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Ilkka Ylhäinen

Essays on the Economics of Small Business Finance

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Jyväskylä University School of Business and Economics
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ABSTRACT

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This dissertation studies the financing of small businesses. It focuses on the role of government funding in alleviating credit market imperfections and on the evolution of the cost and use of credit over the firm life cycle.

The first two essays utilize the panel data of Finnish manufacturing firms covering the 2000-2008 period and focus on the financing provided by a state-owned specialized financing company, whose objective is to cure credit market imperfections.

The first essay studies the repeat customers among the firms that obtain subsidized financing using dynamic discrete choice methods. The findings suggest that while the permanent unobserved firm-specific heterogeneity accounts for much of this persistence, the firms that have previously obtained subsidized financing are also more likely to obtain subsidized financing in the future.

The second essay studies the real and financial effects of subsidized loans granted to small businesses using several alternative econometric policy evaluation methods. The findings suggest that subsidized financing helps firms to expand their operations. However, the effects on labor productivity are negative or insignificant, casting doubt on the potential of subsidized financing to promote long-term productivity and economic growth.

The third essay studies the life-cycle profiles of small firms' financing costs and use of credit using a panel of Finnish firms from the period 1999-2010. The findings suggest that the cross-sectional age profiles of financing costs are hump-shaped and consistent with hold-up theories. In contrast, the financing costs decrease monotonically as firms mature when cohort or firm fixed effects are controlled for. The findings suggest that these differences in the life-cycle profiles relate to cohort effects. The findings also indicate that firms are more dependent on financial intermediaries in the early periods of their lives. Several findings are made about the cohort effects. The younger cohorts face lower financing costs than the older cohorts do. The younger cohorts also rely less on new bank loans than the older cohorts, whereas the amount of bank financing used suggests a more complex relationship. Cohorts born during recessions, particularly the Finnish Great Depression and the banking crisis of the 1990s, pay higher financing costs and use lower amounts of bank loans, even after controlling for the creditworthiness of firms.

Keywords: credit market imperfections, small business finance, subsidized loans, loan guarantees, policy evaluation, treatment effects, life-cycle effects

Author's address Ilkka Ylhäinen
Jyväskylä University School of Business and Economics
P.O. Box 35, FI-40014 University of Jyväskylä
ilkka.ylhainen@gmail.com

Supervisor Professor Ari Hyytinen
Jyväskylä University School of Business and Economics

Reviewers Professor Panu Kalmi
University of Vaasa

Professor Mervi Niskanen
University of Eastern Finland

Opponent Professor Panu Kalmi
University of Vaasa

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Tuusula, June 2013
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1 INTRODUCTION

Conventional wisdom suggests that loan markets may not function ideally among small, young firms that are informationally opaque. The widely held view that small businesses are the engine of economic growth and that market imperfections impede their growth have encouraged government interventions in the markets for small business finance (see, e.g., Beck and Demirguc-Kunt 2006). Two main economic rationales for such interventions have been suggested in the previous literature (see, e.g., Lerner 1999, 2002). The first rationale is based on financial constraints. The corporate finance literature suggests that small, young firms could be more likely to face financial constraints than their larger, more mature counterparts are (see, e.g., Beck and Demirguc-Kunt 2006; Beck et al. 2006; Berger and Udell 1998). The second rationale is based on positive externalities. The subsidizing of high technology firms could generate R&D spillovers that could benefit the society as a whole (e.g., Lerner 1999, 2002; see also Griliches 1992). This dissertation focuses on the financial constraint rationale of government intervention in the small business loan markets.

