Abstract

This doctoral thesis consists of four papers. The two first papers are related to financial economics and the other two to labour economics. All four papers deal with microeconomics analysis of individuals and firms. Where the first two are from a firms perspective and the two second once are from an individual perspective. Moreover, all four papers underline the importance of innovation for productivity, competitiveness and economic growth.

In the first essay we use German Community Innovation Survey to identify financially constrained firms. Contrary to previous studies we find that the relationship between financial constraints and firm size is inverted u-shaped and that it is the group of medium sized firms which has the largest funding gaps. This is explained by the fact that these firms have high innovation capabilities but at the same time face high cost of capital. Furthermore, we test if financial constraints have an impact on firm productivity growth. We find negative effects from funding gaps on productivity, but only for investment in tangible capital and not for innovation investments.

The second essay investigates whether there has been a change in the productivity and funding mix of innovative SMEs post stricter bank regulations. Our result shows that the likelihood of using bank loans as a funding source has not changed for innovation investments nor for tangible investments after stricter capital regulations have been announced. On the other hand, sources such as subsidies have increased due to regulatory programs that have been implemented in the aftermath of the recent financial crisis. Furthermore, SMEs productivity has not changed post stricter bank regulations. Overall, the impact from different sources of funding on productivity is rather limited.

The third essay explores firm formation by migrants with a STEM background. The result shows that native born STEM workers have a higher probability to form firms relative to migrants. Further categorization of migrants shows that refugees are more likely to become entrepreneurs than EU-labour migrants. Overall, entrepreneurial migrants have equal or higher predicted income in comparison to native born STEM entrepreneurs.

The fourth essay analysis wage effects from changing work tasks using a tasked-based approach where workers are mapped in a two dimensional model classified by their cognitive and routine task content. The result shows clear signs of wage polarization. switch from routine and manual tasks to non routine cognitive task yields an average wage premium of about 2-6%. More importantly, while the gap was 1-5% in the beginning of the period, it increased to 10-13% at the end of the period. The result suggest that adapting new production technology and innovations to complement analytical skills has a higher
and increasing marginal productivity compared to technologies aimed to replace or complement routinized and manual work tasks. The period of this study is associated with several so-called breakthrough technologies such as, computerization, robotization, digitalization and the introduction of IT technology.

**Keywords:** Financial constraints, SMEs and innovation capability, Productivity, Funding mix, Bank regulation Technological change, Marginal productivity and wages, Work tasks, STEM, migration, Entrepreneurship.


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Stockholm, April 2019 Linda Dastory
Introduction

The purpose of the study

This thesis started as a project to study financial constraints among small firms and banking regulations as a consequence of the 2007-2008 international financial crisis. During the research process I learned that financial constraints are in particularly relevant for small innovative enterprises. In association to presence of market failures in the financial markets, this also leads to incorporation of governmental regulations, debt, equity and venture capital and other financial sources into the analysis.

The two first papers of my dissertation is devoted to deepen the understanding of how the technical progress through innovation in small firm is financed. The first of the two papers relates innovation capability to firm size and financial sources, and the second considers whether the banking regulations affects the funding mix of financial sources for innovations.

My third paper relates to the two former by deepening the understanding of the link between technical progress and entrepreneurship by considering new firm formation by STEM-entrepreneurs. In this study, I classify the STEM entrepreneurs into different categories depending on their geographical origin, gender and in the case of immigrants, also reason for settlement.

My final paper analyses the importance of technical change for the continuous change of work tasks and the consequences on wages.

The main purpose of the research in this thesis is to better understand how the complex processes of financing, technical change, innovation and entrepreneurship contributes to economic growth and employment. In this respect, my work belongs to the research tradition that tries to capture, describe and analyze economic development through the lens that captures society from a micro-economic perspective. The starting point for my studies is unique companies and unique individuals.

The research approach

The prime objective of my study is to capture, measure and better understand the economic processes that leads to increased productivity, higher wages and more jobs. A main challenge is to find representative data to apply on appropriate empirical methodologies, and to build the research on relevant theoretical frameworks.

My data comes from three different sources. The first is German data from the Mannheim Innovation Survey. The second is data from the German Innovation Survey. My third data sources is universal register information on all unique firms in Sweden and all unique individuals on the labour market, both employers and employees. The richest data sources is the the Swedish data provided by Statistics Sweden. Today, Sweden has among the extensive data information in the world for analyzing micro-foundation for technical change, innovation, entrepreneurship, productivity, wages and growth. This
data also allows for including issues such as the impact of immigration and refugee-immigration into the analysis, which I do in my thesis.

My empirical approach is a panel data analysis. There are several advantages using panel data, including that it allows the user to account for heterogeneity across the individual units, which are assumed away in pooled data. It also allows the user to deal with time-invariant omitted variables, and panel data are less likely to have problems with auto-correlation and multicollinearity as time series data do (see Baltagi (2008)).

