the productivity growth it's also important to know where it comes from. One important factor is technological development that is based on new innovations. With technological innovations firms can create high-quality products, make their production more efficient or improve their management. In firm this can lead to quick improvements that have a major impact on that firm's life. (Maliranta, 2014.)

In figure 3, productivity growth can be seen as a movement to the upper productivity level. Therefore the slope of the lines between the points describes the productivity growth. At the time t firm c has low productivity but also when time passes its productivity growth is very weak. Firm c eventually exits the market. Firms a and b have higher productivity growth (their slopes are more steep). They grow and eventually they are on higher productivity level than the firm d that was in the market before a or b. Firm d also shrinks during this because of the reallocation of resources. Workers and market shares move to the firms a and b.

2.3.5 Creative destruction

Firm's lifecycle and the different phases of it are actually closely related to the creative destruction. Firms' lifecycle and all that happens in the market from entry to the reallocation between surviving firms can be seen as components of creative destruction.

Creative destruction means process where new innovations replace older technologies. The economy is changing all the time and new opportunities are available for firms constantly. Firms are always trying to improve their actions and production to gain success. Innovations occur when firms are reaching for better performance. As a result some products and firms cannot compete in the market anymore and they exit from the market. This is how creative destruction works. To see it more accurately, it can be divided into these components presented before (entry, exit and reallocation of resources) which eventually lead to productivity growth. (Aghion, Akcigit & Howitt, 2013.)

Aghion and Howitt define creative destruction as a force driving economic growth. This means, that innovations that drive economic growth, also destroy and replace results of older innovations that have become obsolete. This concept was first introduced by Schumpeter (1942). According to his growth model, growth is generated by a random sequence of quality-improving innovations. (Aghion & Howitt, 2009, 85.)

Creative destruction has two effects: positive (creative) and negative (destructive). Creation happens when industry's productivity grows. This is when new jobs in the industry are more productive than the old jobs in the same industry. These new, more productive jobs can be created in the old firms in the industry or totally in new firms. The destruction effect is when low productivity jobs are destroyed. Jobs are destroyed when firms is reducing their staff or when firms exit from the market. (Maliranta, 2014, 20-22.)

Creative destruction's impact on productivity growth and therefore for economic growth is significant. Productivity growth happened this way should be supported. Creative destruction may not still be in the favor of the politicians, because the effects of this mechanism do not occur immediately. This can lead to political regulation and interference if the politicians think the disadvantages of creative destruction are too high. Acting against the creative destruction can reduce the advantages it offers and lead to non-optimal level of innovations and therefore to lost for the economy. Also subsidies that small firms gain from government can reduce creative destruction.

2.4 Productivity decompositions

Earlier literature focusing on productivity of firms, industries or economies knows several different methods to study productivity. To measure the productivity contributions of different components, one may use productivity decompositions. There are several different decompositions that differ from each other. Next we will introduce the basic idea of the decompositions, and some generally known decompositions.

Aggregate productivity means weighted average of productivity at the firm-level or plant-level. Changes in the aggregate productivity can be the result of change in the average productivity of firms or it can also change because of the changes between the firms. Such changes can be changes in the market shares of continuing firms, entry and exit. Need to study the effects of these components have led to the development of productivity decomposition methods. Decompositions break the aggregate productivity into these subcomponents. (Melitz & Polanec, 2015.)

The first to break the aggregate productivity down were Baily, Hulten and Campbell (1992). At first, the aggregate productivity at period t can be defined as a weighted average of firm productivity

$$\Phi_t = \sum_i s_{it}\varphi_{it} \qquad (2),$$

where s_{it} is the firm's i share at period t. The shares sum to 1. φ_{it} is firm's i productivity at time t.

The aggregate productivity change that we are interested of is therefore $\Delta\Phi$, which is $s_{i2}\varphi_{i2} - s_{i1}\varphi_{i1}$. In this decomposition introduced by Baily, Hulten and Campbell (later on BHC) this change in aggregate productivity is decomposed into three categories: continuing firms, entrants and exiting firms. For the entrants the share in the first period is zero, $s_{i,1} = 0.$ For the exiting firms the share is zero at the second period, $s_{i,2} = 0.$ The component describing the continuing (or surviving) firms can be divided into components: sum of productivity changes so that the firms' share is held constant or the share changes so that the firms' productivity is held constant. The first of these is so called within component and the second one is so called between-component. In BHC decompositions there are four components altogether. (Baily, Hulten & Campbell, 1992.)

Melitz and Polanec (2015) introduce the BHC decomposition in the following form

$$\Delta\Phi = \sum_{i\in S}(s_{i2}\varphi_{i2} - s_{i1}\varphi_{i1}) + \sum_{i\epsilon E} s_{i2}\varphi_{i2} - \sum_{i\epsilon X} s_{i1}\varphi_{i1} \qquad (3),$$

where S, E and X are referring to surviving, entering and exiting firms. In this form one can only see three components, even though there actually are four. The first component, which describes the surviving firms, can still be decomposed into two parts: within component which describes the productivity growth within surviving firms, and between component which describes the reallocation between surviving firms. The full decomposition with all four components is presented below. (Melitz & Polanec, 2015.)

$$\Delta\Phi = \sum_{i\epsilon S} s_{i1}(\varphi_{i2} - \varphi_{i1}) + \sum_{i\epsilon S}(s_{i2} - s_{i1})\varphi_{i2} + \sum_{i\epsilon E} s_{i2}\varphi_{i2} - \sum_{i\epsilon X} s_{i1}\varphi_{i1} \quad (4)$$

BHC decomposition created the basis for productivity decompositions. Griliches and Regev (1995) used BHC decomposition as a basis to their on decompositions (from now on GR). The difference to the BHC method is that Griliches and Regev used reference average productivity level as a benchmark and they compared the effects of components to that. GR method uses average productivity between periods 1 and 2 as a reference average productivity, $\overline{\Phi} = \frac{(\Phi_1 + \Phi_2)}{2}$. (Griliches & Regev, 1995.)

The GR decomposition has same kind of form than BHC with the only difference of reference average productivity level. The GR decomposition is presented below. (Melitz & Polanec, 2015.)

$$\Delta\Phi = \sum_{i\epsilon S}[S_{i2}(\varphi_{i2} - \overline{\Phi}) - s_{i1}(\varphi_{i1} - \overline{\Phi})] + \sum_{i\epsilon E} s_{i2}(\varphi_{i2} - \overline{\Phi}) - \sum_{i\epsilon X} s_{i1}(\varphi_{i1} - \overline{\Phi}) \quad (5)$$

In the BHC decomposition the impact of entrants is always positive and the impact of exiting firms is always negative, no matter what is the productivity of those firms. The GR decomposition is more accurate with entrants and exits. In GR method the impact of entrants can be also negative, if the entrants' productivity is lower than the average productivity. Exiting firms' impact can also be positive if their productivity is higher than the average. This is because the entrants and exiting firms' productivity is being compared to the reference average productivity level. (Melitz & Polanec, 2015.)

Another BHC-based decomposition was introduces by Foster, Haltiwanger and Krizan (2001). This decomposition is generally called FHK decomposition. The difference to the previous (GR) is very little: instead of using average productivity between two periods as a reference average productivity level, FHK decomposition uses productivity level of period 1. This FHK decomposition also divides the aggregate productivity into four components like the previous one but also incorporates a totally new component, so called cross firm component. Cross component captures the covariance between changes in the market share and changes in productivity. (Foster et al., 2001.)

In FHK decomposition the entry and exit mechanisms can be either positive or negative, just like in the GR method. In the FHK only the benchmark (reference average productivity level) is different. This mitigates the bias that might be caused without the benchmark. If the benchmark wouldn't exist there would be possibility to wrong conclusion about entry and exit. The FHK decomposition is presented below. (Melitz & Polanec, 2015.)

$$\Delta\Phi = \sum_{i \epsilon S} [s_{i2}(\varphi_{i2} - \Phi_1) - s_{i1}(\varphi_{i1} - \Phi_1)] + \sum_{i \epsilon E} s_{i2}(\varphi_{i2} - \Phi_1) - \sum_{i \epsilon X} s_{i1}(\varphi_{i1} - \Phi_1) \quad (6)$$

Olley and Pakes introduced another commonly used decomposition in the 1996, so called OP decomposition. This decomposition uses different mechanism to explain aggregate productivity changes and it has had many various forms in different surveys. OP decomposition divides the aggregate productivity into two components. Below is presented a form of OP decomposition, which Melitz and Polanec (2015) introduced in their article.

$$\Phi_t = \overline{\varphi_t} + \sum_i (s_{it} - \bar{s})(\varphi_{it} - \bar{\varphi}) \quad (7),$$

where $\overline{\varphi_t}$ is unweighted firm productivity mean and $\bar{s_t}$ is the mean market share. This decomposition divides the aggregate productivity into two components. The first one shows the shifts in the productivity distribution and the second one in the captures the market share reallocations. OP decomposition has also been modified by Melitz and Polanec recently into dynamic Olley-Pakes decomposition, which also observes entry and exit mechanism. (Melitz & Polanec, 2015.)

In the decompositions introduced before the entry and exit mechanisms are being compared to specific benchmark. In a decomposition that was developed by Diewert and Fox (DF decomposition), the exiting firms' productivity are being compared to the surviving firms' mean level in their base year. Correspondingly the entrants' productivity is being compared to the mean level of surviving firms in the comparison year. This DF decomposition was later modified by Maliranta (2005) and it can be presented in the following form

$$\Delta\Phi = EN_t + EX_t + BW_t + WH_t + CR_t \quad (8),$$

where the first component on the right side is the entry mechanism, the second is exit mechanism, third is the between component, the fourth one is within component, and the last is cross-term. The components can be defined as below. (Maliranta, 2005; Maliranta & Kauhanen, 2012.)

$$EN_t = s_t^E[\Phi_t^E - \Phi_t^C] \quad (9)$$

$$EX_t = s_{t-1}^D[\Phi_{t-1}^c - \Phi_{t-1}^D] \quad (10)$$

$$BW_t = \sum_{i \epsilon C} \Delta w_{it}^C [\bar{\varphi}_{it} - \bar{\Phi}_t^C] \quad (11)$$

$$WH_t = \sum_{i \epsilon C} \bar{\varphi}_{it}^C \Delta\varphi_{it} \quad (12)$$

$$CR_t = \sum_{i \epsilon C} \overline{w}_i \frac{\varphi_{it} - \overline{\Phi}}{\overline{\Phi}} \left(\frac{\overline{\varphi}_i - \overline{\Phi}}{\overline{\Phi}} \right) \tag{13}$$

In his paper Balk (2016) provided an overview of decompositions. In his paper he emphasizes that there are no unique decomposition and also the importance of the benchmark, to which we compare the entry and exit mechanism. Balk states that because of its symmetry and the natural way to deal with the benchmark for entrants and exiting firms', he prefers the DF decomposition.

Also some earlier literature has been done considering the different decompositions and comparison of them. Melitz and Polanec (2015) have made and extension to the earlier introduced OP decomposition. This so called dynamic Olley-Peaks decomposition takes also entry and exit into account. They argue that other decompositions introduce some biases in entry and exit. According to their results the biases that other decompositions cause can be significant in over five-year period. In their article they don't take in to account the DF decomposition that has been considered as a good development among the methods to study aggregate productivity changes according to Balk (2016). (Melitz & Polanec, 2015.)

3 BACKGROUND LITERATURE

In this chapter is provided some earlier literature. Since we are interested in job creation and productivity, the background literature is divided into two parts. First we'll introduce research considering the job creation and growth in firms and in high-growth firms. Job creation and growth contains articles that are focusing on size-growth relationship and age-growth relationship. The results differ from each other a lot. In the next section is presented the earlier literature considering productivity and productivity growth in firms. These results are also compared between firms and high-growth firms. In this chapter is also provided a short overview to unemployment and development of productivity in Finland. At the end of the chapter is introduced briefly more specific information about information and communication technology.

3.1 Job creation and growth in firms

Research considering job creation and firm growth has a history of several decades. In this section we go through studies from 1987 to 2016 and discuss about the results and compare them. Methods and data availability has changed over time, and also the earlier results give motivation to different aspects so results are coming more reliable and accurate when going forward this timeline. Job creation and firm growth are closely related to the Gibrat's Law so most of these studies are testing if the law holds.

Besides focusing on the relationship between firm size and growth the other factor under examination has been age of the firm. Firm growth has also been found to decrease with firm age besides of firm size. Evans has studied firm growth focusing also to age variable. In his study (1987a) Evans examined both age and size effects on firm growth. He used data from Small Business Administration (SBA) that was collected by Dun and Bradstreet that consists of 20,000 manufacturing firms. Data from this source has already been told to be problematic according to Davis et al. (1995) in this thesis. Firms were analyzed between 1976 and 1982. As a measurement for firm size Evans used employment, which has been used in several studies. He also points out that separating firm's organic and inorganic growth is impossible with this data. (Evans, 1987a.)

Measurement for firm age in Evans' study is rather problematic. Firms in DMI data for those years have been categorized rather widely: 7-20, 21-45, 46-95 and over 96 years. Accurate age can be obtained only for firms that are under 7 years old. Although it makes it easier to compare the results to other surveys because of the age measurement, it can be that the results are not that accurate because of the wide categories. Results are discussed more accurately further. (Evans, 1987a.)

Another study made by Evans (1987b) also focused on the same factors. The study focused on a sample that included 100 manufacturing industries between 1976 and 1980. The data used in this paper is actually from the same source than in Evans's other paper that was introduced before. The difference between this paper and the other published in the same year from Evans is the target. In the first one (1987a) Evans tested alternative theories considering firm growth. The other one (1987b) is focusing on the growth in different industries. Evans is using same principles in both studies: the categorizing of the firms by age and methods used in measuring are the very same. (Evans, 1987b.)

Evans reports same results in both papers. Key finding is that age is an important factor in firm dynamics, and growth and probability of failure seems to decrease with age. Survival rates are higher for more mature firms. According to the results presented the negative relationship between age and growth holds for 78% of the industries. The second key finding is that firm growth decreases with a diminishing rate with the firm size. Negative relationship between size and growth holds for 89% of the industries, which is even more than for age. These results also suggest that Gibrat's Law does not hold.

Comparing Evans (1987a, 1987b) results to that Samuels got lot earlier points out a conflict. Samuels suggested that larger companies have higher mean growth rates but Evans reports that smaller and younger firms are faster growing. Larger sample used by Evans could offer better results but those results must be read with caution because of the source of the data. Second note when comparing the results is the measurement of growth: Evans uses firm's employment and Samuels uses net assets of the firm which makes the comparing more problematic. One should still notice that measurements used by Evans are not that good either: the firms' age categories are wide and data does not allow separating organic and inorganic growth.

Davis, Haltiwanger and Schuh (1995) criticized the research related to job creation and firm growth in their article. They reported different results about firm growth and job creation. Davis et al. were skeptical about the perception that small businesses create most of the jobs, like earlier literature (Evans, 1987a, 1987b) seems to show. They showed in their paper, that the data used in earlier studies in unsuitable for job creation research. According to Davis et al. the data used by Samuels and Evans (Dun and Bradstreet) is not suitable because of two problems. First, the data is showing differences in U.S. employment statistics when compared to Bureau of Labour Statistics or the Bureau of the Census. Second, the database does not track accurately firms' births and deaths or other employment events. Davis et al. also revealed some empirical biases that can occur in these kinds of studies, referring to regression-to-the-mean fallacy and size distribution fallacy which both already introduced before. (Davis et al., 1995.)

The results that Davis et al. got for relationship between firm size and growth are different again from the earlier findings. They used U.S. Census Bureau data for manufacturing plants from 1972 to 1988 and found new information. According to their results large firms and plants got the highest job creation and destruction rates in the U.S. manufacturing sector. They found no systematic relationship between net job growth and firm or plant size. Therefore the results from earlier literature differ from each other a lot: some evidence that larger firms create jobs and some evidence that smaller firms create the most of the jobs. We must not forget the importance of the firms' age. (Davis et al., 1995.)

Some new information about job creation was offered later by Haltiwanger, Jarmin and Miranda (2013) in their research about job creating firms. They studied which kinds of firms create most of the jobs. The data in their research is from the Census Bureau's Longitudinal Business Database (LBD). The data they used covers all firms and establishments in nonfarm business sector in the U.S. for the period between 1976 and 2005. That data is firm-level and plant-level data, which have not been used before them in this kind of research. They also have respect for the birth of the firms. Haltiwanger et al. are using average growth rates in their analysis to avoid the regression-to-the-mean bias. Also the data is more suitable for this purpose than the ones used before. (Haltiwanger et al., 2013.)

Haltiwanger et al. demonstrated that after controlling the age of the firm, the negative relationship between net job growth and firm size disappears. Also some evidence was found to support the perception that smaller firms create most of the jobs. However, more robust and important finding is the role of firm's age. Smaller firms have much higher job destruction rates because of the exit mechanism. According to Haltiwanger et al. about 40% of the jobs created by startups are being eliminated in five years. They also find that if a firm survives in the market, it grows more rapidly than older firms in the market. Haltiwanger et al. state that after entry the new firms either grow or exit the market. (Haltiwanger et al., 2013.)

Earlier literature offers various set of different points of view to the job creation. Anyadike-Danes et al. (2014) focused on the impact of firm size, survival and growth on overall job growth. They studied these variables in six northern Europe countries (Finland, Austria, Germany, Sweden, Norway and the UK). Data they are using is somewhat special: purpose-built data set that was made by experts so that the data is suitable for comparing the results between countries. This data has been gathered from several sources from the target countries mentioned before. In this survey they studied firms founded in 1998 for the first decade of their life and compared the impacts between these firms.

Their results were following. A very small part of the smallest firms' have major impact on cross-country differences in job growth. According to them the overall job growth is mainly explained by the firms that have 1 – 4 jobs or more than 20. So the most important groups are the smallest and the largest firms. In this survey they used Austria as a benchmark and compared it to other countries. The differences in the job creation rates between countries are explained by the contribution of the smallest firms'. The results reveal some information about the firms' performance after entry. Newly-born firms are usually small: data used here reveals that over 75% of the new firms have five or less employees and not many survive the next ten years. Anyadike-Danes also found the same as before: smallest firms that survive grow most rapidly. Like Haltiwanger et al. (2013) also Anyadike-Danes et al. came to the conclusion that firm size and growth are inversely related but when age of the firm is controlled this relationship disappears. According to Anyadike-Danes et al. relatively large part of the firms is still small after first decade of birth. This is in conflict with the earlier perception that firms either grow or exit the market. This has also been called up-or-out dynamics before. (Anyadike-Danes et al., 2014.)

All the papers presented above have been done using different methods and data. The results also differ from each other, which is reasonable because of the measurements and data. Some of the empirical evidence suggests that larger firms create most of the jobs, and others suggest that smaller firms have more significant contribution to job creation. Next we'll go through some earlier literature considering the job creation in high-growth firms. We'll discuss about the results and their differences to the average firms' job creation after that.

Not that much literature has been done about the high-growth firms' job creation. High-growth firms and gazelles have not been as a target of economic research for that long yet, but some literature can be found. Many of these papers use different definitions for high-growth firms, which makes the results less comparable.

Haltiwanger et al. (2016) studied job creation, output and productivity impacts of young firms' that have high growth rates. They use two databases that are related to each other. Both databases are based on Census Business Register. Haltiwanger et al. used Longitudinal Business Database (LBD), which is the same that Haltiwanger et al. used in their earlier study (2013), to construct measures for firm employment and growth. They then appended firm level revenue data that was contained in the Business Register. LBD contains annual observations from 1976 to 2013. With this data they can make annual plant-level and firm-level employment growth rates. (Haltiwanger et al., 2016.)

Haltiwanger et al. find that high-growth firms' contribution to the job creation is relatively high, even though the young firms are very heterogeneous. Many of the young firms do not survive more than few years. They also make the same conclusion that many others: small businesses that survive in the market grow relatively fast. According to them the median net employment growth for young firms is zero, which means that a lot of jobs are destroyed. Higher mean net employment growth implies positive skewness in employment growth, which means there are some firms that have high growth rates and they are driving the mean employment growth. (Haltiwanger et al., 2016.)