The corporate finance literature identifies two common problems of asymmetric information that distort the perfect and frictionless capital markets envisioned by Modigliani and Miller (1958): adverse selection and moral hazard. *Adverse selection* refers to the situation of hidden information (cf. Akerlof 1970); bad borrowers, who can masquerade themselves as good ones, may be more likely to apply for external finance than good borrowers. *Moral hazard* refers to the situation of hidden action; the entrepreneur may exert low effort and use the funds for purposes other than those intended by the financiers. These information frictions could be particularly acute among informationally opaque small businesses, which often rely on bank loans and which may have few assets to pledge as collateral early in their growth cycles (e.g., Gertler and Cilchrist 1994; Berger and Udell 1998). The credit market imperfections arising from informational asymmetries could make the external financing of such firms costly or difficult to obtain (e.g., Fazzari et al. 1988; Hubbard 1998; Stein 2003). There is indeed an existing view that such market imperfections could constrain the growth of small businesses (e.g., Beck and Demirguc-Kunt 2006).

Poorly capitalized firms, such as start-ups, could also be the ones that are the most hurt by disruptions in the availability of credit (Holmström and Tirole 1997). Earlier empirical evidence suggests that bank-dependent firms are most affected by the tightening of monetary policy and by the negative shocks faced by the banking sector (e.g., Gertler and Gilchrist 1994; Kroszner et al. 2007; Dell'Ariccia et al. 2008; Khwaja and Mian 2008).

The Finnish financial system has traditionally been bank-based (see, e.g., Hyytinen et al. 2003; Keloharju and Niskanen 2001; Niskanen and Niskanen 2004). Banks and government funding sources have also remained an important source of finance for Finnish small businesses after the devastating depression and banking crisis of the 1990s. Business Financing Surveys (2009, 2010) highlight the importance of banks in the financing of small businesses. During the 2008-2010 period, approximately 70 to 90 percent of Finnish micro, small, and medium-sized firms that obtained new external financing used banks as their source of financing. During the same period, the surveys report that in these size classes, from 10 percent to more than 20 percent of the firms that obtained new external financing received financing from Finnvera plc, a major state-owned specialized financing company (Business Financing Survey 2009, 2010). This result indicates that the role of state-owned financial institutions in the financing of small businesses in the Finnish markets is not negligible.

Before the international financial crisis that began in 2008, only a small percentage of firms reported financing obstacles. The side effects of the crisis were also reflected in the Finnish credit markets; in 2009, nearly 40 percent of micro firms and more than one-fourth of other firms reported financing difficulties – a sharp increase from previous years (Business Financing Survey 2009).[1] The international financial crisis notwithstanding, government intervention in the Finnish markets for small business finance had also been prevalent before the crisis. Evidence of the magnitude of this intervention is provided by Koski and Pajarinen (2010), who document that during 2008, approximately 30 000 firms, or approximately 10 percent of the firm population, obtained public support from the major government programs targeted for entrepreneurial activities. Controversy remains about the desirability of such interventions (see, e.g., de Meza 2002). For instance, the cross-country study of La Porta et al. (2002) suggests that state-owned financial institutions allocate capital inefficiently. Other studies, such as Andrianova et al. (2012), challenge this view. Overall, the earlier research on the effects of state-owned financial institutions on the efficiency of credit allocation provides conflicting conclusions.

Despite the prevalence of government intervention in the markets for small business finance in Finland and in other countries, there exists surprisingly little microeconometric evidence about the effects of these policies. This dissertation aims to overcome this gap in the literature. The first two essays analyze the dynamics and the real and financial effects of subsidized financing

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[1] See also Hyytinen (2011, 194) for a longer time series of the reported financing obstacles that extends back to the 1980s and highlights the significance of the 1990s depression.

granted to Finnish manufacturing firms by the specialized financing company Finnvera plc. This company provides a unique case for the evaluation of the government policies, given that the mission of the company, as stated in the law that governs Finnvera, is to cure imperfections in the markets for small business finance.

The previous theories of financial intermediation, such as that of Diamond (1989), predict that there are life-cycle effects in corporate finance. Building on this literature, the third essay empirically analyzes the life-cycle profiles of the cost and use of credit of Finnish small businesses. In addition, the essay analyzes cohort-specific effects in the cost and use of credit, with a particular focus on the cohorts born during the Finnish Great Depression and the banking crisis of the 1990s. Because one key rationale for the policies subsidizing small businesses originates from the presumed market imperfections that could make external finance costly or difficult to obtain, this analysis further supplements the evaluation of the role of government in the credit markets.