The thesis is an empirical contribution to the literature and the theoretical foundations are derived from several strand of the research including both finance, entrepreneurship and the economics of innovation.

Conclusions

The general conclusions from this dissertations are as follows; In the first part of this thesis the link between innovation capability, firm size and financial constraints is investigated. The results show that relationship between firm size and financial constraints is inverse u-shaped were medium sized firms are the most constrained firms.

There may be several explanations for this result. As outlined in the theoretical framework the demand for innovation funding depends on a firms’ innovation capability, thus, the higher innovation capability, the flatter the demand curve for innovation funding. Accordingly, medium sized firms may have a higher innovation capability and thereby a higher funding need then their smaller counterparts. In the same time medium sized firms may also face higher marginal cost of capital in comparison to larger firms. Furthermore, there seems to be a larger amount of unpursued tangible investment opportunities which could be an indication that tangible investment projects are more financially constraints. However, a possible explanation is that we do not control for the size of the investment project. Thus, tangible investments may in average be large and therefore require a larger amount of debt and hence, affect the probability of receiving debt funding. Finally, our results show that, funding gaps for tangible investments reduce productivity of firms while we do not find this adverse effect on productivity from funding gaps for innovation investments.

The second part of this thesis investigates whether there has been a change in the financing sources for tangible and innovation investments post implementation of Basel III. It investigates if the funding mix, and in particular the use of bank loans, has changed post Basel III and whether this has changed differently for SMEs in comparison to large firms. The result shows that the likelihood of using bank loan as a funding source has not changed post stricter bank regulation for neither tangible investments nor for innovation investments. However, a change in the funding mix of the firms is observed as the probability of using sources such as equity, mezzanine capital and overdraft has decreased while the probability of using subsides has significantly increased. Moreover, strong evidence is found that firm size is an important determinant of the funding mix. The main
results of these two papers yield a better identification of financially constrained firms, which in turn allows for more precise and improved policy suggestions.

The third part of the thesis explores firm formation by migrants with a STEM background. The result shows that migrants are less likely to form their own business, but those who are entrepreneurs earn income at least as large as that of their native-born counterparts. From a policy perspective, this study contributes to an increased understanding of the importance of migrant entrepreneurs in STEM sectors of the economy, which are widely held to be a driver of welfare and growth in developed countries. Importantly, we document that refugee entrepreneurs are as productive as other STEM entrepreneurs when we use total earnings as a proxy for their productivity.

The fourth part of this thesis aims to gain a deeper understanding of the implications of the technical change for the labor market by exploiting data that allows for identifying both skills, work tasks and occupations for the universe of workers in a panel data setting. The result shows clear signs of wage polarization which are in line with previous literature. It suggests an average wage premium of about 4-8% when switching to non-routine cognitive tasks from other occupational tasks. But more importantly, while the gap was 3-5% in the beginning of the period (negative wage effect which switching from routine manual in the beginning of the period), it increased to 10-17% at the end of the period. The result suggests that adapting new production technology and innovations to complement analytical skills has a higher and increasing marginal productivity compared to technologies aimed to replace or complement routinized and manual work tasks. The main contribution of the task approach is that it relaxes the implicit equivalence between workers education, skills and their jobs task. The implication of this view is that the workers are not paid according to their skills, but for the productivity or market value of a task that is performed with a certain skill. This market value changes sometimes very radically by technological development.

The theoretical underpinning of these results are discussed briefly in the following section.

**Theoretical Framework**

A firm has essentially two available sources for investment expenditures: internal funding and external funding. In its core essence internal funding originates from retained earnings while external funding consists of various debt contracts such as bank loans. Contrary to the Modigliani-Miller theorem, capital structure matters in imperfect capital markets with presence of information asymmetry. When supplier of credit have less information regarding the quality of a certain investment, they are forced to charge a risk premium reflecting the average risk of an investment project. This creates a wedge between the cost of internal and external capital. Thus, investors are faced with a hierarchy of funding sources were funds with lower cost will be used first. Hence, internal fund-

\footnote{See (Autor & Handel 2013)}
ing will be preferred over debt and debt over equity. Generally this is refereed to as the pecking order theory. Given that internal funding is finite, firms usually need to seek external funding. However, due to market imperfections firms with potentially profitable investment opportunities may not be able to acquire it. Thus, a firm is considered being financially constrained if investment is restricted by its access to internal funding due to the fact that it is unable to acquire sufficient external funding.

Financial constraint is in particularly relevant for young and small innovative firms. The availability of external funding has been acknowledge as a significant determination factor for hampering the growth of small and medium sized firms Jarvis (2000), Mina et al. (2013). Moreover, small firms are associated with higher operational risk and consequently with a greater likelihood of bankruptcy. In addition the younger and smaller the firm, the shorter is their track record and the less collateral is available. This creates obstacles for debt funding (Hall & Lerner 2010, Berger & Udell 1998, 2002, Guariglia 2008).