Haltiwanger et al. (2016) also explored some characteristics of high-growth firms. According to them, high-growth firms are more likely to be young than mature firms. This occurs even when the age is controlled. Number of high-growth firms varies between industries and regions. High-growth firms had a lot more activity in high-tech industries and energy producing industries. (Haltiwanger et al., 2016.)

Comparing the results and conclusions got in the earlier literature may not be easy. Different data and methods used make it difficult. In different times made studies about the effectiveness of Gibrat's Law has lead us to different conclusions. Some studies (Samuels, 1965) have empirical evidence, which shows that larger companies grow faster. However, many other studies (Evans, 1987a, 1987b; Haltiwanger et al., 2013; Anyadike-Danes, 2014; Haltiwanger et al., 2016) have shown that smaller firms have higher growth rates. This is even when the regression-to-the-mean fallacy is paid attention using average firm sizes. Davis et al. (1995) on the other hand conclude that no strong relationship between size and growth can be found. As a conclusion we can say, that results from job creation research are in conflict but mainly the results are pointing to the direction that small firms' have a major impact. One should still remember the pointed empirical finding that age has shown to be more significant factor.

3.2 Firms' productivity

High-growth firms' contribution to the productivity is another interesting point when analyzing high-growth firms' effect on economy. When thinking about the economic growth, the productivity growth is the most important element in the long run. Even though productivity is important for growth, there is not much we know about high-growth firms' contribution on productivity. Much more literature is done focusing on the job creation effect of these firms'. Further we present some earlier literature considering productivity. There are many different aspects that one can look into it, and we have introduced here some of them.

Maliranta (1998) studied the importance of technology generation, learning by doing and spillover effect to the performance. He used plant-level panel data from Finland manufacturing sector. The performance was measured using total productivity factor indicator, which shows the shares of capital stock productivity and labor productivity. The indicator used in this study works like weighted average of labor and capital productivity. Goal of the study was to seek differences in technical efficiency between establishments. Data they were using was from two periods: 1975-1984 and 1981-1994. (Maliranta, 1998.)

The results show that the differences in the level of performance between generations are significant. The total productivity factor indicator seems to be higher for new generations, so it's decreasing when moving towards the older generations. Some explanations can be concluded from this. First of all, the new generations may have more modern capital stock that can be more effective. Another result from the study is that the rate of growth is higher for new generation plants, which indicates that probably some learning by doing effect has happened. Also third result was found. The firm spillover effect tends to increase when moving towards the older generations. (Maliranta, 1998.)

Maliranta (2001) has studied how the structural changes that enhance productivity have affected on the labor productivity growth and total productivity growth in Finnish manufacturing. The research was done by examining the period from late 1980's to middle 1990's. Maliranta uses Longitudinal Data on Plants in Manufacturing (LPDM), which has been created from Industry Statistics to be used in research. Also some data is from Business Register on Plants (BRP), which has more accurate data from plants. (Maliranta, 2001.)

According to the results of the research the productivity-enhancing structural changes boosted the labor and total productivity growth in the late 1980's. Maliranta analyzed the impact of structural changes with so called between components. The values of between were high during that period. Also another components of structural changes, entry and exit, had impact on productivity growth. The second finding was that firms with preference to import and R&D intensity seem to add the productivity-enhancing structural changes. The effects of R&D come with lag of 3-5 years. (Maliranta, 2001.)

The results Maliranta has got are quite the same that other earlier literature and also economic theory states: the structural changes, or creative destruction, have a major impact on productivity. Innovations that lead to technological development such as information and communication technology are in key role for productivity development. The second finding that R&D effects on structural changes has been found also earlier and it has got support.

Jalava and Pohjola have studied the relationship between technology and economic growth. Next is introduced some research focusing on these aspects. More importantly these next articles introduced are targeting on information and communication technology. ICT is the newest general purpose technology and its significance has been even more important to Finland in the last decades.

Jalava and Pohjola (2007) studied, what kind of impact the information and communication technology has on output and productivity growth. They studied these impacts in Finland for the years 1995 - 2005 which was the period that ICT rose and developed in Finland the most. Data Jalava and Pohjola used in this survey is from Statistics Finland. Because not all data needed was available in Finland, they had to turn to U.S. Bureau of Economic Analysis (BEA). (Jalava & Pohjola, 2007.)

According to the results the ICT had large impact on GDP and production on that period which is not surprising. The results show that one fifth of the quality adjusted GDP was from information and communication technology. The rate of growth was 4.06% at that time. This is huge contribution because the share of ICT was about 5%. Big part of this growth is probably because of Nokia. ICT also had impact on productivity growth. The labor productivity was 2.87% a year and contribution of ICT capital deepening was 0.46. When summing up the labor productivity growth from ICT and the multi-factor productivity growth, ICT's contribution to the aggregate productivity growth was 1.87% of the improvements in GDP per hour worked. Totally this is 65% of labor productivity growth. (Jalava & Pohjola, 2007.)

Jalava and Pohjola (2008) the roles of electricity and ICT development in Finland's economic growth. Finland has been one of the leading countries in electricity and even more in ICT so these new technologies are in key role for economic growth in Finland. They used data for electricity from periods 1900 - 1913 and 1920 - 1938. For ICT impacts the data was from years 1980 - 1990 and 1990 - 2004. (Jalava & Pohjola, 2008.)

In their results they state that Finland was back then one of the leading countries in information technology. In Finland the contribution of ICT to the GDP growth was three times as large as electricity's. ICT's contribution to the multifactor productivity was 60% when electricity's was only one third. In Finland ICT development was rapid and it was advanced and applied into production very fast. Also huge ICT sector had effect on this. They also compared the results to equivalents from United States. In Finland the contribution of ICT was larger than in U.S. but the electricity's contribution was higher in United States. (Jalava & Pohjola, 2008.)

Another aspect to the productivity can be found in the article made by Hyytinen and Maliranta. In their research (2013) they studied industries productivity evolution using VDF decomposition (Vainiomäki-Diewert-Fox decomposition) that divides the productivity evolution into four components: entry, exit, reallocation of resources and productivity growth. Three first components actually describe the creative destruction as told before. The goal was to find out how new firms in the market contribute to the industry productivity growth when they enter the market, and after that. They used Finnish micro-level business data, which was both firm-level and plant-level. (Hyytinen & Maliranta, 2013.)

Their analysis shows that the most important component for industry productivity growth is the average productivity growth of firms'. The results also show that the impact is so important because the older and larger firms, which have larger market shares can renew themselves and that way improve their productivity. This is in conflict with the common perception that the firm growth should be rapid at the very early stages of the firm life. (Hyytinen & Maliranta, 2013.)

The second finding in their study is that even though the labor productivity is much lower in the new firms in the market, the effect is mitigated because those firms have so small employment shares. If the young firm would be average size, the negative effect would be two or three times larger.

The third finding in their study was considering the age-group decomposition also used in the research. The exit mechanism usually has positive effect on the average productivity in the industry because low productivity firms exit the market. According to their results the exit effect is positive and prolonged but it declines over the life cycle of the firm. However, the exit mechanism is still visible after ten years. (Hyytinen & Maliranta, 2013.)

The fourth finding was that younger firms that survive in the market tend to have higher growth rates when compared to older firms. The results show that the contribution to the between component (reallocation of resources) varies with firm age. Young firms that grow rapidly have negative effect on aggregate productivity via reallocation of resources because even though they grop rapidly, most of them still have low productivity. (Hyytinen & Maliranta, 2013.)

A lot studied aspect to productivity is the entrants' effect on industry's productivity. Dumont, Rayp, Verschelde and Merlevede (2016) have made and article about start-ups' and young firms' contribution to the industries' efficiency growth. The article aims to provide empirical evidence on how the young firms contribute to the efficiency growth in different industries. The research includes six EU countries (Belgium, Finland, France, Germany, Spain and Italy). They examine the object through technical efficiency decomposition, which has four components: firm-level efficiency growth, reallocation of market shares, and entry and exit mechanism. (Dumont et al., 2016.)

In every EU country of the study, the entering firms have had lower efficiency than more mature incumbents in the industry. Starting firms are more efficient than the entrants. Starting firms refer to young firms here. In Finland the starting firms are even more efficient than mature firms according to these results. In the results they also state, that efficiency increases with firm age, but not in Finland and especially in Belgium. The efficiency difference between entrants and young firms can be explained through market selection. The low productivity firms exit shortly after entry. In Finland, France and Spain the existing firms are on average more productive than the entrants in their first year. (Dumont et al., 2016.)

These results are in conflict with earlier literature. There's been empirical evidence, that young firms have lower productivity than the older incumbents in the market. Those entrants that have the lowest productivity will exit the market and after learning-by-doing effect and reallocation of resources the other entrants and older firms in the market will grow. Some explanation can still be found for the results. Young firms can have new technology or new information available that improves the productivity. Also some new innovations that young firms have can increase their efficiency.

The studies and results introduced above are only a very small part of the literature made of productivity. The aim of presenting this earlier literature is to provide a view of productivity research and its results that show the variables and factors that create productivity growth. Also some studies about productivity differences were shown. The results show that productivity varies over regions in Finland and also over generations in manufacturing. According to the results structural changes also have positive effect on productivity growth. Further is introduced some research about high-growth firms and their productivity. Mostly attention has gathered the job creation aspect when considering the high-growth firms. Productivity can be seen as important as job creation, especially in the long run.

Already earlier introduced article by Haltiwanger et al. (2016) focused on young firms that have high growth rates. Job creation, output and productivity growth contributions of these firms' were analyzed. The results show that these firms contribute to the productivity growth and output level growth disproportionately. Young firms although seem to be very heterogeneous and many of them do not survive in the market very long. Those that do survive have higher output growth than the older firms in the market. (Haltiwanger et al., 2016.)

Haltiwanger et al. also examined the determinants of the high-growth firms. According to them, high-growth firms are more likely to be young than older firms, even when the firm size is controlled. They also found that there is a lot of variation between industries. The difference in high-growth firm activity between industries varies between 40% and zero. (Haltiwanger et al., 2016.)

Productivity and output growth contribution of high-growth firms seems to be important according to Haltiwanger et al. Also the determinants that Haltiwanger et al. are introducing in their paper are supported by earlier literature and also introduced earlier in this thesis (see 2.1.1).

Very little literature is considering the differences in productivity and job creation between high-growth firms and average firms. Nevertheless the results introduced in this chapter provide valuable information about firm dynamics and the factors that cause job creation and productivity growth. Next we summarize these results to provide clearer picture.

3.3 Results of empirical studies

Summarizing the results may help to give clearer picture of the earlier literature. The research focusing on job creation and productivity in firms has had many results, and partially the results are in conflict with each other. Below is presented the results in simpler form.

TABLE 2 Background literature results about job creation.

Author	Year	Hypothesis	Data	Result and other notes
Samuels	1965	Does the Gibrat's Law hold?	DMI, 400 obs.	Larger firms grow faster.
Evans	1987a	Relationship between firm size, age, and growth	SBA 20,000 obs.	Firm age is important factor, probability of failure decreases with firm age, Gibrat's Law does not hold.
	1987b	Relationship between firm size, age, and growth	SBA 20,000 obs.	Relationship between age and growth holds for 78% of industries, relationship between size and growth hold for 89% of industries.
Davis et al.	1995	Relationship between firm size, age, and growth. Evaluating earlier literature.	Data from manufacturing plants, 1972-1988.	No systematic relationship between net job growth and size.
Haltiwanger et al.	2013	Which firms create most of the jobs?	Census Bureau's Longitudinal Business Database (LPD), 1976-2005.	Smaller firms create most of the jobs, after controlling the age the negative relationship between size and growth disappeared. Smaller firms have higher destruction rates.
Anyadike-Danes et al.	2014	Impact of firm size, survival and growth on overall job growth	Produced by distributed micro-data analysis. Several sources.	Very small part of smallest firms have huge role in cross-country job growth. Also largest firms have major impact. Smallest firms that survive grow most rapidly.
Haltiwanger et al.	2016	High growth young firms contribution to the job creation	Longitudinal Business Database (LBD)	High-growth firms' impact on job creation is relatively high, but small firms are heterogeneous. Small firms that survive in the market grow more rapidly.

TABLE 3 Background literature results about productivity.

Author	Year	Hypothesis	Data	Result and other notes
Maliranta	1998	Importance of technology generation, learning-by-doing and spillover effect to the performance	Plant-level panel data from Finnish manufacturing sector	Differences in the level of performance between generations are significant.
	2001	How structural changes that enhance productivity has effected the labor and total factor productivity growth?	Longitudinal data on Plants in Manufacturing (LPDM)	Productivity-enhancing structural changes boosted labor and total productivity growth in the late 1980's.
Jalava, Pohjola	2007	Role of ICT in output and productivity growth in Finland	Statistics Finland and U.S. Bureau of Economic Analysis 1995-2005	ICT's contribution to aggregate productivity growth was 1,87% - 65% of labor productivity growth
	2008	Role of electricity and ICT in economic growth in Finland	Data for electricity from 1900-1913 and 1920-1938. For ICT from 1980-1990 and 1990-2004.	Growth contribution of ICT much higher in Finland than in U.S. ICT's contribution to the MFP growth was 60%.
Hyytinen, Maliranta	2013	How entrants contribute to industry productivity growth?	Finnish micro-level business data, firm-level and plant-level.	Most important component for industry productivity growth is average productivity growth of firms.
Dumont, Rayp, Verschelde, Merlevede	2016	Start-ups' and young firms' contribution to the industries' efficiency growth	Firm-level estimates of technical efficiency to get decomposition of industry-level efficiency	Entering firms have lower efficiency than their more mature incumbents. Starting firms are more efficient than entrants.
Haltiwanger, Jarmin, Kulick, Miranda,	2016	High-growth firms' contribution to productivity	Longitudinal Business Database (LBD)	High-growth firms' contribute to productivity growth and output level growth disproportionately. Many of the young firms do not survive in the market long.

3.4 Unemployment and productivity in Finland

3.4.1 Unemployment

The level of unemployment has varied in Finland during the past decades. By definition the unemployment means people that belong to the labor force but have no job. The biggest disadvantages of unemployment for the individual are decrease in the standards of living, the weakening of relationships and social status, and also economical unsafety. Unemployment is also a major factor for poverty. From the economy's aspect the unemployment causes decrease in production and increase in social and healthcare expenses.

The statistics and measurements for unemployment vary across countries. In Finland unemployed are people who have no job but have applied for one in the past four weeks. In Finland one is considered as working age person if the one is 15 - 74 years old. Unemployment statistics are also reported for ages 15 - 64. Most common measurement for unemployment is unemployment rate, but other nearly as common is employment rate. Examining the unemployment one must pay attention to the seasonal changes in employment. For example beginning and ending of school semester affects to employment statistics. Also some jobs are seasonal. Grey employment (=employment that cannot be seen in statistics) causes some bias to the statistics.

Unemployment can be divided into several categories. For example seasonal unemployment, cyclical unemployment, frictional unemployment and structural unemployment are different forms of unemployment. Seasonal unemployment is caused by changes in the demand of the work in different seasons of the year. Some professions employ only at summer for example so the unemployment caused by seasons may be seen in statistics. Cyclical unemployment means increased unemployment during downturns in the economy. This is followed by the decreased demand of the work. Frictional unemployment means period of unemployment between two jobs. Sometimes when one is searching for a new job it can take a while. Also the time after graduation until one finds a job is called frictional unemployment. Structural unemployment is followed when the structures of the economy change. For example technological development can cause for some professions' and industries' exit. After this the demand for the work decreases and the demand of work is moved to another professions and industries with the technological development. Structural unemployment is the result of creative destruction. Destruction of some jobs can be seen as a "destructive" part of creative destruction. This may seem negative at first because the supply of the work doesn't adjust to the situation that fast. When the supply of the work adjusts the structural unemployment decreases. This is the "creative" part of the creative destruction. Besides of the factors presented above there are a lot more factors that cause unemployment but these are the most common.

According to the information from Statistics Finland the unemployment in Finland has been quite high since the financial crisis that begun from the United

States in 2007. The situation hasn't got any better because of the debts of some countries in Europe, and other crises. After these the unemployment has not decreased much but rather stayed quite high. The figure below shows the unemployment rates for aged of 15 - 74.

FIGURE 4 Unemployment in Finland for aged of 15-74 04/2006 – 04/2016. (Source: Statistics Finland)

There has been a lot of public conversation about unemployment in Finland and different ways to decrease it. Some participants think that for example increasing the supply of the work might be the solution to high unemployment.

High-growth firms' impact on employment is very significant. According to the Ministry of Employment and the Economy there were 691 high-growth firms in Finland and they created 51,164 new jobs in years 2006 - 2009. On average the employment in high-growth firms grew 74 employees in that three-year period. When adding the fact that the high-growth firms are very small part of the firms in Finland, the impact on job creation is important.

3.4.2 Productivity

Productivity is the most important measurement for efficiency of the economy. Like already introduced before, the productivity is significant component considering long-term economic growth. Usually productivity grows with technological development as a result of innovations. In principle the economy is always reaching for higher productivity and therefore increasing standards of living for its citizens.

Productivity is usually being measured as a produced output per labor input. In product-based production defining the productivity is easy and calculating some numerical values for it is not problematic but most of the firms are currently producing both products and services or only services. In service focused production the productivity is more complicated to calculate. For example social and health care sector is problematic object because of this. In these situations value added can be used as a measurement of productivity.

Recent discussion about competitiveness of Finland is closely related to the productivity. Competitiveness means firms', industries' or the whole economy's capability to survive from the economic competition. Productivity grew well in Finland until the 2007. After this the productivity growth has decreased and partly turned into negative even. The figure below illustrates the change in total productivity and labor productivity in Finland for the last decades.

Economy's productivity development 1976-2014, %

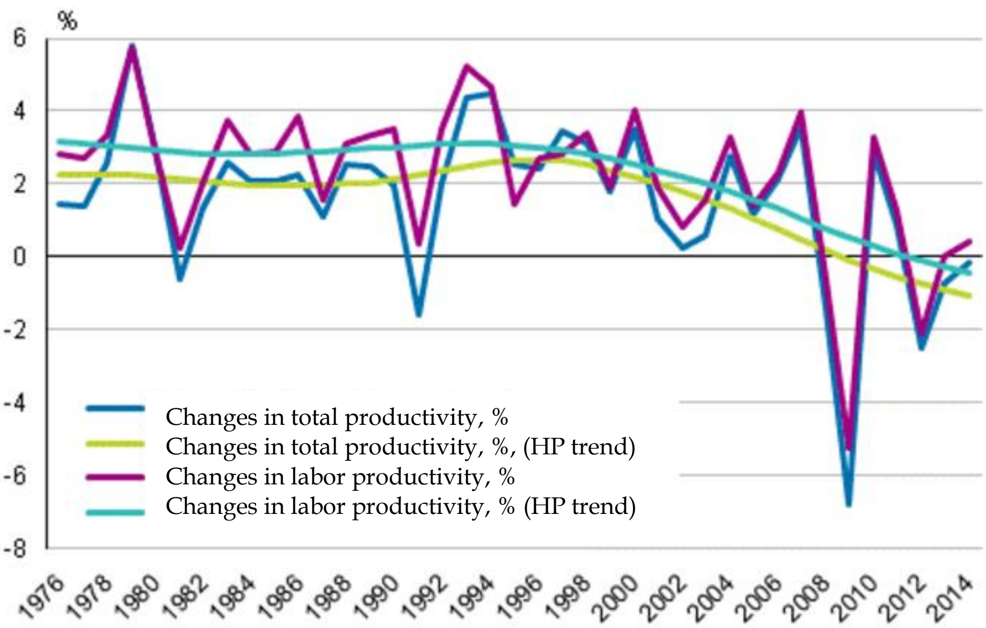

FIGURE 5 Percentile changes in the total productivity and labor productivity in Finland for the years 1976-2014. (Source: Statistics Finland)

One can see clearly from the figure 5 that the productivity growth level was good in Finland until year 2000. The growth rate of productivity has decreased after that. In 2007 when the financial crisis begun the labor and total productivity growth in Finland turned deeply negative. After this the evolution of the productivity growth has been quite stagnant. This slows the economic growth down.