The rest of the introductory chapter is organized as follows: Section 2 provides a review of the previous literature. Sub-section 2.1 discusses the credit market equilibrium and government intervention. Sub-section 2.2 introduces the certification hypothesis. Sub-section 2.3 discusses the relationship between finance and economic growth and reviews the literature on state-owned financial institutions. Sub-section 2.4 discusses the life-cycle effects in small business finance and the potential sources of cohort effects in the cost and use of credit. Section 3 provides an overview of the original essays.

2 BACKGROUND AND PREVIOUS LITERATURE

2.1 Credit market equilibrium and government intervention

The corporate finance literature indicates that the small business loan markets do not function according to the competitive ideal (see, e.g., de Meza 2002). The traditional corporate finance theories have analyzed credit market imperfections in the framework of asymmetric information and have assumed that entrepreneurs are better informed about their projects than banks. The classic study of Stiglitz and Weiss (1981) indicates that when banks cannot distinguish good entrepreneurs from bad ones, they ration credit rather than increase interest rates to avoid adverse selection. In this framework, even good projects are not funded, and there is *underinvestment* at market equilibrium. In contrast, de Meza and Webb (1987) demonstrate that when the good entrepreneurs cross-subsidize the bad ones (who pool with the good ones), too many bad projects receive funding, and there is *overinvestment* at market equilibrium.

Studies in the behavioral corporate finance literature suggest that entrepreneurs are unrealistically optimistic about their prospects and unwilling to discontinue unprofitable projects (see, e.g., Baker and Wurgler 2012; Landier and Thesmar 2009; Hyytinen et al. 2012). Building on the findings from the psychology literature, de Meza and Southey (1996) reverse the information structure of the earlier theories and suggest that banks are better informed about firms' prospects than the overly optimistic entrepreneurs are. De Meza (2002) suggests that the existence of overly optimistic entrepreneurs could reinforce the problem of overlending. Manove and Padilla (1999) show that when the entrepreneurs are overly optimistic, the competition between banks may result in an insufficiently conservative amount of lending. This, in turn, would reduce the efficiency of the credit markets.

Overall, the existing theories provide conflicting predictions on whether too much or too little lending occurs in the market equilibrium. Ambiguity also remains on whether policy interventions in the credit markets are welfare-improving (e.g., Boadway and Keen 2005; de Meza 2002; Parker 2002). The tra-

ditional theories of financial intermediation suggest that banks exist because of their comparative advantage in the mitigation of informational asymmetries (e.g., Diamond 1984). Hence, it is not clear whether bureaucrats with no informational advantage over the private sector could improve the market allocation of capital through subsidies (e.g., Parker 2002).

Gale (1990a, 1990b, 1991) predicts that governments could potentially implement welfare-improving credit policies even in the absence of an informational advantage, while the efficient allocation of subsidies remains an important issue. Innes (1991) shows that governments can increase social welfare by providing subsidized credit contracts. However, his analysis also suggests that some common policies, including loan guarantees, generally provide inefficient outcomes by encouraging entrepreneurs to overinvest. De Meza (2002) suggests that lending subsidies may draw in lower-quality firms and reduce efficiency. Finally, political theories and the existing literature on government involvement in the allocation of capital (e.g., La Porta et al. 2002) cast doubt on whether government interventions would be welfare improving.

Modern theories of financial intermediation, such as that of Shleifer and Vishny (2010), suggest that financial intermediaries operating in the financial markets remain vulnerable to investor sentiment. This vulnerability, in turn, could transfer the security market fluctuations into the real economy and cause distortions to the resource allocation (Shleifer and Vishny 2010). Could the state-owned financial institutions alleviate such problems and cure market failures during times of financial distress? Some earlier evidence suggests that state-owned financial institutions could provide more stability during business cycle downturns or financial market turbulence because of their less procyclical lending policies (Bertay et al. 2012; Micco and Panizza 2007). However, not all studies support this view (see, e.g., Iannotta et al. 2011), and concerns remain about the questionable track record of state-owned financial institutions in credit allocation (e.g., Bertay et al. 2012).