Furthermore, it has long been acknowledged that innovation activity is an essential determination factor for productivity, competitiveness and economic growth. The role of young firms’ innovation capacity has been emphasized since their innovations generate structural change in the economy (Mina et al. 2013). Thus, it is of policy concern that restricted access to funding for innovation investments may hinder economic growth and job creation.

Innovation investments differ from tangible investment expenditures due to its intangible nature of the asset being created as well as due to a high degree of uncertainty. Accordingly, similarly to the case of SMEs, there is a lack of collateral that may be used as security for debt funding. These features of innovation investments make raising external funding for innovation projects more expensive in comparison to tangible investments (Hall 2010). Empirical literature confirms that firms tend to use internal funds over external funds when financing innovation projects (Hall 1989, 1992, Himmelberg & Petersen 1994, Bougheas et al. 2003, Czarnitzki & Hottenrott 2011). Overall the theoretical and empirical literature suggest that financial constraints depend not only on information asymmetries and moral hazard problems but also on other firm characteristics (Petersen & Rajan 1995, Czarnitzki 2006, Czarnitzki & Hottenrott 2009, Brown et al. 2012) such as, borrower-lender relationship (Martinelli 1997, Berger & Udell 2002) and other institutional factors (Hall 1992, Bloch 2005, Bhagat & Welch 1995).

A neglected factor in the empirical literature is the concept of innovation capability. It is hypothesized that innovation capability has an impact on financial constraints for innovation investment. This implies that a firm’s capacity to generate and achieve new innovation projects, is an important determinant of financial constraints.

An additional concern that may affect the availability of external funding for innovative SMEs is the increased demand for stricter bank capital regulation. There is a view among scholars that the crisis was primarily a regulatory failure (Acharya et al. 2012). As a result, the Bank for International Settlements has introduced new regulations, gener-
ally referred to as Basel III, which seeks to seal the loophole that was exposed during the financial crisis. In its core essence, Basel III increases minimum capital ratios, tightens the definition of bank capital and requires tighter liquidity requirements (Cosimano & Hakura 2011). While the benefits of higher capital requirements are rather clear in terms of lower leverage and thereby lower risk of bank defaults, there is less consensus regarding its disadvantages. One major concern is that higher capital requirements will increase the overall cost of capital and thereby increase lending rates\(^2\) and mitigate economic activity\(^3\) (Baker & Wurgler 2015). Theoretically higher lending rates should have a greater impact on innovative SMEs.

Moreover, the relationship between technological change and wage distribution has long been a topic of interest among economists. Scholars have generally associated technological progress to an increase in demand for skilled labour in comparison to low-skilled labour. This has been referred to as skilled bias technical change. The shift in labour demand is caused by increased productivity which in turn pushes returns to skills above it’s long run equilibrium level. Thus, there is an increase in skilled labour supply. An increase in both supply and demand for skilled labour is then expected to yield a monotonic growth in the relative amount of skilled labour. A limitation of the classical canonical model, as noted by Acemoglu & Autor (2011) is that it treats technology as exogenous and assumes that technological change by default is skill biased. However, historical evidence shows that technological change can be both complementary and substitutable to skills and coincide with an increased return to education, while production technologies during the end of the second industrial revolution were substitutable to skills. During the past decades, the labour market in the most developed economies have experienced an increasing wage polarization, which has given rise to a number of competing and partly overlapping task-based theoretical frameworks. A task-based framework where there is a clear distinction between labour skills and job tasks becomes particularly important when workers of a given skill level may not only perform a variety of different tasks but also can change and adjust tasks in response to technological change. An additional attractiveness of a task-biased approach is that the analytical tool accommodates the proliferation of IT, automation and other innovation in the development of production technology.

Technical progress is of great importance for sustained productivity and economic growth. New innovation and services that the high-tech sector produces distinguishes an economies output from other nations and allows for capital accumulation, increased wages and productivity growth. A high level of entrepreneurship generates a strong high-tech sector. High-tech entrepreneurs are willing to take risks that the already existing high-tech enterprises will not and are capable to identifying opportunities they fail

\(^2\)See Admati et al. (2013) for a detailed discussion regarding increased capital requirement and capital cost.

\(^3\)See e.g Cummins et al. (1994), Philippon (2009), Gilchrist et al. (2013) for further discussion and evidence on how the cost of capital effects real investments.
to recognize (Jörgenson et al. 2005). In turn, high-tech entrepreneurs linked to the STEM\(^4\) profession are assumed to have a key role in the creation and adoption of scientific and technological innovation (Peri & Sparber 2009). Meanwhile, many OECD countries are experiencing a shortage of STEM (scientists and engineers) labour within high-tech fields. Thus, skilled international migrants may be able to mitigate such labour shortage faced by most developed economies.

\(^4\)STEM workers are defined as university education in physics and chemistry, mathematics and statistics, biology, engineering and IT, or a professional background as a technician or IT operator.
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