There is not much that we know about high-growth firms' contributions to the productivity. Also the earlier literature has provided contradictory results about high-growth firms in Finland. As noted before, according to Autio (2009) there is a phenomenon called "Finnish paradox" effecting in Finland. This means that Finland has no good preconditions for high-growth entrepreneurship. The report published by the Ministry of Employment and the Economy (2012) is stating totally different conclusions. According to them Finland's preconditions to entrepreneurship and high-growth entrepreneurship are better than in other Nordic countries. Hyytinen and Maliranta (2013) state, that firms' with high-growth have low productivity despite of the fact that they grow rapidly. In these firms the growth can be seen as a job creation. So, in high-growth firms the productivity does not necessarily grow fast.

Both unemployment and the productivity in Finland are not in the good level. The impacts of financial crisis in 2007 can still be seen after many years in the Finnish economy and its development. The importance of high-growth firms to the economy is known to be remarkable even though there are still a lot to study.

3.5 Development of ICT

The term ICT, which refers to information and communication technology, has been in use since 1980's. Although there's a long history behind this term, there is no specific definition for it. By some definition it contains the manufacturing of ICT and ICT services. It has also been defined as an extended version of information technology. ICT therefore contains in addition to information technology also integration of telecommunications which includes telephone lines and wireless signals, computers, software and other systems that one can use to store, transmit or to manipulate information.

In Finland ICT developed rapidly and ICT sector grew fast. In Finland both, manufacturing and ICT services had a major part of the employment and value added in business sector. At the end of 1990's in Finland manufacturing and services were one of the relatively highest in OECD countries. Best known from ICT production and development in Finland is Nokia. Nokia was one of the biggest telephone developers and telecommunication producers. Currently the ICT sector is different in Finland. Nokia has stopped telephone development and is focusing on information services and computer programming. Currently programming and information technology are much bigger part of ICT in Finland. The ICT sector is still large in Finland, but the focus has changed to other products and services over time.

Even though ICT sector means ICT production and ICT services, other industries are also related to this technology. Industries can be divided into different categories by their usage of ICT. In Finland we have industries that produce ICT, such as telecommunications, computer programming, information service activities and ICT products. Another category is industries that use ICT in their activities and production. Many of industries are this kind of ICT-intensive industries. Third category is industries that are not using ICT so much or are not depending on it.

Below is presented ICT sectors' shares in OECD countries. In the figure 6 presented ICT sector contains industries that are producing ICT.

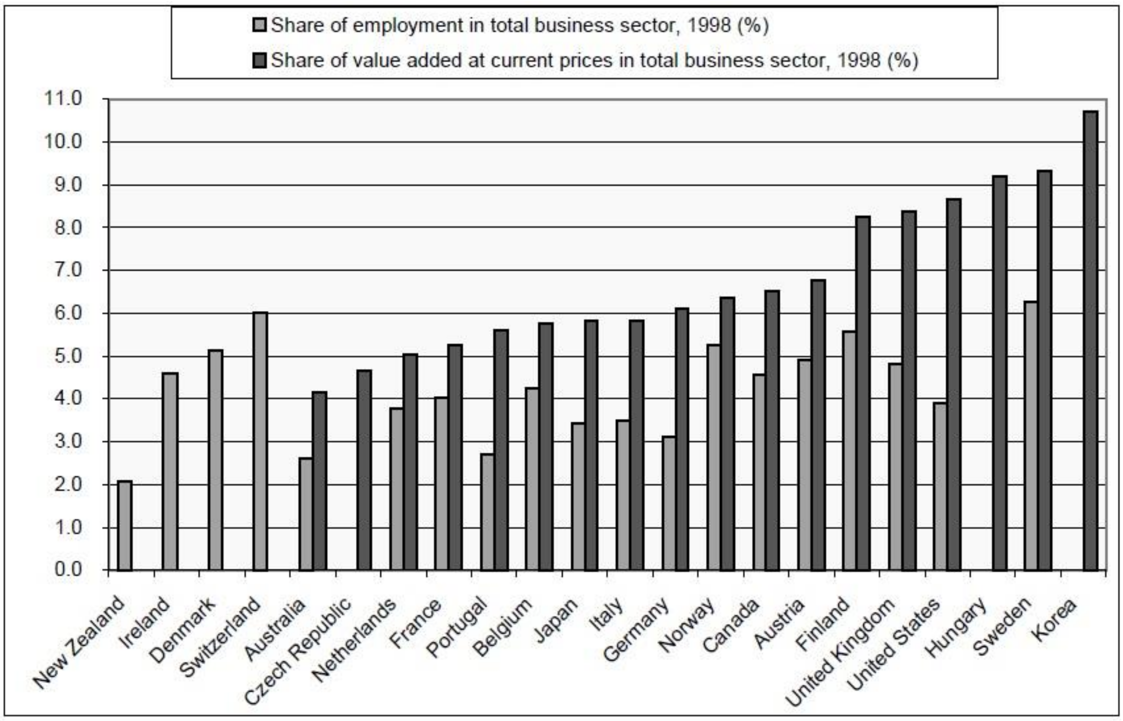

FIGURE 6 The share of ICT sector in the economy, 1998. (Pilat & Lee, 2001.)

Development of ICT has led to various applications of this technology. Currently ICT is being used in every part of life. ICT has improved medical care, education and other public services. Also developing it has positive impact on productivity and therefore to whole economy but also it has impact on employment. In Finland the ICT sector is relatively one of the largest in the world. Development of ICT can be measured with ICT Development Index which measures the level of ICT that are being used. In 2013 the size of ICT sector in Finland was 5.60 %.

Development of ICT can be seen also in different industries. This is because ICT is so called general purpose technology (GPT). ICT development affects to industries in many ways. The faster transmission of information improves production. Also communication has improved and information storing is easier. These are some changes that happen inside the organizations. Development of ICT has also made it easier to firms act more internationally.

When dividing industries by ICT we can divide them into different categories. Some industries such as ICT products are focused on producing different ICT related products. There are also some industries that are focused on different kinds of ICT services, such as telecommunications and information services. These industries can be called ICT producers. Another category is the industries using ICT in their production. This category is called ICT users and it accounts industries that are using a lot ICT in their daily activities. Third category is consisted of industries that are not using ICT (or the use is very limited). The general use of ICT in different industries makes it so called general purpose technology (GPT). History has shown that these GPT's are in a key role for economic growth. (Bresnahan & Trajtenberg, 1995.)

Some research has also done focusing on ICT's impact on productivity. Ark, Inklaar and McGuckin (2003) studied the productivity growth differences between U.S. and Europe in 51 industries in the years 1990-2000. According to their results the productivity growth in the U.S. has been higher because of larger ICT sector and service sector that is using ICT intensively. Results show that Europe is clearly lagging in ICT production and ICT-using industries. This can be because of lower ICT investment levels in Europe. Also it looks like that when the productivity growth in U.S. has increased during 1990's, in Europe the productivity growth has slowed down. This implicates that ICT matters to the productivity growth, like other general purpose technologies in the history. (Ark et al., 2003.)

TABLE 4 Productivity growth and GDP shares of ICT productivity, ICT using and non-ICT industries in the EU and the U.S. (Ark et al., 2003.)

	Productivity growth				GDP share	
	1990—1995		1995—2000		2000	
	EU[b)]	US	EU[b)]	US	EU[b)]	US
Total Economy	1.9	1.1	1.4	2.5	100.0	100.0
ICT Producing Industries	6.7	8.1	8.7	10.1	5.9	7.3
ICT Producing Manufacturing	11.1	15.1	13.8	23.7	1.6	2.6
ICT Producing Services	4.4	3.1	6.5	1.8	4.3	4.7
ICT Using Industries[a)]	1.7	1.5	1.6	4.7	27.0	30.6
ICT Using Manufacturing	3.1	-0.3	2.1	1.2	5.9	4.3
ICT Using Services	1.1	1.9	1.4	5.4	21.1	26.3
Non-ICT Industries	1.6	0.2	0.7	0.5	67.1	62.1
Non-ICT Manufacturing	3.8	3.0	1.5	1.4	11.9	9.3
Non-ICT Services	0.6	-0.4	0.2	0.4	44.7	43.0
Non-ICT Other	2.7	0.7	1.9	0.6	10.5	9.8
Promemoria: with national deflators						
Total Economy	1.9	1.1	1.4	2.5		
ICT Producing Manufacturing	7.8	15.1	10.1	23.7		

[a)] Excluding ICT producing. – [b)] EU includes Austria, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Spain, Sweden.

Table 4 shows the productivity growth in total economy, ICT producing, ICT-using and non-ICT industries. Even though the productivity growth in EU has decreased in 1990's, productivity growth in ICT producing manufacturing has increased. Almost in every industry that is involved with ICT has had productivity growth when non-ICT industries' productivity growth has decreased in 1990's. ICT's effect on productivity has been significant in 1990's when it develop rapidly. (Ark et al., 2003.)

Pilat and Lee (2001) studied the growth differentials in OECD countries. They were focusing on estimating the contribution of ICT-producing and ICT-using to aggregate productivity growth. The data they were using is from STAN database and it covers the information from eleven OECD countries. Problem occurring in this analysis is the differences in measuring ICT sector in different countries. They analyzed the importance of ICT by examining the sectoral productivity performance and the productivity contribution of every sector. (Pilat & Lee, 2001.)

They state in their paper that some countries (Finland, Ireland) have had multifactor productivity growth higher than average and also a large ICT sector. It still seems that ICT sector does not explain productivity growth entirely. In Japan, where ICT sector is large, the productivity growth hasn't increased. There are also some countries that have grown rapidly but have no such ICT sector, such as Australia. Despite of that it seems according to their results that the size of ICT sector is significant factor for productivity. Pilat and Lee also point out that some sector in Finland and United States have increased their productivity growth. This can be the result of ICT spillovers. (Pilat & Lee, 2001.)

Empirical evidence and statistical information about ICT development supports the theory of economic growth and creative destruction. Innovations followed by technological development lead to structural changes in economy and production. ICT production itself is a significant factor for economies but it also impacts indirectly through other industries. For example financial services, insurance and business services can use ICT and that way become more efficient.

4 EMPIRICAL RESEARCH

In this chapter of the thesis is introduced the hypothesis of this thesis and goals of this empirical study. We will also introduce the data being used in the empirical study and the methods we are using to analyze that data. Empirical study aims to take a closer look into the theories introduced before, and also to provide some empirical evidence for them. We will discuss about the results and compare them to earlier literature in chapter 5. This empirical study also aims to provide answers to following questions: 1) Which firms create most of the jobs? 2) Which firms contribute the most to the economic growth through labor productivity growth? 3) What is the contribution of high-growth firms to economic growth? 4) What differences can be found between industry groups in net employment growth and labor productivity growth, and therefore in economic growth?

4.1 Hypothesis and aims of the thesis

Recently there's been a lot of public discussion about employment and economic growth issues in Finland. Slowing, and some years even negative, productivity growth has led to the point that economic growth in Finland has stopped. Stagnant productivity growth has impact on Finland's competitiveness and labor markets. High unemployment, which has remained high for long, and weak productivity growth are threats to development of Finnish economy. A lot of pressure is therefore in politics considering entrepreneurship and new firms. Entrepreneurship is the basis of the economic activity so incentives for entrepreneurship and founding new firms must be the right kind. Micro-level evidence can therefore provide useful information about sources of economic growth. Also understanding the firm-level dynamics considering job creation and productivity development can help some to understand the dynamics of the whole economy.

Productivity and employment in different industries vary over time. New innovations lead to better technologies, which create new industries and also lead to structural changes in already existing ones. Some industries may also disappear entirely. Technology that effects on many industries and is well applicable for most of them is called general purpose technologies. These technologies drive economic growth significantly. The newest general purpose technology is information and communication technology and development of ICT has created an entirely new industry: ICT production. ICT production means products and services related to information and communication technology that consumers and other firms can use. This technological development also has other impacts. Other industries can use this technology in their production and that way improve their activities.

This thesis aims to provide information about job creation and productivity growth impacts of certain firms. High-growth firms create most of the jobs in Finland in the past decade according to Ministry of Employment and the Economy so that this small group of firms is important to the whole economy. We will divide the data into different firm groups and analyze high-growth firms' impact on net job creation and productivity, and compare the results to firms in other categories. We will divide industries into ICT-producers, ICT-users and non-ICT industries. Non-ICT industries are also divided into manufacturing and non-manufacturing, so that we have four industry groups all in all. Non-ICT non-manufacturing industries can be considered as non-ICT services also. We will analyze the high-growth firms and their impact inside and between these industries. This thesis is aiming to provide information about that, if high-growth firms really create more jobs and what is their contribution to productivity in different industries. We also aim to provide information about the relationship between ICT and high-growth firms and differences between these industry groups.

4.2 Data

In this thesis we analyze firm specific productivity contributions and job creation in different industries. We are trying to find out the impact of high-growth firms compared to other firm groups, and we also study the relationship between firm growth and ICT industries. Statistics Finland's Financial Statement Statistics data offers information about the variables that we are interested in. This statistics contains information about enterprises operating in Finland. Statistics include industry-specific data on number of enterprises, personnel, financial statements and itemization of turnover and expenditure. Data also include information on the growth of enterprises and how they have managed after the starting year.[1]

Professor Mika Maliranta has kindly provided industry-level data that contains modified Diewert-Fox decomposition computations. Data is similar to data used in earlier literature by Maliranta (Böckerman & Maliranta, 2012; Hyytinen & Maliranta, 2013). In this thesis we use the non-logarithmic version of modified Diewert-Fox decomposition. We look into data from years 1999 - 2014. This period provides five three-year periods, which allows us to separate high-growth firms from other firm groups in five periods. Three-year changes are used because of the high-growth firm definition. With this time period we can analyze changes in job creation and productivity growth, and therefore also changes in sources of productivity growth. This period has also other advantages. It covers years during dot-com bubble and the financial crisis of 2007 -

[1] Official Statistics of Finland (OSF), Structural business and financial statement statistics [e-publications]. ISSN=2342-6233. Helsinki: Statistics Finland [referred: 10.11.2016]. Access method: http://www.stat.fi/til/yrti/index_en.html

2009 that started from United States, and also some years during the crisis. Also European debt crisis is included in this period. This period offers opportunity to analyze different firms in different situations of economy. Besides of looking into job creation we can analyze productivity growth development before, during and after crisis. Variables of interest are presented more specifically in Appendix.

Like mentioned before, we analyze high-growth firms and compare the results to other firm groups. Data is divided into eight groups, where all groups contain continuing firms. Firm groups are formulated using firms' size and growth rates, which both are targets of this thesis. Also comprehensive background literature of firms' size gives support to this separation. By size the firms are divided into large and small groups using the threshold of ten employees. High-growth firms are also being divided into two groups based on OECD's definition for high-growth firms. We divide high-growth firms into two groups, large and small, also by threshold of ten employees with the condition of annualized average growth rate of 20%. For symmetry, we also define two groups of firms that declined highly during the period. This group is opposite for the high-growth firms.

Earlier in this thesis introduced some possible biases that can occur in size-growth related research. Regression-to-the-mean bias occurs when values of variables of interest are extremely high or low and they are getting closer their long run averages. This includes also the firm size. Very small firms tend to grow and very large firms tend to contract. This may lead to perception that small firms grow faster on average than large firms. In this data is used average employment of beginning and end of the period to deal with this bias. Also distribution bias can occur. This is when firms grow and they move into another size group or category. In this data groups are defined by average annual growth rates, so firms do not move into another group during these three-year periods.

Data provides all variables needed to construct the decomposition. To provide comprehensive analysis economic growth is decomposed into net employment growth and aggregate labor productivity growth. These subcomponents are again decomposed into job creation and destruction, and also to productivity sources. Productivity growth sources are presented more accurately further, but they are within component and structural component, which describes creative destruction. Economic growth here is presented as real value added. Nominal values are deflated using industry specific price indexes from Eurostat.

TABLE 5 Industries and industry categories.

Industries and categories	ID
ICT producing industries	
-Telecommunications	D61
-IT and other information services	D62T63
-Publishing, audiovisual and broadcasting activities	D58T60
ICT-using industries	
-Activities auxiliary to financial service and insurance activities	D66
-Financial service activities, except insurance and pension funding	D64
-Insurance, reinsurance and pension funding, except compulsory social security	D65
-Professional, scientific and technical activities: administrative and support service activities	D69T82
-Wholesale and retail trade	D45T47
-Transportation and storage	D49T53
non-ICT non-manufacturing	
-Accommodation and food services	D55T56
-Arts, entertainment, repair of household goods and other services	D90T99
-Electricity, gas, steam and air condition supply	D35
-Mining and quarrying, except energy producing materials	D07T09
-Mining and quarrying of energy producing materials	D05T06
-Public administration and defense, compulsory social security, education, human health and social work acticities	D84T88
-Real estate activities	D68
-Water supply: sewerage, waste management and remedation activities	D36T39
non-ICT manufacturing	
-Basic metals and fabricated metal products, except machinery and equipment	D24T25
-Chemical, rubber, plastics, fuel products and other non-metallic mineral products	D19T23
-Construction	D41T43
-Food products, beverages and tobacco	D10T12
-Furniture; other manufacturing; repair and installation of machinery and equipment	D31T33
-Machinery and equipment	D26T28
-Textiles, wearing apparel, leather and related products	D13T15
-Transport equipment	D20T30
-Wood and paper products, and printing	D16T18

From table 5 we can see that the number of industries that are producing ICT is much smaller than others so the ICT producing category is much smaller than other categories. However, ICT-using industries are quite equivalent to other two non-ICT categories by number. Many of the industries in non-manufacturing group are private service industries. This gives some information about the data we are using.

In the table 6 is introduced firm groups used in the empirical study of this thesis. Firms are divided into eight groups of continuing firms. The definition for high-growth firms is similar to the OECD's definition. Other firms are divided by the same size as in OECD's definition to make the groups comparable. For symmetry, we have also defined high-decline firm as an opposite to the high-growth firm. To avoid regression-to-the-mean bias we use average employment of firms at the beginning and end of the period, and divide firms by that.

TABLE 6 Firm categories and definitions

Firm category	**Definiton**	
	Growth[2]	**Employees**[3]
Continuing		
large high-growth firm	growth rate ≥ 20%	Employees ≥ 10
small high-growth firm	growth rate ≥ 20%	Employees < 10
large growing	0 < growth rate < 20%	Employees ≥ 10
small growing	0 < growth rate < 20%	Employees < 10
large declining	growth rate < 0	Employees ≥ 10
small declining	growth rate < 0	Employees < 10
large high-decline firm	growth rate ≤ -20%	Employees ≥ 10
small high-decline firm	growth rate ≤ -20%	Employees < 10

[2] Growth here refers to average annualized growth rate for three-year period.
[3] The average number of employees during the three-year period. Average is used to avoid regression-to-the-mean bias.

4.3 Modified Diewert-Fox decomposition

In this thesis we analyze high-growth firms in different industries using modified version of decomposition introduced by Diewert and Fox. This modified version was introduced by Maliranta (2005) and also later used by Maliranta and Kauhanen (2012). We will divide industries into three groups by their relationship to the information and communication technology. First group consists of industries that produce ICT, the second of industries that use ICT and the third of non-users of ICT. This last group will also be divided into two subgroups, manufacturing and non-manufacturing. Using data made with modified Diewert-Fox decomposition we can analyze the job creation and productivity contributions of high-growth firms in these industries and compare them to contributions of other firms. This division into groups helps us analyze the impact of ICT. We apply this method to study firm-level dynamics in industry groups by decomposing aggregate productivity into five components introduced below. Using eight groups of continuing firms we can capture the effect of all of these components and also get a symmetric point of view to firm growth, job creation and productivity development.

Productivity can be defined the following way

$$\Phi_t = \sum_{i \epsilon I} w_{it} \varphi_{it} \qquad (14),$$

where w_{it} is the labor input share of firm *i* at time *t* and φ_{it} is the productivity index of firm *i* at time *t*. Sum of these will result the productivity of specific firm group. Diewert-Fox decomposition can be applied as logarithmic and non-logarithmic version. We apply non-logarithmic version to high-growth analysis.