In sum, the existing evidence on the role of government in the financial markets remains mixed, and the studies provide rather conflicting policy conclusions. The following chapters consider the role of government in the credit markets in more detail. The discussion also considers the evolution of financing costs and the use of credit over the firm life cycle of different cohort groups.

2.2 Asymmetric information, certification and monitoring

Information problems could be acute among informationally opaque small businesses. The previous literature suggests one potential rationale for government intervention for overcoming this problem: the screening conducted by a public financier could provide a signal to private investors about the quality of the project and alleviate financing constraints by reducing information gaps between firms and financiers (Lerner 1999, 2002; Takalo and Tanayama 2010). This certification hypothesis suggests that public venture capital programs

could have a potential role in certifying firms to other investors (Lerner 1999, 2002). There is, in fact, related established literature about the certification provided by private venture capitalists (see, e.g., Megginson and Weiss 1991). The certification paradigm implies that the stake of the public financier could certify that the firms are sound and allow less-informed investors to provide additional capital for the firms (cf. Holmström and Tirole 1997). To be successful, the certification requires that the certifier must have incentives to become informed and to credibly convey this information to the less-informed investors (Megginson and Weiss 1991; Tirole 2006, 250). However, public financiers could still face the problem of free riding in the monitoring activity by private financial intermediaries. This free-riding problem could arise if the stake of the co-financing private financial intermediaries is too small to induce monitoring effort (cf. Tirole 2006, 480).

Lerner (1999) notes that a key implication of the certification paradigm is that the marginal signal value of additional subsidies is sharply decreasing. This hypothesis implies that there is not likely to be a positive relationship between the amount of subsidies and firm performance (Lerner 1999). Therefore, if governments could provide a 'stamp of approval' for firms by certifying them, there is a limited rationale for persistence in subsidized financing. Lerner (1999) provides empirical support for the certification hypothesis. His findings suggest that public venture capital awardees in the U.S. were able to grow faster and to receive more subsequent private venture capital financing, whereas multiple subsidies did not increase performance. The findings also point to some distortions in the granting process of the subsidies. Lerner (2002) notes that public venture capital programs tend to be associated with a number of underperforming firms that have obtained a stream of public funding. Although such underperformance could be related to the high-risk nature of the firms, the findings suggest a more fundamental problem: firms seem to learn from the subsidy application processes over time, which increases their chances to obtain subsidies in the future (Lerner 2002).

The theories of asymmetric information suggest that incentive problems are most acute in the early periods of the firms' life and that such problems diminish over time once the firms acquire a good reputation (Diamond 1989). Because of the problems of asymmetric information, new borrowers subject to moral hazard could begin their reputation acquisition by enlisting a monitor (Diamond 1991). Such an agency could help to resolve the information problems and allow firms with weak balance sheets to obtain financing from less-informed investors (Tirole 2006, 356-359). However, few studies aside from Lerner (1999) have considered the certification role of public financiers within an empirical framework. Therefore, it is not well known whether the government certification would alleviate the informational asymmetries between firms and private financial intermediaries in an efficient manner. Moreover, particularly little is known about the dynamics of subsidized financing. The certification hypothesis would predict a limited scope for persistence in subsidized financing once the firm-specific risk factors are controlled for. However, the

scarce existing literature related to the dynamics of business subsidies suggests that the firms that have previously applied or obtained subsidies are more likely to apply or obtain them again (see Tanayama 2007; Aschhoff 2009; Koski and Pajarinen 2010). However, little is known about whether persistence in the use of subsidized financing originates from true state dependence (i.e., a causal mechanism), such as learning behavior, or whether it originates from permanent unobserved firm-specific heterogeneity, such as risk characteristics. One reason for this lack of knowledge likely relates to the challenge of obtaining sufficient micro-level panel data that would be required for the analysis.