Modified Diewert-Fox decomposition consists of five components. Decomposition can be presented in the following way

$$\Delta\Phi = EN_t + EX_t + BW_t + WH_t + CR_t \qquad (15)$$

$$= s_t^E[\Phi_t^E - \Phi_t^C] + s_{t-1}^D[\Phi_{t-1}^C - \Phi_{t-1}^D] + \sum_{i \epsilon E} \Delta w_{it}^C[\bar{\varphi}_{it} - \bar{\Phi}_t^C] + \sum_{i \epsilon C} \bar{w}_{it}^C \Delta\varphi_{it}$$

$$+ \sum_{i \epsilon C} \bar{w}_i \frac{\varphi_{it} - \bar{\Phi}}{\bar{\Phi}} \left(\frac{\bar{\varphi}_i - \bar{\Phi}}{\bar{\Phi}} \right) \qquad (16)$$

The first line describes the aggregate productivity change, where change is decomposed into five subcomponents. The second line presents the components. EN_t is the effect of entry, EX_t is exit, BW_t is reallocation between firms, WH_t is productivity growth within the firms and CR_t is the cross-term. In this formal presentation *E, D* and *C* refer to new firms, exiting firms and continuing firms.

The first component of decomposition presented above, so called entry, describes the productivity effect of entering firms in industry, or in this case industry category. If the productivity of entering firm is below the average industry productivity, entry will have negative effect on industry productivity. On the other hand, if the entering firm's productivity is higher than average productivity in that industry, entry will have positive effect on industry productivity.

The second component is exit. Exit component describes the effect of exiting firms. Exit component has an inverse interpretation to the entry component. If the exiting firm's productivity is higher than the average productivity in the industry then exit will have negative effect. If exiting firm's productivity is lower than average productivity on that industry, the effect of exit will be positive.

The third component is between. With this component we can analyze the reallocation of resources between firms in an industry. Between component can be positive in two cases. First, between component is positive if firms with increasing share are more productive than firms are on weighted average in that industry. On the other hand, between is also positive if firms with decreasing share have lower productivity than firms on weighted average in that industry. In other words, between component measures the productivity changes caused when resources (or market shares) change between firms in industry. Between component only exists to continuing firms.

The fourth component of DF decomposition is within component. Within measures weighted average productivity growth of firms between time period *t-1* and *t*. These time periods are treated symmetrically. Hyytinen and Maliranta (2013) report that most of the productivity growth happens through within component. Also this component only exists to continuing firms.

The last term in this DF decomposition is cross-term. Cross-term is the third component that describes continuing firms during three-year period. Cross-term is positive when firms with already high productivity have high growth rates of productivity. Interpreting this component is not as simple as the four other terms. This component can be divided into two subcomponents, within cross-term and other cross-terms, which include between, entry and exit.

These components offer wide set of information about sources of industry productivity growth. Decomposition makes it possible to analyze simultaneously continuing firms and also entering and exiting firms, and that way comparing the productivity contributions of these groups. Besides studying productivity contributions of different firm groups, decomposition makes it possible to analyze the productivity sources of firm groups through components of the decomposition.

5 RESULTS

In this chapter we look into results of the empirical study of this thesis and discuss about the results. The results are analyzed from three perspectives. First are analyzed results considering productivity growth and job creation at industry-level. Focus is on analyzing growth of real value added which is a sum of net job growth and labor productivity growth. Second part is focusing on changes in productivity at firm-level. We are trying to clarify contribution of high-growth firms to productivity growth more accurately. Firms are being divided into eight groups that only include only continuing firms for three-year periods. Groups are being defined using their growth rate and size (look chapter 4 for definitions). Third part is focusing on job creation, job destruction and net job growth for different firm groups. The results for this empirical study include results for five three-year periods for every industry group. In the main text is presented average results, more accurate results for every period is presented in Appendix (see Appendix A.4). Because average results do not provide accurate picture for firm dynamics and do not provide information about changes between periods, more periods are included for robustness.

5.1 Generally about results

The results obtained by using modified Diewert-Fox decomposition are presented in tables 7 – 10. These results are averages of all five periods for every industry group. Providing results from several periods provides more accurate results. One can also see the impacts of cyclical fluctuations to firms groups and industries. Chosen periods cover ICT bubble, financial crisis that started in 2007 and recession in Finland followed by the crisis.

This modified Diewert-Fox decomposition includes five subcomponents of aggregate labor productivity growth. Only three of these describe continuing firms and were included in this analysis. Entry and exit subcomponents are not included since entry describes the impact of entering firms to the industry productivity. Exit measures the impact of exiting firms. There are two reasons for this. First, this thesis aims to provide information and results especially about high-growth firms and only reasonable comparison for these are other firms that have continued their business for the whole period of interest. Second reason is related to the data being used in this empirical study. In this study also entry and exit subcomponents were studied, but during the study was found out that these components include some outliers, and therefore this data was not suitable for this kind of analysis. These outliers were result of some organizational changes in large Finnish firms. Continuing empirical study that way would have led to false interpretations and conclusions because entry and exit have significant impact on labor productivity growth, and therefore results for growth of real value added would have been biased.

Aims of this thesis are contributions of high-growth firms to productivity growth and job creation, and also impacts of ICT. The aim is to provide accurate empirical results for impacts of these factors to economic growth. Impacts of ICT are being analyzed in industry-level and firm-level. The results make it possible to analyze high-growth firms' contributions in different industry groups. Besides of that, high-growth firms are compared to other firm groups inside industry groups. With these results, we can provide accurate empirical evidence on firm lifecycle. Dividing firms to groups by their size and growth rate makes it possible to compare firms in different phases of their lifecycle.

5.2 Decompositions of economic growth

In this section is presented the results of this thesis. Results are presented as tables describing the decompositions. Tables 7 - 10 presented further contain decompositions from four industry groups introduced before. In the main text is presented decomposition results in four tables. These tables provide average from three-year period decompositions that are presented more accurately in Appendix (see Appendix A.4).

TABLE 7. Decomposition of economic growth by firm-level sources of employment growth and productivity growth. ICT-producing industries, 1999-2014. %.

1999-2014	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY				Share of labour input				Normalized components		
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Cross	Share at the beginning	Share at the end	Difference	Average share	Within	Between	Cross
	(1)=(2)+(5)	(2)=(3)-(4)	(3)	(4)	(5)=(6)+(7)+(8)	(6)	(7)	(8)							
All firms	5,05	1,49	11,15	9,66	3,56	2,60	-0,15	1,11	100 %	100 %		100 %	2,60	-0,15	1,11
High-growth firms, large	3,99	4,54	4,54	0,00	-0,55	-0,20	-0,45	0,10	4,1 %	10,1 %	6,0 %	7,1 %	-2,84	-6,33	1,47
High-growth firms, small	0,77	1,04	1,04	0,00	-0,27	0,06	-0,26	-0,08	1,0 %	2,4 %	1,4 %	1,7 %	3,75	-15,47	-4,43
Modest growth firms, large	4,86	4,75	4,75	0,00	0,11	-0,18	0,18	0,11	36,8 %	41,4 %	4,6 %	39,1 %	-0,46	0,46	0,28
Modest decline firms, large	-2,42	-5,65	0,00	5,65	3,24	2,53	-0,11	0,82	42,5 %	34,5 %	-8,0 %	38,5 %	6,56	-0,29	2,14
Modest growth firms, small	0,57	0,82	0,82	0,00	-0,25	-0,11	-0,15	0,01	4,2 %	5,1 %	0,8 %	4,7 %	-2,34	-3,16	0,20
Modest decline firms, small	-0,38	-0,72	0,00	0,72	0,34	0,21	0,21	-0,07	5,2 %	4,2 %	-1,0 %	4,7 %	4,38	4,33	-1,57
High-decline firms, large	-1,90	-2,56	0,00	2,56	0,66	0,18	0,25	0,23	4,7 %	1,7 %	-3,0 %	3,2 %	5,67	7,83	7,22
High-decline firms, small	-0,44	-0,73	0,00	0,73	0,29	0,12	0,19	-0,02	1,5 %	0,6 %	-0,9 %	1,0 %	11,44	18,51	-1,72

TABLE 8. Decomposition of economic growth by firm-level sources of employment growth and productivity growth. ICT-using industries, 1999-2014. %.

1999-2014	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY				Share of labour input				Normalized components		
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Cross	Share at the beginning	Share at the end	Difference	Average share	Within	Between	Cross
	(1)=(2)+(5)	(2)=(3)-(4)	(3)	(4)	(5)=(6)+(7)+(8)	(6)	(7)	(8)							
All firms	6,70	7,05	15,95	8,90	-0,35	-0,27	0,00	-0,08	100 %	100 %	0 %	100 %	-0,27	0,00	-0,08
High-growth firms, large	4,67	6,44	6,44	0,00	-1,77	-0,95	-0,26	-0,57	3,6 %	9,4 %	5,7 %	6,5 %	-14,52	-3,98	-8,75
High-growth firms, small	1,10	1,53	1,53	0,00	-0,44	-0,19	0,16	-0,40	1,2 %	2,5 %	1,4 %	1,9 %	-10,34	8,58	-21,82
Modest growth firms, large	5,23	6,10	6,10	0,00	-0,87	-1,06	0,12	0,08	37,1 %	41,2 %	4,1 %	39,1 %	-2,71	0,30	0,20
Modest decline firms, large	-2,33	-3,79	0,00	3,79	1,46	1,44	-0,19	0,22	32,5 %	26,3 %	-6,1 %	29,4 %	4,90	-0,66	0,74
Modest growth firms, small	1,62	1,87	1,87	0,00	-0,25	-0,27	0,03	-0,01	9,0 %	10,3 %	1,3 %	9,7 %	-2,78	0,30	-0,07
Modest decline firms, small	-0,80	-1,45	0,00	1,45	0,65	0,47	0,09	0,08	10,4 %	8,3 %	-2,2 %	9,3 %	5,08	1,00	0,91
High-decline firms, large	-2,05	-2,70	0,00	2,70	0,65	0,24	-0,02	0,43	4,5 %	1,3 %	-3,1 %	2,9 %	8,34	-0,68	14,77
High-decline firms, small	-0,76	-0,96	0,00	0,96	0,20	0,04	0,07	0,09	1,7 %	0,7 %	-1,0 %	1,2 %	3,21	6,19	7,42

TABLE 9. Decomposition of economic growth by firm-level sources of employment growth and productivity growth. Non-ICT non-manufacturing industries, 1999-2014. %.

1999-2014	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY				Share of labour input				Normalized components		
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Cross	Share at the beginning	Share at the end	Difference	Average share	Within	Between	Cross
	(1)=(2)+(5)	(2)=(3)-(4)	(3)	(4)	(5)=(6)+(7)+(8)	(6)	(7)	(8)							
All firms	5,56	11,39	18,17	6,78	-5,83	-4,93	-1,04	0,15	100 %	100 %	0 %	100 %	-4,93	-1,04	0,15
High-growth firms, large	5,69	7,81	7,81	0,00	-2,12	-1,27	-0,65	-0,19	6,4 %	15,7 %	9,3 %	11,0 %	-11,52	-5,94	-1,75
High-growth firms, small	1,13	2,24	2,24	0,00	-1,11	-0,33	-0,49	-0,28	2,0 %	4,0 %	2,0 %	3,0 %	-11,32	-16,53	-9,59
Modest growth firms, large	2,61	5,21	5,21	0,00	-2,60	-2,28	-0,45	0,13	31,8 %	33,0 %	1,3 %	32,4 %	-7,05	-1,38	0,39
Modest decline firms, large	-2,45	-2,39	0,00	2,39	-0,06	-0,36	-0,21	0,52	24,9 %	18,7 %	-6,1 %	21,8 %	-1,67	-0,98	2,38
Modest growth firms, small	1,12	2,91	2,91	0,00	-1,80	-1,00	-0,46	-0,34	14,8 %	15,6 %	0,8 %	15,2 %	-6,55	-3,04	-2,21
Modest decline firms, small	-1,27	-1,96	0,00	1,96	0,68	0,09	0,79	-0,20	15,5 %	11,4 %	-4,1 %	13,5 %	0,66	5,87	-1,45
High-decline firms, large	-0,66	-1,28	0,00	1,28	0,61	0,22	0,04	0,36	2,4 %	0,7 %	-1,6 %	1,6 %	14,28	2,36	22,96
High-decline firms, small	-0,59	-1,15	0,00	1,15	0,56	0,01	0,39	0,16	2,3 %	0,8 %	-1,5 %	1,6 %	0,39	24,85	9,94

TABLE 10. Decomposition of economic growth by firm-level sources of employment growth and productivity growth. Non-ICT manufacturing industries, 1999-2014. %.

1999-2014	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY				Share of labour input				Normalized components		
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Cross	Share at the beginning	Share at the end	Difference	Average share	Within	Between	Cross
	(1)=(2)+(5)	(2)=(3)-(4)	(3)	(4)	(5)=(6)+(7)+(8)	(6)	(7)	(8)							
All firms	1,54	-0,61	11,74	12,35	2,15	0,94	0,66	0,55	100 %	100 %	0 %	100 %	0,94	0,66	0,55
High-growth firms, large	2,70	3,93	3,93	0,00	-1,23	-0,86	-0,09	-0,27	2,9 %	7,7 %	4,9 %	5,3 %	-16,21	-1,76	-5,18
High-growth firms, small	1,00	1,49	1,49	0,00	-0,49	-0,21	-0,22	-0,06	1,9 %	4,7 %	2,7 %	3,3 %	-6,26	-6,67	-1,84
Modest growth firms, large	4,18	5,03	5,03	0,00	-0,85	-0,77	0,16	-0,23	28,5 %	32,7 %	4,2 %	30,6 %	-2,52	0,51	-0,76
Modest decline firms, large	-3,55	-6,96	0,00	6,96	3,41	2,54	-0,02	0,89	41,4 %	34,2 %	-7,3 %	37,8 %	6,72	-0,05	2,34
Modest growth firms, small	1,00	1,29	1,29	0,00	-0,29	-0,11	-0,13	-0,05	8,0 %	9,7 %	1,7 %	8,9 %	-1,20	-1,45	-0,58
Modest decline firms, small	-0,69	-1,22	0,00	1,22	0,53	0,29	0,22	0,03	10,0 %	8,0 %	-2,0 %	9,0 %	3,21	2,41	0,29
High-decline firms, large	-2,44	-3,14	0,00	3,14	0,70	-0,01	0,53	0,18	4,1 %	1,7 %	-2,5 %	2,9 %	-0,44	18,24	6,11
High-decline firms, small	-0,68	-1,04	0,00	1,04	0,36	0,07	0,21	0,08	3,1 %	1,3 %	-1,8 %	2,2 %	3,25	9,89	3,56

5.3 Analysis of productivity and job creation

5.3.1 Results of empirical study

In this section are analyzed empirical results of the modified Diewert-Fox decomposition. Main results are reported in tables 7 – 10. These tables contain average results for five three-year periods from all industry groups. Results for every period are presented in Appendix (see Appendix A.4). In the first column is presented growth of real value added, which is defined as a sum of net job growth and aggregate labor productivity growth. In the second column is presented contributions to net job growth, which is defined as difference of job creation and job destruction. Aggregate labor productivity growth is defined as a sum of subcomponents of labor productivity, within, between and cross-term. Cross-term can be also defined separately to within and other terms (within cross-term and other cross-terms). After labor productivity is presented labor input shares of different firm groups. In addition to shares of beginning and end of the period, also average labor input shares are needed for normalized components. Also the difference between beginning and end labor input shares are reported. The last columns contain normalized components that are calculated by dividing the subcomponents of firm groups by their average labor input share. Normalized components describe the changes in subcomponent of labor productivity for average firm inside a firm group.[4]

As noted before, Ministry of Employment and the Economy have stated that high-growth firms create most of the new jobs in Finland (Ministry of Employment and the Economy, 2011 & 2012). Despite of great ability of job creation of these firms, they have not had much of attention in earlier economics related literature. In this empirical study high-growth firms' contribution to job creation has been studied in four industry groups. For robustness the analysis is repeated for five three-year periods. To highlight the significance of high-growth firms' job creation contributions, average labor input shares must be taken into account. Labor input shares of high-growth firms are small, when compared to other firm groups, but their labor input shares vary between industry groups. In non-ICT non-manufacturing industries high-growth firms' average labor input share was 14,0 % when in other industry groups it was just slightly over 8,0 %. These include both, large and small high-growth firms. So by their labor input share, high-growth firms are relatively small group when compared to large firms, for example.

Results show that contribution of high-growth firms to job creation is significant. For example, in table 7 is presented job creation contribution of high-growth firms in ICT-producing industries. Summed contribution of large and small high-growth firms is 5,59. This means that on average high-growth firms

[4] According to average results, within component for large high-growth firms in ICT-producing industries is -0,20. Normalized within for large high-growth firms is therefore -0,20/7,1%= -2,84.

have created 50,1 % of jobs.[5] Studying results for all periods show that with little variation between industry groups, high-growth firms (large and small) create approximately 49,10 % of new jobs. This value is average from all industry groups. This is significant part of new jobs when noticed also the small average labor input share. High-growth firms' contributions to job creation compared to all firms is presented in figures in Appendix (see Appendix A.3.1). More accurate view shows that the contribution of large high-growth firms is significant.

Purpose of the used industry group deviation is to bring the impact of ICT into light. However, no significant differences in job creation between industry groups can be found. Only difference to be found is the relatively large labor input share of high-growth firms in non-ICT non-manufacturing industries. In non-ICT non-manufacturing industries growth of real value added has happened mostly through net job growth, and high-growth firms' contribution has been significant, but the share of created jobs has remained rather constant between industry groups. Otherwise high-growth firms act rather the same way in every industry group.

Despite of the high job creation contributions of these firms, the aggregate labor productivity growth in high-growth firms is negative. In addition to contributions, normalized components are provided to see the changes in average firm inside a firm group. The importance of labor productivity changes in high-growth firms can be seen when labor input shares are taken into account. Normalized components of labor productivity for high-growth firms are highly negative, which refers to very weak labor productivity growth. This result is also robust, since the highly negative aggregate labor productivity growth repeats in every period. Labor productivity contributions remain small because of relatively small labor input shares. Most of the changes in aggregate labor productivity happen through within component (Hyytinen & Maliranta, 2013), so comparing normalized within components of high-growth firms to within components of all firms' results a huge gap in labor productivity. Measured with within component, weighted average change of productivity within high-growth firms is more than 10 % lower than in all continuing firms. This gap is significant, and varies little between industry groups. In non-ICT non-manufacturing industries this gap is almost 15 % on average and in ICT-producing industries slightly over 7 % on average. Even though high-growth firms create most of new jobs on average, labor productivity growth in these firms is highly negative.

As mentioned before, in addition to high-growth we are also interested in general purpose technologies impacts on labor productivity and therefore also to economic growth. Especially in the aim of this thesis is ICT. Industry deviation is provided for this kind of analysis. Economic growth theory highlights the importance of technological development to economic growth. So according to this, one should be able to find growth and labor productivity differences

[5] Large high-growth firms' contribution to job creation is 4,54 and small high-growth firms' 1,04, which is 5,59 in total. When this is divided by total job creation, the result is job creation of high-growth firms: 5,59/11,15 = 50,1 %.

among industry groups if ICT does have impacts on these factors. According to earlier literature (van Ark et al., 2003; Pilat & Lee, 2001) ICT-producing industries have developed better than others, but also ICT-using industries have had faster economic growth than others. Figure 7 contains a visual presentation of indexes of growth of real value added for every industry group. In this figure is not presented any sources of economic growth, but more figures are provided in Appendix of this thesis (see Appendix A.1.1). Indexes show the differences between industry groups. ICT-using industries have had more economic growth than other industry groups, and the growth has been the weakest in non-ICT manufacturing industries. This result may be related to more intensive usage of ICT, but no necessarily. Also non-ICT non-manufacturing industries have had quite positive development despite of lack in usage of ICT. Sources of economic growth reveal more. Aggregate labor productivity growth has been very weak in ICT-using industries even though they are counted as more intensive users of ICT. Also labor productivity growth in non-ICT manufacturing industries has been rather positive despite of the lack in usage of ICT. Therefore, according to these results no connection can be found between ICT-related industries and better labor productivity growth.