2.3 State-owned financial institutions and economic growth

There is an extensive body of literature analyzing the relationship between finance and economic growth that dates back to Schumpeter (1934) (see Levine 2005). This literature has analyzed whether finance causes growth, or alternatively, whether the positive relationship between financial and economic development originates from reverse causality or omitted variables. The theoretical framework of Greenwood and Jovanovic (1990) suggests that financial intermediaries promote growth because they allow a higher rate of return to be earned on capital, given their superior ability to identify investment opportunities. The growth, in turn, helps to implement costly financial structures. This theoretical framework implies that the development of the financial sector and economic growth are interlinked. Despite various econometric problems and limitations in the datasets, the previous empirical literature indeed suggests the following strong prediction: better financial systems promote economic growth (e.g., King and Levine 1993; Rajan and Zingales 1998, Guiso et al. 2004).

King and Levine (1993) suggest that the level of financial development is a good predictor of future economic growth. Rajan and Zingales (1998) further analyze the specific mechanism through which finance could promote growth. They find that industries that are more dependent on external finance grow disproportionately faster in the countries with more developed financial systems. In addition, Guiso et al. (2004) provide firm-level evidence that local financial development could still matter even in the integrated financial markets; their findings from Italy indicate that better local financial development increases the probability that individuals start their own businesses, promotes the entry of new firms, improves competition and promotes growth.

Beck et al. (2000) highlight that better functioning financial intermediaries improve productivity growth and promote long-term economic growth. Importantly, the evidence suggests that stronger growth originates from improvements in the quality rather than from increases in the volume of bank lending (Jayaratne and Strahan 1996). Indeed, developed financial markets improve resource allocation by increasing investment in growing industries and decreasing investment from declining industries (Wurgler 2000). Bertrand et al. (2007) suggest that a more efficient banking sector fosters the Schumpeterian

process of "creative destruction": the lowering of state intervention in the banking sector in France increased the entry and exit of firms and improved the efficiency of resource allocation. Notably, their findings suggest that government intervention in the banking sector could create implicit barriers to entry and exit by subsidizing poorly performing established firms.

There are several views about state-owned financial institutions. First, the development view, dating back to Gerschenkron (1962), suggests that benevolent governments create state-owned financial institutions to cure market failures. According to this view, state-owned financial institutions maximize welfare by financing socially desirable projects that are not funded by the profit-maximizing private sector, which fails to take into account the social returns (see, e.g., La Porta et al. 2002; Sapienza 2004). Second, the agency view (see Sapienza 2004) similarly builds on the idea that governments aim to cure market failures and maximize welfare. However, this view predicts that bureaucrats working in these institutions have weak incentives and exert low effort or divert resources for their personal benefits, such as career concerns. This scenario results in the misallocation of resources. Third, the political view suggests that politicians control state-owned financial institutions to maximize their own political objectives rather than to cure market failures (e.g., La Porta et al. 2002). According to this view, politicians channel resources to their supporters in the form of subsidies and jobs, while receiving votes, political contributions, and bribes in return (e.g., La Porta et al. 2002; Shleifer and Vishny 1994, 1997). The political view suggests that these projects are politically desirable but socially undesirable, and financing them results in the misallocation of resources.

The empirical evidence about the effects of government ownership of financial institutions suggests that these institutions perform less than optimally, and the findings seem largely consistent with the political view. La Porta et al. (2002) suggest that state-owned financial institutions allocate capital inefficiently. Their cross-country evidence indicates that a high level of state ownership of banks is related to slower subsequent financial development and lower economic and productivity growth. The findings of Sapienza (2004) also suggest that Italian state-owned banks follow political objectives in their lending behavior. Khwaja and Mian (2005) provide evidence from Pakistan that state-owned banks favor politically connected firms by lending more to them despite their higher default rates. Dinc (2005) observes from cross-country data that state-owned banks increase their lending during election years. Micco et al. (2007) find that state-owned banks are less profitable than their private counterparts in developing countries are and that this difference increases during election years. Baum et al. (2010), however, find no difference in the lending behavior of state-owned and private banks during the election cycle in Turkey, although the state-owned banks underperform compared to their private counterparts. Iannotta et al. (2007) observe from their European sample of large banks that state-owned banks have lower profitability, weaker loan quality, and higher insolvency risk than other banks. Cole (2009) provides evidence that the nationalization of banks in India increased the quantity of lending, decreased the quality of