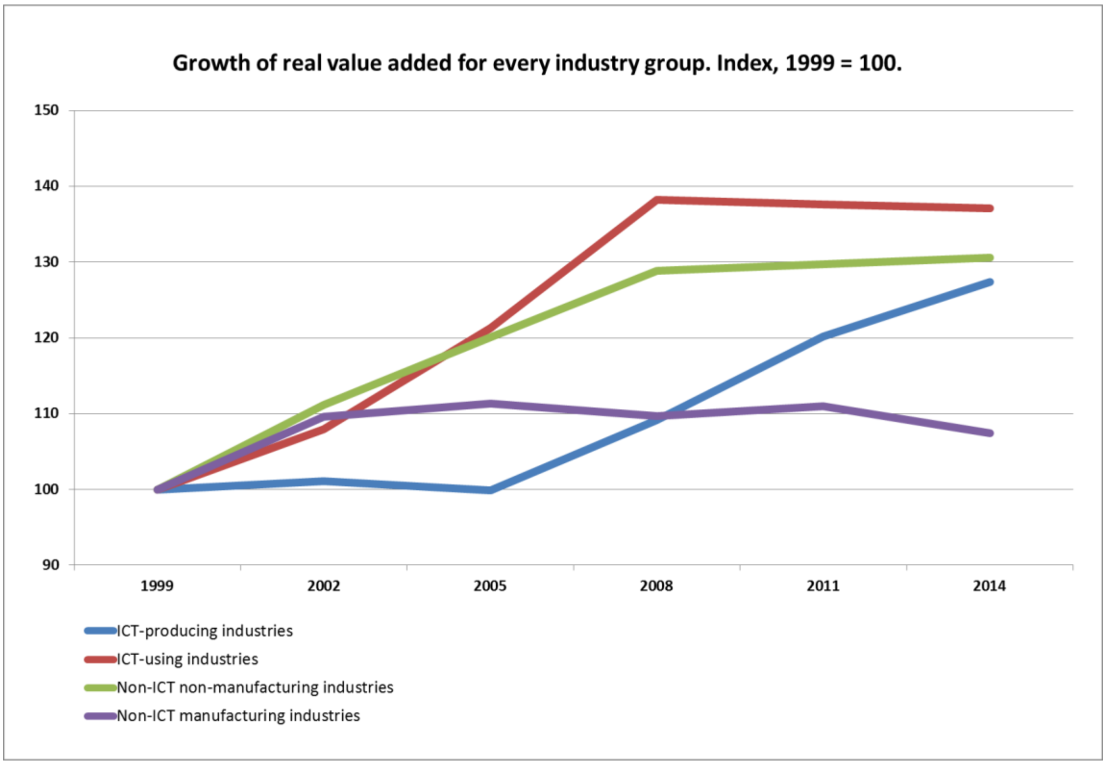

Figure 7 Growth of real value added for every industry group. Index, 1999 = 100.

As noted before, general purpose technologies (such as ICT), are closely related to productivity growth. According to Schumpeterian growth theory innovations may have productivity improving impacts through so called creative destruction (see 2.3.5). Modified Diewert-Fox decomposition includes between component that displays the productivity impacts of shifts of labor input shares, or in other word structural changes. Figure 8 shows the indexes of between component for all industry groups. According to results some productivity improvements through creative destruction has happened in ICT-producing industries and non-ICT manufacturing, but no clear connection between creative destruction and ICT is there to be found. In non-ICT non-manufacturing and ICT-using industries between components have been negative, so in these industries creative destruction have not had any productivity improving impacts. Breakdown of between component shows the firm groups that have had positive labor productivity growth through between component. Mainly positive between components are related to declining firms, especially high-decline firms. Even though the contributions to between component from these firms are small, normalized component show that the productivity growth inside these firm groups are significant. Also this result is robust and can be found from every period.

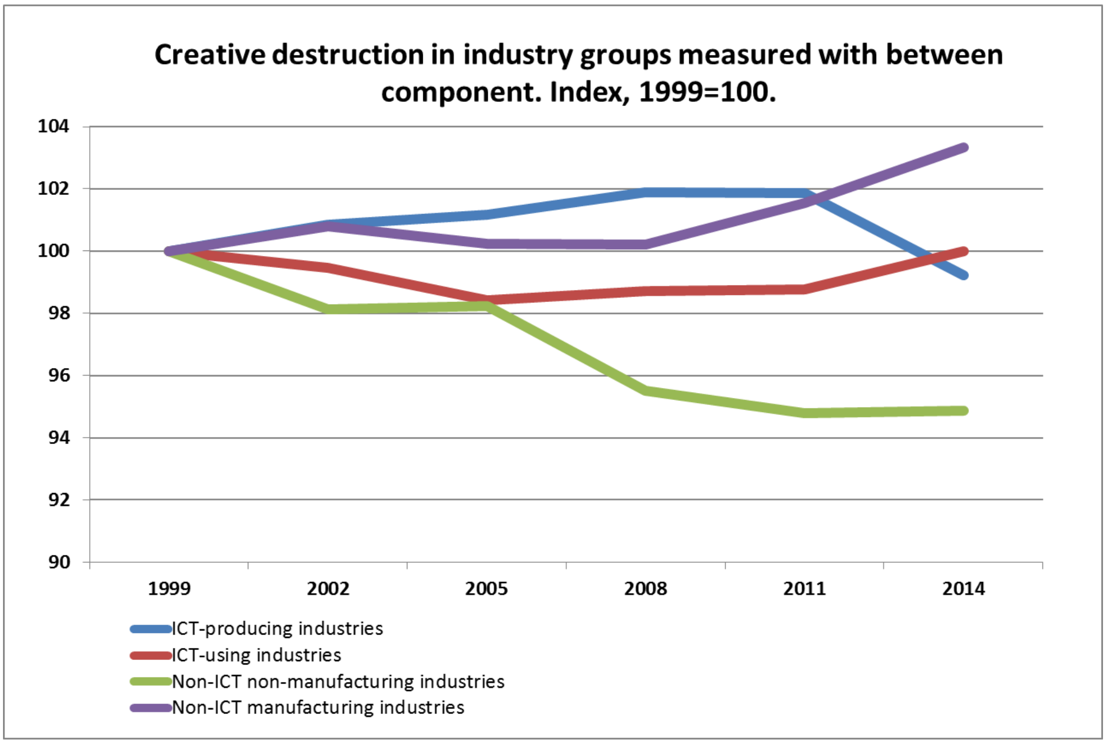

Figure 8 Creative destruction in industry groups measured with between component. Index, 1999=100.

Relationship between net job growth and aggregate labor productivity growth can also be analyzed with decomposition results. According to the results in tables 7 – 10, positive contributions to growth of real value added come from growing firms, which also have negative contributions to aggregate labor productivity growth. On the other hand, declining firms' contributions to aggregate labor productivity growth are positive. These factors seem to develop into opposite directions. This result is also robust since it can be found in every period and no differences between industry groups can be found.

5.3.2 About entry and exit

In this thesis we have applied modified version of productivity decomposition introduced by Diewert and Fox to continuing firm groups in different industry groups. This decomposition also includes two terms considering firms that are not counted as continuing firms. This means firms that enter or exit the market during the three-year period. However, these components are not included into the decomposition results in this thesis for a couple of reasons. First, even though entry and exit have significant impact to industry productivity, we decided to focus on continuing firms since they are comparable to high-growth firms, which are continuing firms and the target of this study. Entry and exit mechanism don't really give much comparable information when studying high-growth firms. Second, in the empirical part of this thesis we actually included entry and exit to the decomposition and studied the impacts. After closer look to the results entry and exit were left out since they included some outliers in the data and that would have given wrong picture about the real value added and therefore lead to wrong interpretation and conclusion. These outliers include large firms in Finland that are counted as entering firms in our data because of their organizational restructuring.

5.3.3 Comparison of results

Earlier literature provides a lot of information and results about firm growth and relationship between ICT and productivity. Some of this literature also has many same elements used also in this thesis. In this section we compare our results to other (rather) similar studies, and see if our analysis provides same kind of results.

Pilat and Lee (2001) studied relationship between ICT and productivity. Pilat and Lee concluded that ICT producing sector has major contribution on productivity development in several OECD countries. They also concluded that large ICT sector does not explain rapid productivity growth since there are examples of countries that have large ICT sector and weak productivity growth, and vice versa. (Pilat & Lee, 2001.)

Van Ark et al. (2003) also studied ICT and productivity. They used same kind of breakdown into industry groups as used in this analysis. According to their analysis productivity growth was significantly rapid in ICT-producing industries when compared to ICT-using industries and non-ICT industries. They compared productivity growth in these industry groups between European countries and United States. Productivity growth was more rapid in United States. Their results also show that productivity growth was weaker in non-ICT industries.

These studies introduced are mainly similar to analysis of this thesis in industry level, and provide valuable information about relationship between ICT and productivity. In this thesis analysis was also applied to firm-level to see the different contributions of firm groups. Results about ICT and productivity growth are rather similar than results of this thesis. These imply that ICT sector has significant impact on productivity, and our analysis also adds that mostly positive productivity growth happens in declining firms even though their contribution to economic growth is negative. On the other hand, mostly new jobs are created in high-growth firms, and their contribution to economic growth is very significant, even though their contribution to productivity is negative.

5.3.4 Results and economic theory

In chapter two of this thesis is introduced theoretical background that is relevant to firm growth and firm-level dynamics. Also some determinants of growth were introduced. This theoretical background consists of earlier literature about high-growth firms, Gibrat's law and firm lifecycle.

Gibrat's law (or law of the proportional effect) is a theory about relationship between firm's size and firm's growth. This theory was introduced by Robert Gibrat. Gibrat's law claims that proportional growth rate of the firm is independent of the firm's absolute size. In other words, all firms in the same industry should grow at the same growth rate. Gibrat's law can be problematic since growing can be organic or inorganic. By inorganic growth one means growth that has happened through acquisition or merger. Another key factor is the measurement of growth and size. According to our results Gibrat's law does not hold. In this thesis we have defined firm groups by their ability to create jobs (grow) so this theory cannot be realized since we have firms in all of these groups. Measuring firm's growth by employment growth has led us to conclusion that large firms and high-growth firms create most of the new jobs.

Another part of theoretical framework in chapter two is firm's lifecycle. This describes firms' development and the steps of firms' life. Many steps can be introduced, like entry, productivity development, changes in firm's size, changes between firms, and exit. Data and methods used in this analysis on make it possible to look into short period in firm's life but different firm groups make it possible to analyze firms in different situations of their lifecycle and comparison of them.

In this thesis we have focused on the continuing firms, so analysis is focused to firm's size, firm's growth by employment and firm's productivity growth. Even though firm's age is a significant factor when focusing on growth and productivity, we do not include it into this analysis. Several three-year periods of this analysis repeat some patterns that are interesting. High-growth firms contribution to net job growth and therefore also to economic growth is significant, but productivity growth is negative at the same time. While these firms grow by employment, their productivity does not grow that rapidly. This happens in every industry group and time period. Our analysis also shows that this does not happen only to high-growth firms. In every firm group firm size and productivity develop into different directions. Declining firms' productivity growth was mainly positive in every period and industry group. Contributions of declining firms were negative and growing firms were positive so in growing phase net job growth is more positive than productivity growth is negative and vice versa. Firms seem to grow first by employment and after that decline while their productivity grows. This can be because of learning-by-doing of new employees or changes in management or organization for example.

5.3.5 Reliability of results

Reliability of results is always connected to many different factors. Factors that have impact on results are quality of data being used and methods. Employment and productivity decomposition results, computed by modified Diewert-Fox decompose, that are used in this empirical study, are received from Professor Mika Maliranta. Noticing these facts about data and methods, we can state that the data is reliable and it provides us possibility to accurate firm-level and industry-level analysis.

In this thesis we analyze high-growth firms' contribution to productivity and job creation, and compare the results to other firm groups that contain also continuing firms. Definition for high-growth firms is from OECD and it is widely used, so there is no possibility to wrong kind of conclusion because of definition. Also industry deviation is used in earlier literature (van Ark et al., 2003). For symmetry we have also defined high-decline firms and used data from years 1999 – 2014 to provide as accurate and wide picture as possible.

Method used in this thesis for analysis of productivity and net job growth is also widely known and used in earlier literature. Different decompositions are common tool when studying industry-level, plant-level and firm-level dynamics so we state that the method provides reliable results. Earlier literature knows many different kinds of decompositions and we ended up using modified Diewert-Fox decomposition since we think it serves our purposes the best possible way.

Results of this analysis are being reported as averages of the three-year decompositions in the main text. Our period includes some business cycles, and these averages smooth the impacts of these cycles quite well. For more accurate analysis, also three-year decompositions are being reported in Appendix and used for analysis in this thesis. This is because economic growth has varied a lot over time in industry groups. Accurate results provide information about changes in aggregate variables, such as net job growth and aggregate labor productivity growth. Still should be noticed that using the averages of decompositions does not change the interpretation of the results and therefore they are good way to present the results. Three-year decompositions in Appendix provide accurate results, but one should still be cautious when interpreting them. Some normalized components have extremely high values, which may be because of outliers in the data. These effects also smooth in average decompositions.

Even though these results provide valuable information about sources of economic growth, some important points must be brought to light. First, decomposition results only include data from continuing firms, so no impacts of entry and exit is included. These subcomponents have effect on aggregate labor productivity. Second, job creation and destruction are complicated factors, since the firm-level data does not provide information about the sources of job creation. This means that results do not separate organic and inorganic (synthetic) growth. Organic growth means actual growth of new jobs, and synthetic growth refers to growth by acquisitions. Third noticeable point is the study of ICT. Many different ways to measure the usage and relationship to ICT is introduced in earlier literature, and dividing industries into industry groups is only one way to measure these impacts. It is possible that using, for example, ICT-intensity or ICT-capital as measurement would provide more accurate results about the relationship between labor productivity and information and communication technology.

Noticing the facts presented in this section we can state that the results of this empirical study are reliable and provide useful information since the method and data can be stated reliable. Also this thesis includes sections that introduce empirical problems, and these are also noted in this thesis.

6 CONCLUSIONS

This thesis aims to study productivity and job creation contributions of high-growth firms. It also aims to provide information and empirical evidence about differences in variables in industries that have different relationship to ICT. Theoretical framework considering this topic includes wide definition about high-growth firms and determinants of high-growth firms. We also introduced Gibrat's law, which is a theory about relationship between firm size and firm growth. Theoretical framework also includes theory about firm's lifecycle and methods of studying productivity. We have also introduced earlier literature widely before the empirical study of this thesis.

In empirical study of this thesis we studied decompositions of economic growth by employment and labor productivity. Used method decomposes labor productivity into five components, and three of them describe continuing firms. We were mostly interested about the components of continuing firms so only those are reported in results. Average decompositions are presented in tables 7 – 10, and for every period in Appendix (see Appendix A.4). Decompositions are calculated to four industry groups in five periods, and every industry group includes eight subgroups.

Results of these decompositions are not very easy to read or interpret because of the amount of information they include. High-growth firms' contribution to aggregate productivity was mostly negative in every period and in every industry group despite of that those firms grow very fast when measured by employment. Productivity does not develop as fast in these as employment grows. According to results, impacts of ICT cannot be found among high-growth firms. Their contribution remained similar in every industry group, and was positive because of highly positive net job growth. Normalized components show that the actual changes in productivity for average high-growth firm are huge. Measured with within component, the weighted average of productivity changes within firms is more than 10 % lower in high-growth firms compared to all firms. Another important firm group was large firms, which create a lot of jobs but also destroy them, and have significant contributions to aggregate labor productivity growth. When thinking the whole industry, or industry group as in this thesis, these are important factors. Another point of view to productivity growth is the sources of productivity growth, which means the subcomponents, within, between and cross-term. According to results changes in aggregate productivity happen through within component that measures weighted average productivity changes. Between component measures the impact of creative destruction. In some periods also between component had significant values. This means that happened reallocation between firms. Cross-term's values were mostly little lower but in some industry groups also cross-term was significant factor of productivity growth in some years. Interpretation of cross-term is much more complicated than other subcomponents.

Another aspect to economic growth in this thesis was job creation. Results show that high-growth firms are responsible for the most of the jobs created, and on average they create approximately 49,10 % of the new jobs. In non-ICT non-manufacturing industries net job growth was highest in every period. In this industry category productivity growth was weakest in every period so it seems that productivity and job creation have certain relationship at industry-level. The same effect can be found among the firm groups.

These results provide a lot of useful information about firm-level dynamics and especially about high-growth firms. Even though these firms don't have positive productivity contribution, the changes in their labor productivity are significant and they still create significant amount of new jobs. It is possible that labor productivity develops slower in these firms since they grow rapidly by employment.

This thesis and the results of this empirical study also give a lot of motivation for further analysis. Since productivity growth is negative in high-growth firms but they grow by employment, it would be interesting to follow and analyze these firms more than just in their period of employment growth. For example, the next three-year period of high-growth firms after the high-growth-period would be interesting. Also studying the determinants of growth could provide valuable information.

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APPENDIX

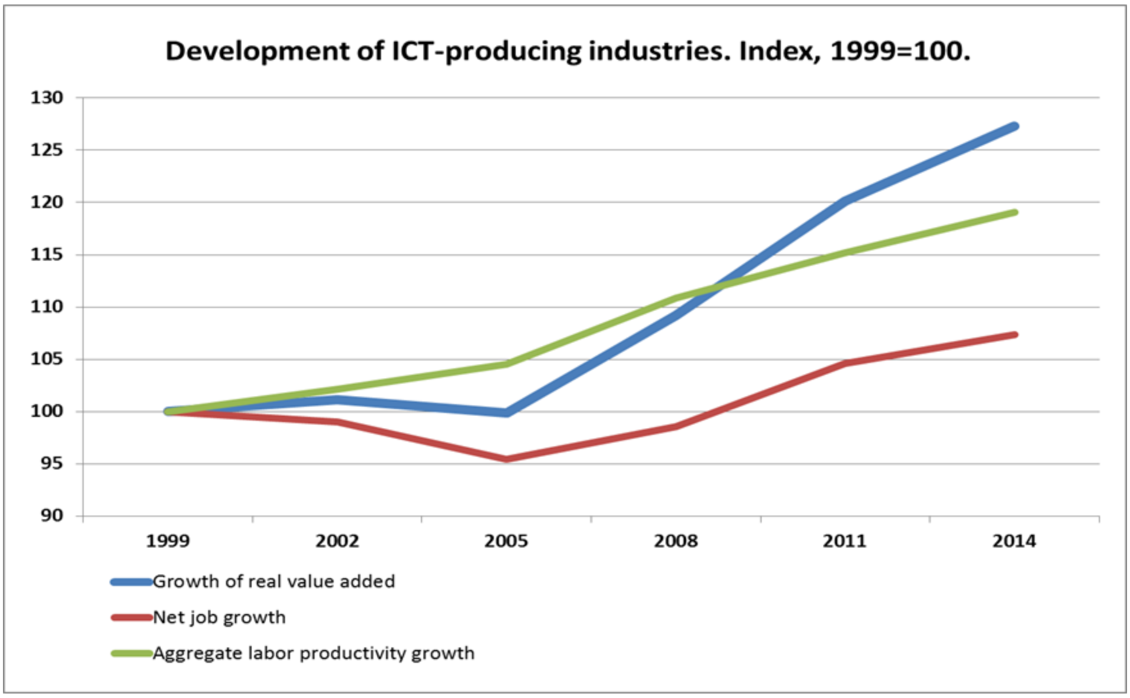
A.1 Economic growth

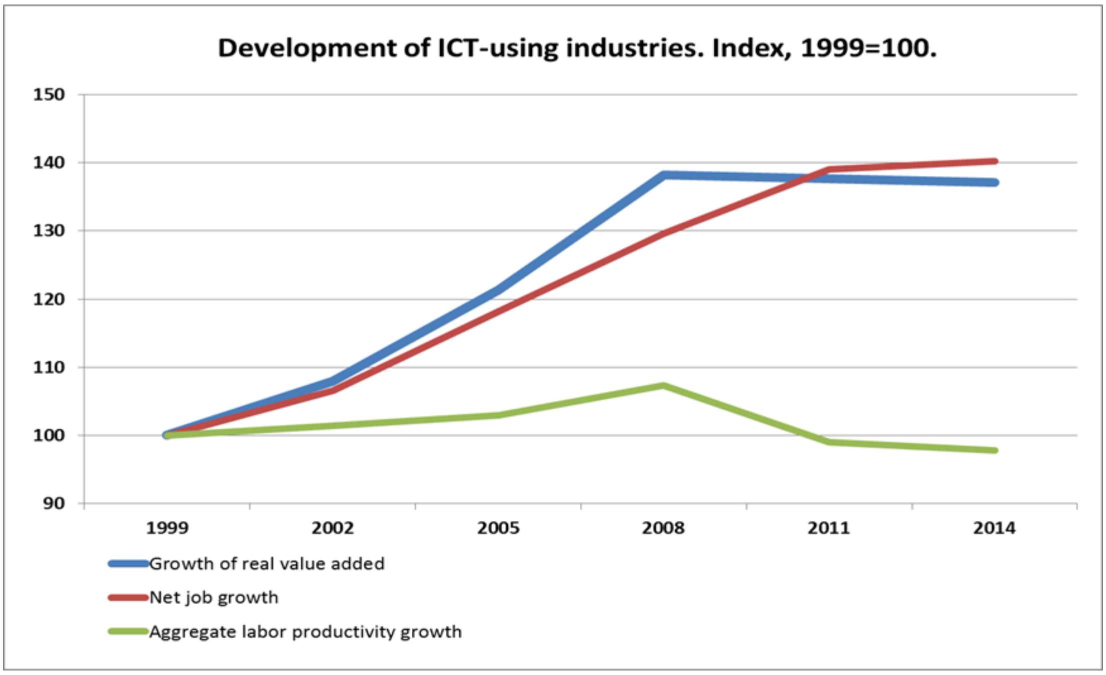
To study economic growth and sources of it, we analyze net employment growth and labor productivity growth in this thesis. Relationship between these can be defined the following way