lending, and had no effects on the real economy. Carvalho (2010) suggests that politicians provide rents to voters by subsidizing firms to shift capital and labor towards more politically attractive regions in Brazil. Mian (2003) finds that state-owned banks in emerging markets perform uniformly poorly and survive only because of government support.

An important question remains about whether the seemingly poor performance of state-owned financial institutions is due to the reason that they operate in the marginal sectors of the financial markets or countries with poor institutions. Berger et al. (2005), for instance, suggest that the long-term performance of state-owned banks is generally poor and associated with high non-performing loan ratios. However, the researchers note that this finding could also reflect the different objectives of these institutions, such as development goals instead of profit maximization. Andrianova et al. (2012) suggest that the findings of La Porta et al. (2002) are reversed when more fundamental determinants of economic growth, including institutional quality, are controlled for. Their more recent country-level findings indeed indicate that the government ownership of banks is associated with *higher* long-term growth rates. This finding seems to contradict the political view and support the development view. However, it remains difficult to draw accurate conclusions from cross-sectional and cross-country studies that are econometrically vulnerable to issues such as data quality, unobserved heterogeneity or reverse causality. Additionally, much of the literature on state-owned financial institutions originates from emerging markets, and it is not clear whether these findings may be generalized to more developed institutional environments.

There is also evidence suggesting that state-owned financial institutions could provide more stable lending over the business cycle than private banks. The findings of Micco and Panizza (2006) and Bertay et al. (2012) suggest that the lending behavior of state-owned banks is less pro-cyclical than the lending behavior of private banks. Bertay et al. (2012) also provide evidence that the lending behavior of state-owned banks is less pro-cyclical, especially in countries with good governance, and even countercyclical in high-income countries. Moreover, they find that state-owned banks expand credit relatively more during banking crises. They conclude by suggesting that these findings could imply a stabilizing role for state-owned banks over the business cycle and during the times of financial instability. The authors also note, however, that the questionable track record of state-owned banks in the allocation of credit challenges their use as a short-term countercyclical tool.

Overall, the earlier research implies the need to evaluate the performance of state-owned financial institutions in terms of efficient resource allocation and to address the role of these institutions in the mitigation of market imperfections. This information would help to draw implications about the prospects of state-owned financial institutions to promote long-term economic growth. Ideally, this would call for microeconometric policy evaluation methods and high-quality micro data within a suitable institutional framework. Such an empirical

approach could help to overcome the potential concerns related to the previous literature, including the problems of reverse causality and omitted variables.

2.4 Life-cycle effects in the cost and use of credit

The conventional wisdom suggests that there are life-cycle effects in corporate finance. Diamond (1989) predicts that incentive problems are most severe for young firms that have short track records (see also Boot and Thakor 1994), with these problems becoming less severe over time for the firms that acquire a good reputation. This theoretical framework builds on the joint effect of adverse selection and moral hazard: If there is widespread adverse selection, the reputation effects are not sufficient to eliminate the incentive problems for the borrowers with short track records. These firms select excessively risky projects. Over time, the firms acquire a good track record, and the reputation effects diminish and, finally, eliminate the incentive problems. In the absence of substantial initial adverse selection, the reputation effects would work immediately. In this theoretical framework, the cost of credit would decrease over time as the firm gets older and does not default. This framework also provides a basis for understanding why firms could be more dependent on the monitoring provided by financial intermediaries early in their lives (see also Diamond 1991).

Hold-up theories imply an alternative life-cycle profile for financing costs (see Sharpe 1990, Rajan 1992, von Thadden 2004; Kim et al. 2012): In a two-period framework, the competition between banks prompts them to offer low subsidized borrowing rates for new firms in the first period. However, the firms become informationally locked in after obtaining the loan because the bank gains an information monopoly over them. Because of this informational capture, the banks then extract rents from the firms in the form of higher borrowing rates. This scenario implies rising financing costs in the next period. Kim et al. (2012) predict the full life-cycle profile that extends beyond the two-period framework: In their model, there are rising interest rate mark-ups for the younger firms that have become locked in and decreasing mark-ups for the older firms whose quality has been revealed. They also report empirical evidence in favor of their hypothesis using Norwegian small business data.

The earlier studies imply that the information environment faced by small businesses could have changed substantially over time. Jappelli and Pagano (2000) suggest that the availability of borrower-specific credit information has improved over time because of the birth of credit bureaus and credit rating agencies. This improved information environment could generally reduce the adverse selection, lower the informational rents that banks can extract from borrowers, and improve borrower discipline (Jappelli and Pagano 1993, 2000; Padilla and Pagano 1997, 2000). Petersen and Rajan (2002) also suggest that technological innovations in the banking sector, such as credit scoring, have improved the availability of credit for more distant firms in the U.S. The financial development would generally reduce the cost of external finance available to

firms (Rajan and Zingales 1998). These fundamental changes in the information environment and financial system could suggest the existence of cohort-specific differences in the cost and use of credit. However, these potential cohort effects remain a largely unexplored area in the earlier empirical literature.

Recessions and banking crises could also have lasting effects on informationally opaque borrowers. There is evidence suggesting that bank-dependent borrowers could remain vulnerable to the disruptions in the availability of credit. Holmström and Tirole (1997), for instance, predict that poorly capitalized firms are the firms that are most hurt by credit tightening. The empirical evidence indeed suggests that bank-dependent firms are affected most by the tightening of monetary policy and the negative shocks faced by the banking sector (e.g., Gertler and Gilchrist 1994; Kroszner et al. 2007; Dell'Ariccia et al. 2008; Khwaja and Mian 2008). Kashyap et al. (1994) also observe that financial constraints are more binding during recessionary periods. Braun and Larrain (2005) suggest that industries that are more dependent on external finance suffer more during recessions. Furthermore, Kashyap and Stein (2000) find that the effects of monetary policy are stronger for banks with less liquid balance sheets. The theoretical literature on the micro foundations of credit cycles also suggests that financial market imperfections could have significant real effects: shocks to collateral values, and their interaction with credit limits, could affect borrower net worth and could result in large and persistent fluctuations in the output and asset prices (Kiyotaki and Moore 1997; Bernanke and Gertler 1989).

Banking crises and the termination of lending relationships could have significant adverse consequences for firms and the economy (see, e.g., Bernanke 1983). Slovin et al. (1993) find that firms face significant negative effects from an unexpected termination of bank relationships because of bank failure, as measured by their share prices. Ongena et al. (2003), in turn, argue that such effects were small and temporary during the Norwegian banking crisis. The studies on the real effects of banking crises generally face the significant challenge of distinguishing between loan supply and demand shocks. Peek and Rosengren (2000) find that loan supply shocks originating from the Japanese banking crisis had real effects on economic activity in the U.S. Ashcraft (2005) finds that failures of healthy banks – subsidiaries of failed lead banks in a multi-bank holding company – had significant and permanent effects on real economic activity. Dell'Ariccia et al. (2008) provide international evidence that sectors that are more dependent on external finance perform relatively worse during banking crises. Kroszner et al. (2007) find that sectors that are more dependent on external finance contract disproportionately more during banking crises in countries with deeper financial systems.