$$\Delta GDP = \Delta NETR + \Delta AGG_{LP} \quad ,$$

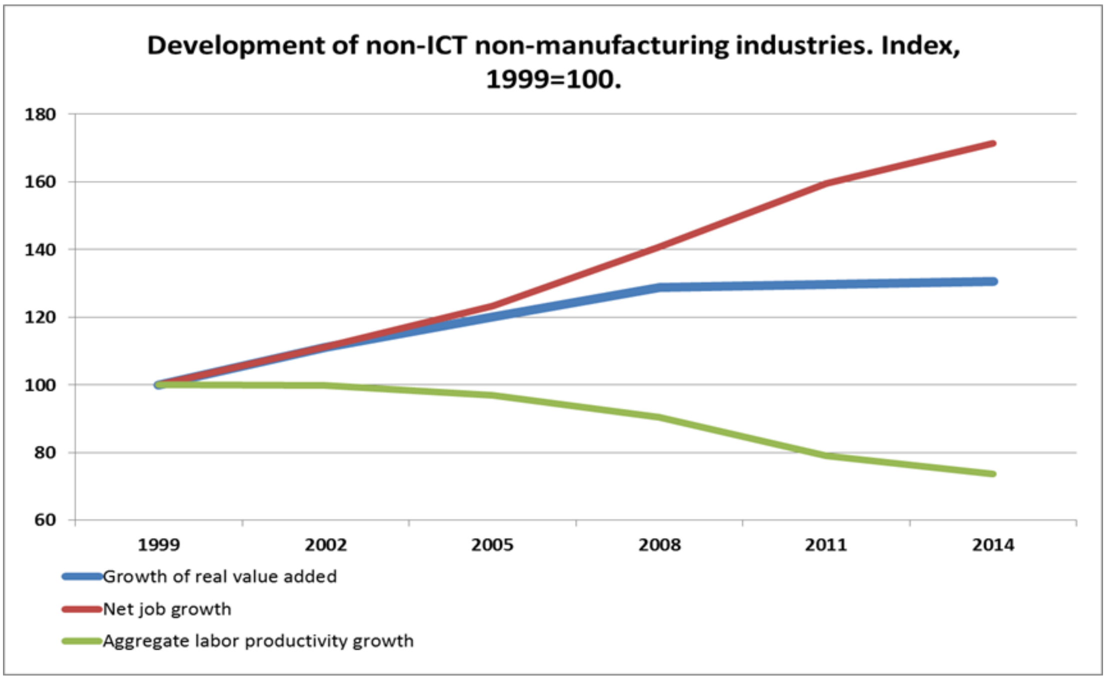
where NETR refers to net job growth rate and AGG_{LP} to aggregate labor productivity growth. Change in GDP is defined as change in real value added.

A.1.1 Development of industry groups





Development of ICT-using industries. Index, 1999=100.
150
140
130
120
110
100
90
1999
2002
2005
2008
2011
2014
Growth of real value added
Net job growth
Aggregate labor productivity growth



Development of non-ICT non-manufacturing industries. Index, 1999=100.
180
160
140
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100
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60
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2002
2005
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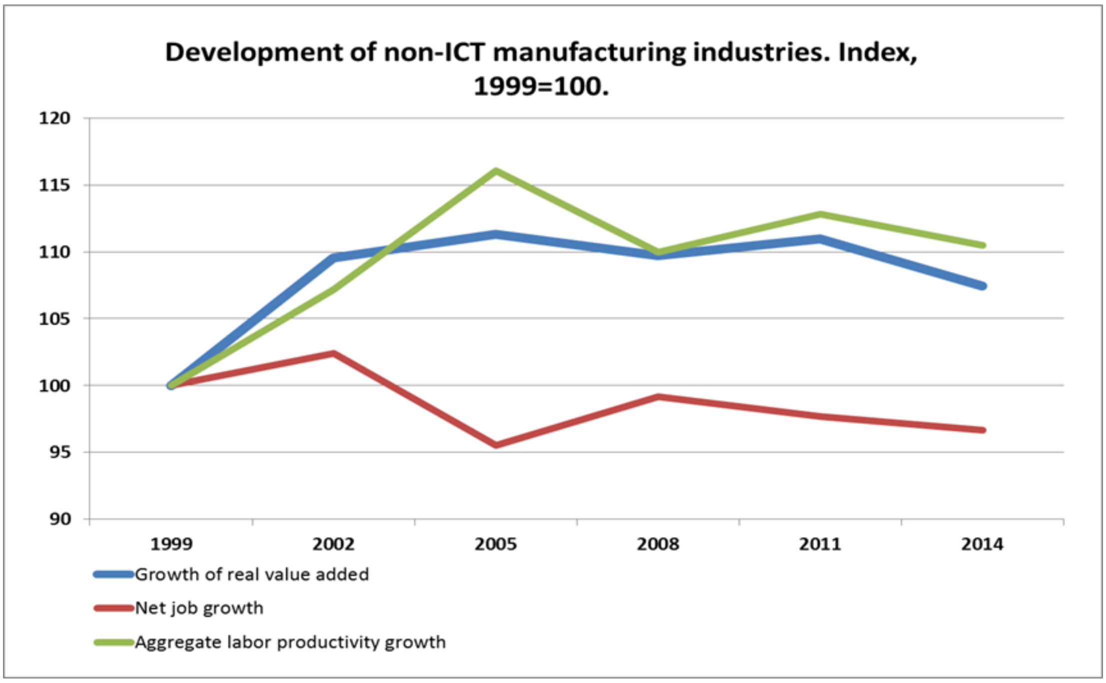
2011
2014
Growth of real value added
Net job growth
Aggregate labor productivity growth



A.2 Productivity

In this thesis we use value-added based labor productivity to measure changes in labor productivity. Industry groups' output is measured using real value added (RVA), which is nominal value added (VA) deflated by some suitable price index. In this empirical study we use industry-specific price index from Eurostat.

Balk (2016) defines value added in the following way. Value added (VA) is defined as revenue minus intermediate input costs. When this is deflated with the price index from Eurostat we get real value added that is used in this thesis. For labor productivity is usually used some measurement for labor input, which is usually total number of hours worked or persons employed. Using this we get formal presentation for labor productivity.

$$LP_{kt} = RVA^{kt}/L^{kt}$$

In this LP_{kt} refers to firm group k's labor productivity at the period t. Balk (2016) presents the same definition for industries but in this thesis we apply this to firm groups inside industry groups. To provide labor productivity accurately one must consider that firm groups are not equal inside the industry groups. For this we have weighted the firm groups by employment so that they sum up to 1. This gives us weighted average productivities of industry groups.

A.3 Job creation and destruction

In this thesis we have studied job creation and job destruction of different firm groups in different industry groups. In the results of this thesis job creation is presented as a simple value for every firm group and therefore also to the industry groups. Those values named "job creation" are actually job creation rates.

For every firm group inside these industry groups have been calculated job creation (JC) values. This value is the absolute number of new jobs inside some firm group. When this value is divided by the average labor of the whole industry group we get job creation rate (JCR). JCR tells how big share of the industry's new jobs is from some firm group. Formal forms are presented below

$$JC_{k,t} = employment_{k,t} - employment_{k,t-1}$$

Above is mathematical form of job creation. For firm group k at period t job creation is difference in employment between period t-1 and t. For job destruction the definition is the same, but the difference between periods is reverse.

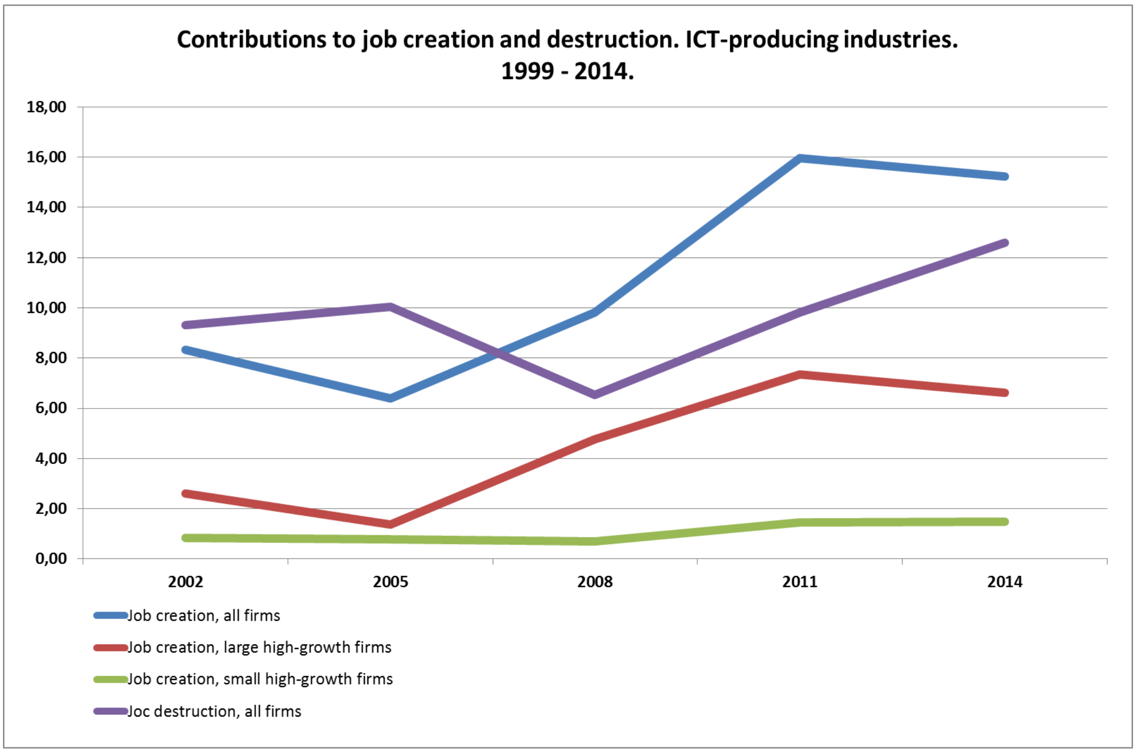
$$JD_{k,t} = employment_{k,t-1} - employment_{k,t}$$

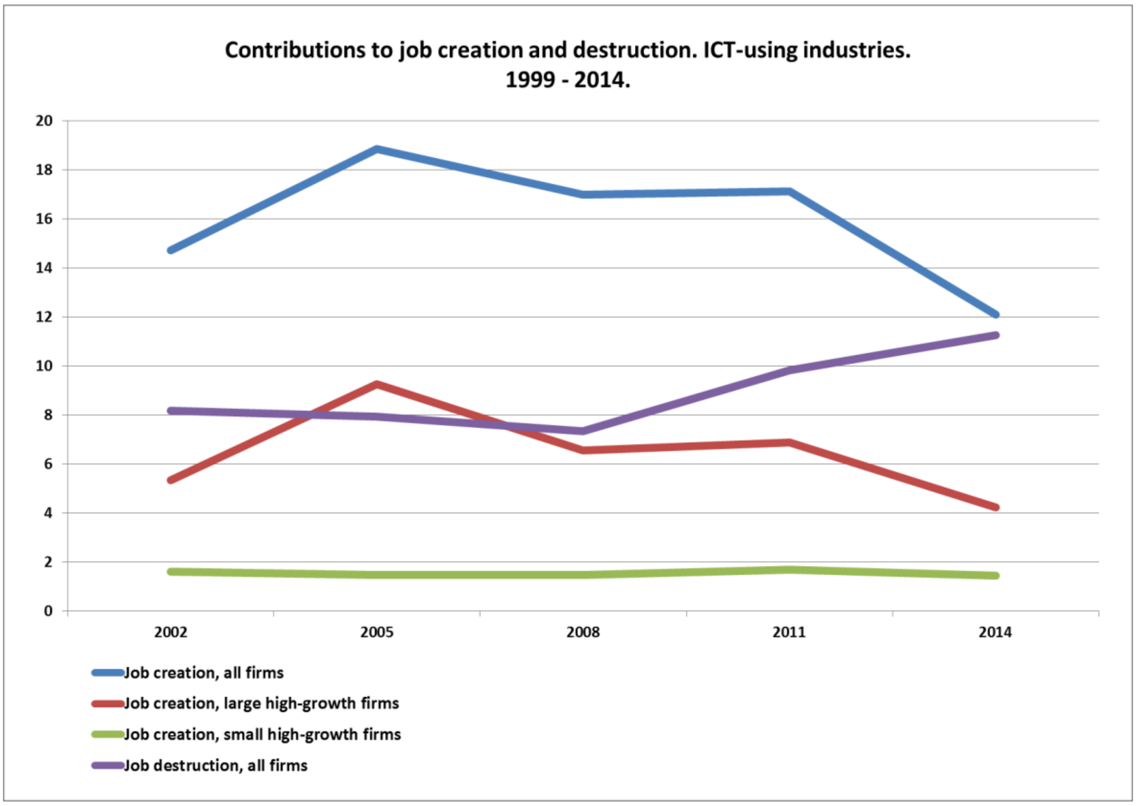
With these definitions we can now define the actual job creation rates and job destruction rates. Because JC and JD are absolute values of employment, they are not that interesting. Shares of the firm groups vary inside the industries, so we must use relative changes. Mathematical form for job creation rate is presented below.

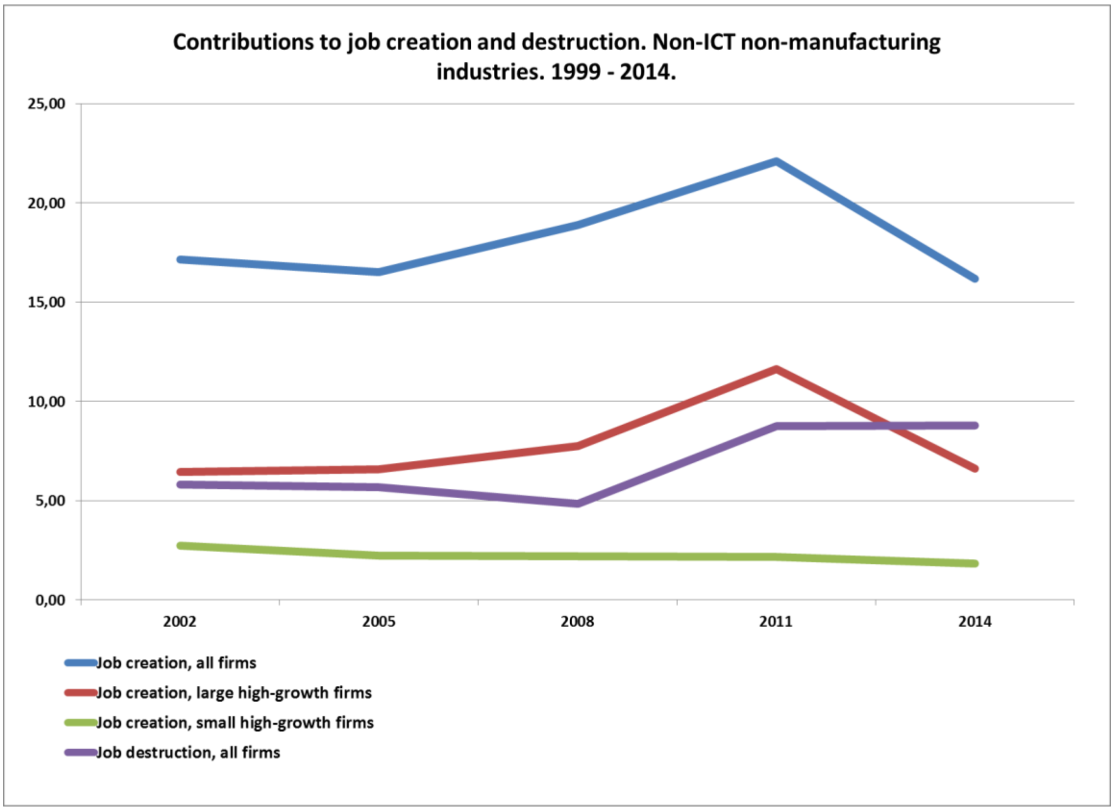
$$JCR_{k,t} = \frac{JC_{k,t}}{industry's\ average\ labor\ between\ period\ t\ and\ t-1}$$

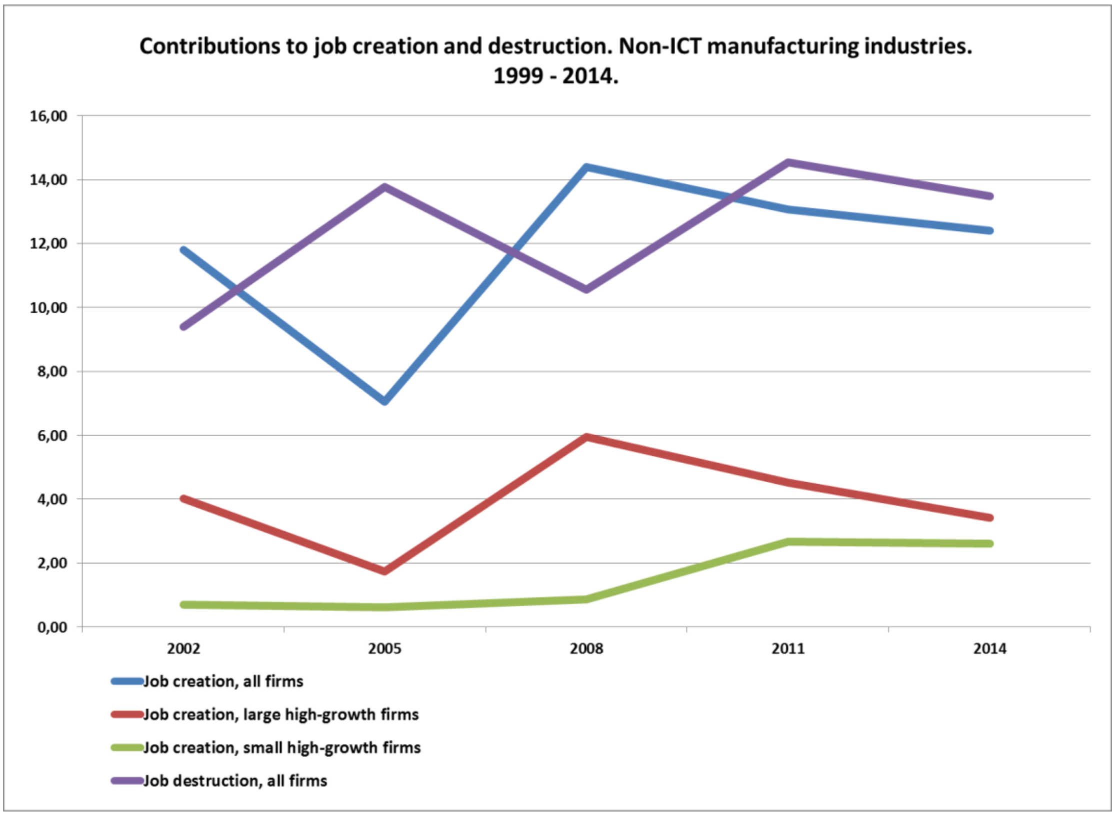
Job destruction rate is defined the same way, but of course, with the JD value.

A.3.1 Contributions to job creation






Contributions to job creation and destruction. Non-ICT non-manufacturing industries. 1999 - 2014.
25,00
20,00
15,00
10,00
5,00
0,00
2002
2005
2008
2011
2014
Job creation, all firms
Job creation, large high-growth firms
Job creation, small high-growth firms
Job destruction, all firms


Contributions to job creation and destruction. Non-ICT manufacturing industries. 1999 - 2014.
16,00
14,00
12,00
10,00
8,00
6,00
4,00
2,00
0,00
2002
2005
2008
2011
2014
Job creation, all firms
Job creation, large high-growth firms
Job creation, small high-growth firms
Job destruction, all firms

A.4 Decompositions

In this section is presented the accurate results of modified Diewert-Fox decomposition. Results in the main text are three-year averages calculated from these results. For every industry category, results are being reported in three-year periods and therefore our data includes five three-year decomposition tables.

A.4.1 Decomposition of ICT-producing industries

1999-2002	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	1,12	-1,00	8,32	9,32	2,12	0,35	0,85	0,92	0,00	100 %	100 %	0 %	100 %	0,35	0,85	0,92	0,00
High-growth firms, large	1,29	2,61	2,61		-1,32	-1,11	-0,30	0,09	0,00	1,2 %	4,5 %	3,4 %	2,9 %	-38,91	-10,46	3,14	-0,01
High-growth firms, small	0,37	0,82	0,82		-0,46	-0,15	-0,32	0,01	0,00	0,7 %	1,7 %	1,1 %	1,2 %	-12,74	-25,98	1,09	-0,02
Modest growth firms, large	4,02	4,06	4,06		-0,04	-1,80	1,02	0,73	0,00	34,5 %	40,2 %	5,7 %	37,3 %	-4,82	2,74	1,97	0,00
Modest decline firms, large	-2,42	-6,48		6,48	4,06	3,40	0,07	0,60	0,00	48,5 %	40,8 %	-7,7 %	44,6 %	7,61	0,15	1,34	0,00
Modest growth firms, small	0,23	0,83	0,83		-0,60	-0,32	-0,18	-0,10	0,00	4,7 %	5,8 %	1,1 %	5,2 %	-6,05	-3,46	-1,89	0,00
Modest decline firms, small	-0,32	-0,71		0,71	0,39	0,38	0,22	-0,21	0,00	5,9 %	5,1 %	-0,8 %	5,5 %	6,91	3,92	-3,72	0,00
High-decline firms, large	-1,35	-1,34		1,34	-0,01	0,01	0,17	-0,19	0,00	2,9 %	1,2 %	-1,7 %	2,0 %	0,64	8,09	-9,06	0,00
High-decline firms, small	-0,70	-0,79		0,79	0,09	-0,06	0,17	-0,02	0,00	1,7 %	0,7 %	-1,0 %	1,2 %	-4,67	14,24	-1,87	0,01

2002-2005	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	-1,25	-3,64	6,41	10,04	2,39	0,04	0,32	2,03	0,00	100 %	100 %	0 %	100 %	0,04	0,32	2,03	0,00
High-growth firms, large	0,58	1,36	1,36		-0,78	-0,58	-0,43	0,23	0,01	1,0 %	2,6 %	1,6 %	1,8 %	-31,68	-23,88	12,57	0,33
High-growth firms, small	0,44	0,77	0,77		-0,34	-0,17	-0,21	0,04	0,00	0,6 %	1,5 %	0,9 %	1,0 %	-16,54	-20,52	3,85	0,29
Modest growth firms, large	2,44	3,57	3,57		-1,13	-2,84	0,09	1,61	0,00	37,1 %	42,6 %	5,5 %	39,9 %	-7,11	0,23	4,05	0,00
Modest decline firms, large	-3,08	-5,79		5,79	2,72	2,27	0,14	0,31	0,00	46,0 %	41,4 %	-4,6 %	43,7 %	5,19	0,32	0,70	0,00
Modest growth firms, small	0,50	0,70	0,70		-0,21	-0,07	-0,17	0,02	0,00	3,6 %	4,5 %	0,9 %	4,1 %	-1,61	-4,05	0,47	0,06
Modest decline firms, small	-0,58	-0,79		0,79	0,20	0,05	0,16	0,00	0,00	5,7 %	5,1 %	-0,6 %	5,4 %	0,94	2,91	-0,05	-0,04
High-decline firms, large	-1,23	-2,73		2,73	1,50	1,06	0,51	-0,07	-0,01	4,6 %	1,7 %	-2,9 %	3,1 %	34,15	16,47	-2,19	-0,23
High-decline firms, small	-0,32	-0,73		0,73	0,41	0,29	0,22	-0,10	0,00	1,3 %	0,6 %	-0,8 %	1,0 %	30,77	23,00	-10,58	-0,32

2005-2008	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	9,37	3,29	9,83	6,54	6,08	6,18	0,72	-0,82	-0,03	100 %	100 %	0 %	100 %	6,18	0,72	-0,82	-0,03
High-growth firms, large	5,86	4,76	4,76		1,10	1,05	-0,18	0,25	-0,02	3,4 %	8,9 %	5,5 %	6,1 %	17,08	-2,95	4,13	-0,28
High-growth firms, small	0,88	0,70	0,70		0,19	0,74	-0,21	-0,33	0,00	0,5 %	1,3 %	0,8 %	0,9 %	78,14	-22,70	-35,30	-0,30
Modest growth firms, large	3,71	3,70	3,70		0,01	2,25	-0,40	-1,83	0,00	39,2 %	42,1 %	2,9 %	40,6 %	5,54	-0,99	-4,50	0,00
Modest decline firms, large	0,56	-3,46		3,46	4,02	2,48	0,44	1,11	-0,01	42,4 %	36,7 %	-5,8 %	39,5 %	6,26	1,11	2,80	-0,01
Modest growth firms, small	0,81	0,68	0,68		0,13	0,19	-0,12	0,06	0,00	4,3 %	4,9 %	0,6 %	4,6 %	4,17	-2,58	1,25	0,02
Modest decline firms, small	-0,06	-0,55		0,55	0,49	0,34	0,26	-0,10	0,00	5,1 %	4,3 %	-0,9 %	4,7 %	7,27	5,46	-2,13	-0,10
High-decline firms, large	-2,28	-2,04		2,04	-0,24	-1,04	0,73	0,07	0,00	4,0 %	1,4 %	-2,6 %	2,7 %	-37,77	26,61	2,53	-0,05
High-decline firms, small	-0,15	-0,49		0,49	0,34	0,17	0,21	-0,04	0,00	1,1 %	0,4 %	-0,6 %	0,7 %	23,05	28,17	-5,67	-0,05

2008-2011	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	10,04	6,16	15,96	9,80	3,89	3,69	-0,04	0,24	0,00	100 %	100 %	0 %	100 %	3,69	-0,04	0,24	0,00
High-growth firms, large	6,58	7,34	7,34		-0,76	-0,04	-0,76	0,04	0,00	5,7 %	13,7 %	8,0 %	9,7 %	-0,42	-7,83	0,42	-0,02
High-growth firms, small	1,10	1,45	1,45		-0,35	0,00	-0,27	-0,07	0,00	1,3 %	2,9 %	1,6 %	2,1 %	-0,13	-12,98	-3,35	-0,02
Modest growth firms, large	8,50	6,21	6,21		2,29	2,01	0,27	0,01	0,00	41,4 %	45,0 %	3,5 %	43,2 %	4,66	0,61	0,02	0,00
Modest decline firms, large	-3,98	-5,56		5,56	1,58	1,82	-0,37	0,13	0,00	35,4 %	26,7 %	-8,7 %	31,1 %	5,84	-1,19	0,42	0,00
Modest growth firms, small	0,71	0,96	0,96		-0,25	-0,13	-0,10	-0,01	0,00	4,5 %	5,2 %	0,7 %	4,9 %	-2,63	-2,15	-0,24	-0,01
Modest decline firms, small	-0,29	-0,73		0,73	0,45	0,29	0,23	-0,07	0,00	5,4 %	4,0 %	-1,3 %	4,7 %	6,09	4,86	-1,41	0,01
High-decline firms, large	-2,02	-2,71		2,71	0,69	-0,32	0,81	0,19	0,00	4,6 %	1,8 %	-2,8 %	3,2 %	-9,97	25,56	5,96	0,10
High-decline firms, small	-0,56	-0,80		0,80	0,24	0,06	0,17	0,02	0,00	1,6 %	0,6 %	-1,0 %	1,1 %	5,46	15,06	1,59	0,04

2011-2014	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	6,04	2,62	15,22	12,61	3,42	2,76	-2,58	3,25	-0,04	100 %	100 %	0 %	100 %	2,76	-2,58	3,25	-0,04
High-growth firms, large	5,64	6,62	6,62		-0,98	-0,33	-0,57	-0,07	-0,01	6,1 %	13,7 %	7,5 %	9,9 %	-3,33	-5,76	-0,70	-0,08
High-growth firms, small	1,06	1,47	1,47		-0,42	-0,09	-0,30	-0,02	0,00	1,4 %	3,2 %	1,8 %	2,3 %	-4,05	-13,15	-0,92	-0,16
Modest growth firms, large	5,63	6,20	6,20		-0,58	-0,54	-0,07	0,03	0,00	32,6 %	37,9 %	5,3 %	35,3 %	-1,52	-0,20	0,08	0,00
Modest decline firms, large	-3,17	-6,98		6,98	3,80	2,67	-0,84	2,00	-0,02	43,7 %	34,0 %	-9,7 %	38,9 %	6,87	-2,17	5,13	-0,04
Modest growth firms, small	0,61	0,92	0,92		-0,31	-0,22	-0,17	0,08	0,00	4,1 %	5,0 %	0,9 %	4,6 %	-4,91	-3,65	1,79	-0,07
Modest decline firms, small	-0,66	-0,82		0,82	0,16	-0,02	0,17	0,01	0,00	4,6 %	3,6 %	-1,0 %	4,1 %	-0,52	4,08	0,15	0,08
High-decline firms, large	-2,62	-3,96		3,96	1,34	1,18	-0,98	1,16	-0,02	5,9 %	1,9 %	-3,9 %	3,9 %	30,03	-25,06	29,67	-0,47
High-decline firms, small	-0,49	-0,85		0,85	0,36	0,12	0,18	0,06	0,00	1,5 %	0,6 %	-1,0 %	1,1 %	10,91	17,16	5,66	0,27

A.4.2 Decomposition of ICT-using industries

1999-2002	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	7,92	6,53	14,70	8,17	1,39	2,42	-0,54	-0,49	0,00	100 %	100 %	0 %	100 %	2,42	-0,54	-0,49	0,00
High-growth firms, large	3,95	5,33	5,33		-1,38	-0,71	-0,45	-0,21	0,00	2,8 %	7,1 %	4,3 %	4,9 %	-14,51	-9,09	-4,36	0,01
High-growth firms, small	1,32	1,60	1,60		-0,28	-0,17	0,03	-0,13	0,00	1,2 %	2,6 %	1,4 %	1,9 %	-9,14	1,65	-6,96	-0,02
Modest growth firms, large	5,81	5,76	5,76		0,05	0,06	0,07	-0,08	0,00	38,6 %	42,8 %	4,2 %	40,7 %	0,14	0,17	-0,19	0,00
Modest decline firms, large	-2,24	-3,59		3,59	1,35	1,82	-0,27	-0,20	0,00	29,8 %	24,6 %	-5,2 %	27,2 %	6,69	-0,99	-0,75	0,00
Modest growth firms, small	1,94	2,01	2,01		-0,08	0,04	0,00	-0,12	0,00	9,9 %	11,4 %	1,5 %	10,6 %	0,37	0,03	-1,12	0,00
Modest decline firms, small	-0,52	-1,62		1,62	1,10	0,98	0,19	-0,07	0,00	12,1 %	9,7 %	-2,4 %	10,9 %	9,03	1,72	-0,62	0,01
High-decline firms, large	-1,63	-2,01		2,01	0,37	0,30	-0,21	0,28	0,00	3,8 %	1,1 %	-2,7 %	2,5 %	12,09	-8,38	11,37	-0,01
High-decline firms, small	-0,70	-0,95		0,95	0,25	0,11	0,10	0,04	0,00	1,9 %	0,8 %	-1,1 %	1,3 %	8,53	7,28	3,31	-0,01

2002-2005	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	12,44	10,94	18,85	7,91	1,50	2,67	-1,05	-0,13	0,00	100 %	100 %	0 %	100 %	2,67	-1,05	-0,13	0,00
High-growth firms, large	6,17	9,26	9,26		-3,09	-0,68	-0,49	-1,91	0,00	4,8 %	12,2 %	7,4 %	8,5 %	-8,04	-5,79	-22,49	-0,01
High-growth firms, small	1,29	1,47	1,47		-0,18	-0,15	0,02	-0,05	0,00	1,2 %	2,6 %	1,3 %	1,9 %	-7,84	1,01	-2,62	0,00
Modest growth firms, large	7,20	6,23	6,23		0,97	0,63	0,03	0,31	0,00	36,7 %	39,6 %	2,9 %	38,2 %	1,64	0,08	0,82	0,00
Modest decline firms, large	-1,66	-3,46		3,46	1,80	1,92	-0,62	0,50	0,00	30,1 %	23,9 %	-6,2 %	27,0 %	7,10	-2,29	1,85	-0,01
Modest growth firms, small	2,05	1,89	1,89		0,16	0,11	-0,01	0,06	0,00	9,7 %	10,8 %	1,0 %	10,3 %	1,06	-0,09	0,58	0,00
Modest decline firms, small	-0,55	-1,49		1,49	0,94	0,66	0,14	0,14	0,00	11,8 %	9,1 %	-2,7 %	10,5 %	6,29	1,33	1,34	0,01
High-decline firms, large	-1,30	-2,00		2,00	0,70	0,12	-0,15	0,72	0,00	3,8 %	1,2 %	-2,7 %	2,5 %	4,98	-5,90	29,03	0,06
High-decline firms, small	-0,75	-0,96		0,96	0,20	0,07	0,03	0,10	0,00	1,8 %	0,7 %	-1,1 %	1,2 %	5,87	2,37	8,26	0,03

2005-2008	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	13,92	9,66	16,98	7,32	4,26	2,74	0,30	1,22	-0,01	100 %	100 %	0 %	100 %	2,74	0,30	1,22	-0,01
High-growth firms, large	5,03	6,54	6,54		-1,51	-1,14	-0,19	-0,18	0,00	4,1 %	10,4 %	6,3 %	7,3 %	-15,68	-2,57	-2,51	-0,01
High-growth firms, small	1,46	1,47	1,47		-0,01	-0,05	0,07	-0,03	0,00	1,2 %	2,5 %	1,3 %	1,8 %	-2,77	4,04	-1,81	-0,17
Modest growth firms, large	7,34	7,09	7,09		0,25	-0,18	0,24	0,19	0,00	43,0 %	46,3 %	3,3 %	44,6 %	-0,40	0,54	0,42	0,00
Modest decline firms, large	0,10	-2,50		2,50	2,60	2,17	-0,10	0,53	0,00	26,6 %	21,2 %	-5,5 %	23,9 %	9,10	-0,41	2,20	0,00
Modest growth firms, small	2,30	1,88	1,88		0,43	0,24	0,05	0,14	0,00	9,3 %	10,4 %	1,0 %	9,9 %	2,39	0,47	1,44	0,01
Modest decline firms, small	-0,03	-1,22		1,22	1,19	0,92	0,07	0,19	0,00	10,1 %	7,8 %	-2,3 %	9,0 %	10,30	0,79	2,16	0,01
High-decline firms, large	-1,71	-2,84		2,84	1,14	0,73	0,07	0,33	0,00	4,1 %	0,9 %	-3,2 %	2,5 %	29,29	2,88	13,16	0,04
High-decline firms, small	-0,58	-0,76		0,76	0,18	0,05	0,08	0,06	-0,01	1,5 %	0,6 %	-0,9 %	1,0 %	4,62	7,44	5,98	-0,59

2008-2011	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	-0,63	7,28	17,11	9,83	-7,91	-6,11	0,04	-1,85	0,18	100 %	100 %	0 %	100 %	-6,11	0,04	-1,85	0,18
High-growth firms, large	5,09	6,87	6,87		-1,78	-1,25	-0,03	-0,49	0,00	3,6 %	9,9 %	6,3 %	6,7 %	-18,56	-0,51	-7,34	-0,04
High-growth firms, small	0,24	1,69	1,69		-1,44	-0,34	0,67	-1,95	0,17	1,2 %	2,6 %	1,4 %	1,9 %	-18,00	35,67	-103,71	9,09
Modest growth firms, large	2,86	6,65	6,65		-3,79	-3,41	-0,32	-0,06	0,00	39,6 %	43,8 %	4,1 %	41,7 %	-8,17	-0,76	-0,14	0,00
Modest decline firms, large	-3,76	-3,85		3,85	0,09	0,29	-0,18	-0,02	0,00	31,1 %	24,6 %	-6,5 %	27,9 %	1,03	-0,63	-0,06	-0,01
Modest growth firms, small	0,86	1,90	1,90		-1,04	-0,98	0,08	-0,13	0,00	8,5 %	9,7 %	1,1 %	9,1 %	-10,76	0,84	-1,44	-0,02
Modest decline firms, small	-1,53	-1,45		1,45	-0,08	-0,16	0,01	0,07	0,00	9,0 %	7,0 %	-2,0 %	8,0 %	-1,96	0,14	0,86	-0,02
High-decline firms, large	-3,27	-3,40		3,40	0,13	-0,22	-0,27	0,61	0,00	5,2 %	1,8 %	-3,4 %	3,5 %	-6,23	-7,56	17,41	0,09
High-decline firms, small	-0,96	-1,12		1,12	0,17	-0,05	0,08	0,12	0,01	1,7 %	0,7 %	-1,0 %	1,2 %	-4,05	6,76	10,25	1,01

2011-2014	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	-0,36	0,84	12,09	11,26	-1,19	-3,08	1,25	0,65	0,01	100 %	100 %	0 %	100 %	-3,08	1,25	0,65	0,01
High-growth firms, large	3,10	4,22	4,22		-1,11	-0,94	-0,13	-0,04	0,00	3,0 %	7,3 %	4,4 %	5,2 %	-18,20	-2,58	-0,71	-0,06
High-growth firms, small	1,17	1,44	1,44		-0,27	-0,25	0,00	-0,02	-0,01	1,0 %	2,5 %	1,4 %	1,8 %	-13,91	0,01	-1,16	-0,30
Modest growth firms, large	2,95	4,77	4,77		-1,81	-2,41	0,56	0,02	0,01	28,7 %	33,6 %	4,9 %	31,2 %	-7,72	1,80	0,07	0,02
Modest decline firms, large	-4,07	-5,55		5,55	1,48	1,00	0,19	0,28	0,00	42,9 %	36,6 %	-6,3 %	39,7 %	2,52	0,49	0,71	0,01
Modest growth firms, small	0,97	1,67	1,67		-0,70	-0,74	0,03	0,02	0,00	8,0 %	9,6 %	1,7 %	8,8 %	-8,46	0,32	0,21	0,00
Modest decline firms, small	-1,36	-1,47		1,47	0,11	-0,03	0,06	0,09	0,00	9,6 %	8,0 %	-1,6 %	8,8 %	-0,38	0,67	0,97	0,00
High-decline firms, large	-2,32	-3,24		3,24	0,92	0,27	0,45	0,19	0,01	5,1 %	1,6 %	-3,5 %	3,4 %	8,16	13,39	5,71	0,17
High-decline firms, small	-0,79	-0,99		0,99	0,20	0,01	0,09	0,10	0,01	1,7 %	0,7 %	-1,0 %	1,2 %	0,63	7,18	8,47	0,43

A.4.3 Decomposition of non-ICT non-manufacturing industries

1999-2002	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	11,46	11,35	17,15	5,80	0,11	0,37	-1,87	1,61	-0,34	100 %	100 %	0 %	100 %	0,37	-1,87	1,61	-0,34
High-growth firms, large	4,87	6,45	6,45		-1,58	-1,49	0,16	-0,23	-0,01	5,0 %	12,4 %	7,4 %	8,7 %	-17,17	1,81	-2,68	-0,10
High-growth firms, small	1,22	2,75	2,75		-1,53	-0,09	-0,91	-0,38	-0,15	2,9 %	5,6 %	2,7 %	4,2 %	-2,21	-21,51	-8,92	-3,55
Modest growth firms, large	3,84	4,48	4,48		-0,64	-0,53	-0,58	0,58	-0,11	33,1 %	33,6 %	0,5 %	33,3 %	-1,60	-1,75	1,76	-0,33
Modest decline firms, large	0,63	-1,28		1,28	1,91	1,03	-2,06	3,29	-0,35	10,9 %	8,1 %	-2,8 %	9,5 %	10,82	-21,76	34,71	-3,65
Modest growth firms, small	1,53	3,47	3,47		-1,94	-0,05	-0,98	-0,74	-0,17	20,6 %	21,5 %	0,9 %	21,1 %	-0,23	-4,64	-3,52	-0,82
Modest decline firms, small	-0,80	-2,47		2,47	1,67	1,23	1,12	-0,89	0,21	23,4 %	17,4 %	-6,1 %	20,4 %	6,03	5,51	-4,37	1,01
High-decline firms, large	0,10	-0,95		0,95	1,05	0,19	0,84	-0,13	0,15	1,6 %	0,5 %	-1,1 %	1,1 %	17,69	77,59	-11,63	13,48
High-decline firms, small	-0,26	-1,10		1,10	0,83	0,09	0,54	0,10	0,10	2,5 %	0,9 %	-1,5 %	1,7 %	5,49	32,09	5,98	5,74

2002-2005	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	7,93	10,84	16,52	5,68	-2,91	-2,44	0,11	-0,58	0,17	100 %	100 %	0 %	100 %	-2,44	0,11	-0,58	0,17
High-growth firms, large	4,71	6,59	6,59		-1,88	-0,44	-1,40	0,03	-0,06	4,6 %	12,5 %	7,9 %	8,6 %	-5,18	-16,32	0,31	-0,72
High-growth firms, small	1,34	2,23	2,23		-0,89	-0,24	-0,48	-0,14	-0,04	2,4 %	4,8 %	2,4 %	3,6 %	-6,72	-13,38	-3,84	-1,00
Modest growth firms, large	3,22	4,57	4,57		-1,35	-1,84	0,93	-0,51	0,08	31,4 %	31,9 %	0,5 %	31,7 %	-5,82	2,94	-1,62	0,25
Modest decline firms, large	-1,75	-1,90		1,90	0,14	-0,35	0,65	-0,23	0,07	19,0 %	14,4 %	-4,6 %	16,7 %	-2,10	3,90	-1,39	0,43
Modest growth firms, small	1,94	3,14	3,14		-1,20	-0,53	-0,39	-0,24	-0,04	19,7 %	20,7 %	1,0 %	20,2 %	-2,60	-1,96	-1,21	-0,18
Modest decline firms, small	-0,93	-2,22		2,22	1,29	0,44	1,14	-0,39	0,11	19,5 %	14,5 %	-5,0 %	17,0 %	2,58	6,67	-2,32	0,62
High-decline firms, large	-0,08	-0,60		0,60	0,52	0,41	-0,78	0,89	0,00	1,3 %	0,4 %	-0,9 %	0,9 %	46,77	-89,54	101,93	0,50
High-decline firms, small	-0,35	-0,97		0,97	0,62	0,12	0,44	0,03	0,04	2,1 %	0,8 %	-1,3 %	1,4 %	8,08	31,06	1,81	2,66

2005-2008	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	7,24	14,04	18,89	4,85	-6,80	-3,86	-2,76	-0,18	0,02	100 %	100 %	0 %	100 %	-3,86	-2,76	-0,18	0,02
High-growth firms, large	4,54	7,75	7,75		-3,21	-1,48	-1,34	-0,48	0,09	7,7 %	15,9 %	8,2 %	11,8 %	-12,56	-11,42	-4,05	0,74
High-growth firms, small	0,89	2,19	2,19		-1,30	-0,60	-0,49	-0,18	-0,04	2,4 %	4,6 %	2,2 %	3,5 %	-17,28	-13,95	-5,03	-1,07
Modest growth firms, large	2,87	5,89	5,89		-3,02	-1,28	-2,46	0,96	-0,24	38,3 %	38,1 %	-0,1 %	38,2 %	-3,34	-6,45	2,51	-0,62
Modest decline firms, large	-0,42	-1,13		1,13	0,71	0,29	0,50	-0,20	0,12	13,8 %	10,1 %	-3,7 %	12,0 %	2,46	4,16	-1,68	0,98
Modest growth firms, small	1,51	3,06	3,06		-1,55	-1,05	-0,22	-0,27	-0,01	18,4 %	18,7 %	0,3 %	18,5 %	-5,69	-1,20	-1,44	-0,03
Modest decline firms, small	-0,59	-1,56		1,56	0,96	0,12	0,90	-0,11	0,06	16,5 %	11,7 %	-4,7 %	14,1 %	0,83	6,35	-0,80	0,46
High-decline firms, large	-1,06	-1,25		1,25	0,19	0,12	0,02	-0,01	0,05	1,2 %	0,3 %	-0,9 %	0,8 %	15,44	2,65	-0,99	6,78
High-decline firms, small	-0,48	-0,91		0,91	0,44	0,01	0,34	0,10	-0,02	1,7 %	0,6 %	-1,2 %	1,2 %	1,00	29,15	8,70	-1,53

2008-2011	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	0,70	13,33	22,10	8,77	-12,63	-11,64	-0,77	-0,22	-0,04	100 %	100 %	0 %	100 %	-11,64	-0,77	-0,22	-0,04
High-growth firms, large	9,59	11,63	11,63		-2,05	-2,12	0,18	-0,09	-0,01	6,3 %	18,6 %	12,4 %	12,5 %	-17,04	1,44	-0,74	-0,07
High-growth firms, small	1,13	2,17	2,17		-1,04	-0,31	-0,39	-0,33	-0,01	1,7 %	3,4 %	1,7 %	2,5 %	-12,19	-15,50	-12,86	-0,59
Modest growth firms, large	1,76	5,54	5,54		-3,77	-3,22	-0,31	-0,24	-0,01	27,2 %	28,3 %	1,1 %	27,8 %	-11,58	-1,12	-0,86	-0,02
Modest decline firms, large	-8,14	-4,10		4,10	-4,04	-3,48	-0,32	-0,22	-0,02	35,2 %	26,0 %	-9,2 %	30,6 %	-11,36	-1,04	-0,71	-0,08
Modest growth firms, small	0,34	2,76	2,76		-2,42	-1,78	-0,41	-0,23	-0,01	12,5 %	13,2 %	0,7 %	12,8 %	-13,84	-3,18	-1,79	-0,06
Modest decline firms, small	-1,92	-1,57		1,57	-0,36	-0,75	0,38	0,00	0,02	12,2 %	8,9 %	-3,3 %	10,5 %	-7,13	3,56	-0,01	0,20
High-decline firms, large	-1,19	-1,77		1,77	0,59	0,05	-0,27	0,81	0,00	2,3 %	0,7 %	-1,7 %	1,5 %	3,16	-17,84	53,97	-0,33
High-decline firms, small	-0,91	-1,33		1,33	0,42	-0,03	0,38	0,07	0,01	2,5 %	0,9 %	-1,6 %	1,7 %	-1,90	21,86	4,20	0,47

2011-2014	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	0,69	7,40	16,17	8,77	-6,71	-7,09	0,07	0,31	0,00	100 %	100 %	0 %	100 %	-7,09	0,07	0,31	0,00
High-growth firms, large	4,74	6,61	6,61		-1,87	-0,81	-0,87	-0,19	0,00	7,2 %	15,4 %	8,3 %	11,3 %	-7,16	-7,68	-1,70	-0,02
High-growth firms, small	1,07	1,84	1,84		-0,77	-0,43	-0,18	-0,15	-0,01	1,4 %	3,1 %	1,6 %	2,3 %	-18,86	-7,73	-6,67	-0,53
Modest growth firms, large	1,35	5,58	5,58		-4,23	-4,55	0,20	0,14	-0,01	32,1 %	34,9 %	2,8 %	33,5 %	-13,57	0,59	0,40	-0,03
Modest decline firms, large	-2,57	-3,56		3,56	0,99	0,69	0,17	0,12	0,01	29,2 %	22,9 %	-6,3 %	26,0 %	2,67	0,66	0,45	0,05
Modest growth firms, small	0,26	2,14	2,14		-1,88	-1,59	-0,31	0,02	0,00	10,6 %	11,5 %	0,9 %	11,1 %	-14,33	-2,81	0,19	-0,03
Modest decline firms, small	-2,11	-1,97		1,97	-0,14	-0,59	0,43	0,02	0,01	13,3 %	10,0 %	-3,3 %	11,6 %	-5,12	3,71	0,15	0,05
High-decline firms, large	-1,09	-1,82		1,82	0,73	0,34	0,37	0,01	0,00	3,7 %	1,3 %	-2,4 %	2,5 %	13,53	14,74	0,52	0,12
High-decline firms, small	-0,96	-1,43		1,43	0,46	-0,16	0,26	0,35	0,01	2,5 %	0,9 %	-1,5 %	1,7 %	-9,19	15,27	20,41	0,69

A.4.4 Decomposition of non-ICT manufacturing industries

1999-2002	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	9,55	2,39	11,79	9,40	7,15	5,49	0,79	0,87	0,01	100 %	100 %	0 %	100 %	5,49	0,79	0,87	0,01
High-growth firms, large	2,66	4,02	4,02		-1,36	-1,06	-0,43	0,14	0,00	3,1 %	7,2 %	4,1 %	5,2 %	-20,46	-8,35	2,66	-0,02
High-growth firms, small	0,47	0,69	0,69		-0,22	-0,07	-0,11	-0,04	0,00	0,6 %	1,3 %	0,7 %	0,9 %	-7,93	-12,00	-3,73	-0,02
Modest growth firms, large	10,50	6,19	6,19		4,32	3,32	0,51	0,48	0,01	42,4 %	47,1 %	4,7 %	44,7 %	7,42	1,14	1,08	0,01
Modest decline firms, large	-2,46	-5,87		5,87	3,42	2,90	0,12	0,40	0,00	41,1 %	33,7 %	-7,5 %	37,4 %	7,76	0,31	1,08	-0,01
Modest growth firms, small	0,53	0,90	0,90		-0,36	-0,15	-0,14	-0,07	0,00	4,4 %	5,1 %	0,7 %	4,7 %	-3,23	-2,99	-1,44	-0,03
Modest decline firms, small	-0,32	-0,82		0,82	0,50	0,32	0,24	-0,06	0,00	5,5 %	4,4 %	-1,1 %	5,0 %	6,42	4,78	-1,23	0,03
High-decline firms, large	-1,56	-2,19		2,19	0,63	0,18	0,44	0,01	0,00	1,9 %	0,8 %	-1,1 %	1,4 %	12,95	32,03	0,88	0,32
High-decline firms, small	-0,27	-0,51		0,51	0,25	0,07	0,17	0,00	0,00	1,0 %	0,4 %	-0,6 %	0,7 %	9,92	25,72	0,55	0,25

2002-2005	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	1,61	-6,71	7,06	13,77	8,31	9,21	-0,56	-0,34	0,00	100 %	100 %	0 %	100 %	9,21	-0,56	-0,34	0,00
High-growth firms, large	1,40	1,73	1,73		-0,34	-0,01	-0,25	-0,08	0,00	1,4 %	3,6 %	2,2 %	2,5 %	-0,24	-9,81	-3,11	-0,12
High-growth firms, small	0,52	0,62	0,62		-0,10	0,05	-0,12	-0,03	0,00	0,5 %	1,3 %	0,8 %	0,9 %	5,03	-13,03	-2,79	-0,15
Modest growth firms, large	5,13	3,83	3,83		1,30	2,04	-0,15	-0,59	0,00	27,9 %	33,7 %	5,8 %	30,8 %	6,63	-0,48	-1,93	0,00
Modest decline firms, large	-2,89	-7,66		7,66	4,77	4,74	-0,32	0,35	0,00	52,8 %	47,5 %	-5,3 %	50,2 %	9,45	-0,64	0,70	0,00
Modest growth firms, small	1,18	0,88	0,88		0,30	0,53	-0,17	-0,06	0,00	4,4 %	5,6 %	1,3 %	5,0 %	10,64	-3,49	-1,12	-0,04
Modest decline firms, small	-0,04	-1,04		1,04	1,00	0,85	0,18	-0,04	0,00	6,1 %	5,3 %	-0,8 %	5,7 %	15,03	3,21	-0,68	0,04
High-decline firms, large	-3,39	-4,40		4,40	1,01	0,83	0,11	0,08	0,00	5,6 %	2,3 %	-3,3 %	4,0 %	20,80	2,70	1,91	0,05
High-decline firms, small	-0,30	-0,67		0,67	0,37	0,18	0,16	0,03	0,00	1,3 %	0,6 %	-0,7 %	0,9 %	18,96	17,45	2,88	0,19

2005-2008	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	-1,40	3,84	14,40	10,56	-5,24	-6,05	-0,01	0,82	-0,03	100 %	100 %	0 %	100 %	-6,05	-0,01	0,82	-0,03
High-growth firms, large	3,21	5,96	5,96		-2,75	-1,77	-0,64	-0,33	-0,01	2,7 %	9,4 %	6,8 %	6,1 %	-29,25	-10,49	-5,52	-0,16
High-growth firms, small	0,42	0,86	0,86		-0,44	-0,16	-0,22	-0,06	-0,01	0,7 %	1,5 %	0,8 %	1,1 %	-14,34	-20,36	-5,56	-0,62
Modest growth firms, large	0,62	6,50	6,50		-5,88	-5,23	-0,06	-0,60	0,00	36,4 %	40,7 %	4,3 %	38,6 %	-13,56	-0,15	-1,54	0,00
Modest decline firms, large	-4,15	-7,02		7,02	2,87	1,39	0,09	1,39	0,00	47,9 %	37,9 %	-10,0 %	42,9 %	3,24	0,21	3,24	0,00
Modest growth firms, small	1,01	1,08	1,08		-0,07	0,04	-0,04	-0,06	0,00	4,6 %	5,4 %	0,8 %	5,0 %	0,74	-0,87	-1,19	-0,02
Modest decline firms, small	-0,25	-0,79		0,79	0,54	0,35	0,18	0,00	0,00	4,9 %	4,0 %	-0,9 %	4,4 %	7,85	4,15	0,08	0,03
High-decline firms, large	-1,97	-2,23		2,23	0,27	-0,73	0,58	0,44	-0,01	2,0 %	0,7 %	-1,3 %	1,3 %	-54,84	43,05	32,63	-1,00
High-decline firms, small	-0,31	-0,52		0,52	0,21	0,07	0,10	0,04	0,00	0,9 %	0,4 %	-0,5 %	0,6 %	11,10	16,03	6,75	0,06

2008-2011	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	1,10	-1,49	13,06	14,55	2,59	-0,67	1,33	1,93	0,03	100 %	100 %	0 %	100 %	-0,67	1,33	1,93	0,03
High-growth firms, large	3,80	4,52	4,52		-0,71	-0,61	0,51	-0,63	0,01	3,2 %	8,5 %	5,3 %	5,9 %	-10,42	8,80	-10,72	0,17
High-growth firms, small	2,14	2,68	2,68		-0,53	-0,19	-0,26	-0,07	-0,01	3,1 %	13,1 %	10,0 %	8,1 %	-2,38	-3,24	-0,90	-0,06
Modest growth firms, large	2,93	4,01	4,01		-1,07	-1,01	0,06	-0,12	0,00	24,8 %	50,7 %	25,9 %	37,7 %	-2,69	0,17	-0,33	0,01
Modest decline firms, large	-3,65	-6,76		6,76	3,11	1,06	-0,21	2,26	0,00	34,0 %	48,9 %	14,9 %	41,5 %	2,57	-0,52	5,45	0,00
Modest growth firms, small	1,72	1,87	1,87		-0,15	-0,03	-0,06	-0,05	0,00	11,2 %	24,0 %	12,8 %	17,6 %	-0,20	-0,37	-0,26	-0,01
Modest decline firms, small	-0,92	-1,63		1,63	0,70	0,40	0,21	0,09	0,00	13,2 %	18,4 %	5,2 %	15,8 %	2,56	1,31	0,56	0,02
High-decline firms, large	-3,76	-4,42		4,42	0,65	-0,39	0,77	0,26	0,01	5,8 %	4,4 %	-1,4 %	5,1 %	-7,63	15,06	4,99	0,26
High-decline firms, small	-1,13	-1,75		1,75	0,62	0,10	0,31	0,20	0,01	4,7 %	3,2 %	-1,5 %	3,9 %	2,56	7,87	5,09	0,15

2011-2014	OUTPUT	EMPLOYMENT			LABOR PRODUCTIVITY					SHARE OF LABOR INPUT				NORMALIZED COMPONENTS			
	Growth of real value added	Net job growth	Creation	Destruction	Aggregate productivity	Within	Between	Within-cross	Other cross-terms	Share at the beginning	Share at the end	Difference	Average	Within	Between	Within-cross	Other cross-terms
All firms	-3,19	-1,09	12,41	13,49	-2,11	-3,27	1,75	-0,59	0,03	100 %	100 %	0 %	100 %	-3,27	1,75	-0,59	0,03
High-growth firms, large	2,44	3,42	3,42		-0,98	-0,85	0,33	-0,47	0,01	3,2 %	8,2 %	5,0 %	5,7 %	-14,81	5,83	-8,28	0,14
High-growth firms, small	1,46	2,61	2,61		-1,14	-0,66	-0,39	-0,09	-0,01	2,9 %	7,1 %	4,2 %	5,0 %	-13,08	-7,65	-1,70	-0,21
Modest growth firms, large	1,73	4,63	4,63		-2,91	-2,98	0,42	-0,36	0,01	21,0 %	24,4 %	3,4 %	22,7 %	-13,10	1,84	-1,56	0,03
Modest decline firms, large	-4,62	-7,50		7,50	2,88	2,60	0,24	0,04	0,00	39,6 %	32,7 %	-6,9 %	36,2 %	7,20	0,66	0,10	0,01
Modest growth firms, small	0,59	1,74	1,74		-1,15	-0,91	-0,22	-0,02	-0,01	10,4 %	12,7 %	2,3 %	11,6 %	-7,88	-1,89	-0,13	-0,04
Modest decline firms, small	-1,88	-1,82		1,82	-0,07	-0,47	0,28	0,12	0,01	13,9 %	11,2 %	-2,8 %	12,6 %	-3,78	2,21	0,98	0,05
High-decline firms, large	-1,52	-2,44		2,44	0,93	0,06	0,76	0,09	0,01	4,1 %	1,6 %	-2,5 %	2,9 %	2,06	26,57	3,19	0,45
High-decline firms, small	-1,37	-1,73		1,73	0,36	-0,06	0,32	0,09	0,01	4,7 %	2,0 %	-2,8 %	3,3 %	-1,90	9,66	2,83	0,25