Further evidence on the effects of banking sector shocks is provided by Paravisini (2008), who suggests that financial shocks faced by financially constrained banks have an instant, persistent, and amplified effect on the credit supply in Argentina. Khwaja and Mian (2008) provide evidence that liquidity shocks to banks are passed on to borrowers in Pakistan. Their findings also suggest that small firms that are unable to hedge their lending face particularly

large declines in their overall borrowing and show increased financial distress because of this difficulty. Chava and Purnanandam (2011) also suggest that bank-dependent firms in the U.S. suffered larger valuation losses and declines in capital expenditures and profitability during the Russian crisis of 1998 than firms with access to public debt markets. Overall, these earlier studies indicate that bank-dependent firms are most hurt during financial crises. However, it is also worth noting that this evidence still partially relies on publicly listed firms rather than more bank-dependent privately held small businesses.[2]

A few studies suggest that recessions could affect the attitudes of corporate managers towards external finance in a persistent fashion. These studies indicate that corporate managers who started their businesses during a recession may have less faith in financial markets; for example, Graham and Narasimham (2004) find that highly leveraged, publicly listed U.S. firms that suffered through the Great Depression used less leverage in the 1940s than other firms. In addition, these firms' use of leverage appears to increase when the Depression-era manager retires or leaves the firm. Malmendier et al. (2011) provide evidence that the CEOs of publicly listed firms who grew up during the U.S. Great Depression lean excessively towards internal finance. Schoar and Zuo (2011) observe more broadly in their sample of publicly listed U.S. firms that CEOs who started their careers during recessions use more conservative management approaches than others, including the lower use of leverage. Finally, Malmendier and Nagel (2010) provide complementary evidence suggesting that macroeconomic shocks faced earlier in life affect the financial risk taking of individuals. The question remains whether differences between recession and non-recession cohorts would also be observed among bank-dependent small businesses in other institutional environments. There is also a remaining challenge regarding how to control for other cohort-specific effects, including differences in creditworthiness, between recession and non-recession cohorts.

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2 For additional studies that concentrate on the financial crisis that originated from the U.S. subprime mortgage crisis, see also, e.g., Almeida et al. (2009), Campello et al. (2010), Duchin et al. (2010) and Ivashina and Scharfstein (2010).

3 OVERVIEW OF THE ESSAYS

3.1 Essay I: Persistence of government funding in small business finance

The first essay studies the dynamics of subsidized loans and guarantees granted for small businesses. The study focuses on the specialized financing company Finnvera plc, whose main objective is to cure credit market imperfections. The findings of the study indicate that there are repeat customers among the firms that obtain subsidized financing. The study contributes to the scarce literature on the dynamics of business subsidies by analyzing whether such persistence originates from true state dependence, such as learning behavior, or permanent unobserved firm-specific heterogeneity, such as risk characteristics.

The main analysis of the study uses a balanced panel of 7999 Finnish manufacturing corporations observed over the 2000-2008 period. The dataset is constructed from the register data provided by Statistics Finland. The business register is used as a master dataset, and the business subsidy database and financial statement panel are then match merged with that data. The empirical approach of the study employs dynamic discrete choice panel models, which include pooled and random effects probit estimators and the dynamic probit estimator of Wooldridge (2005). The study pays attention to the identification of true state dependence in short panels, which requires that the initial conditions and unobserved firm-specific heterogeneity are controlled for.

The findings suggest that while the unobserved heterogeneity accounts for much of the persistence observed in the data, there is still positive state dependence in the subsidized financing granted for the firms. That is, previously subsidized firms are more likely to also be subsidized in the future, even after the observed and permanent unobserved firm-specific characteristics are controlled for. The predicted probability ratios suggest that the previous guarantee clients are 2.3- or 3.4-times more likely to obtain guarantees than other firms when the time unit of the panel is one or two years, respectively. When the time unit of the panel is two years, the previous loan clients are 20% more likely to

obtain loans than the rest of the firms. The short-term persistence in loans observed at the yearly horizon was found to relate to unobserved firm-specific heterogeneity. Either way, the persistence is magnified rather than diminished over a longer term.

The findings suggest several potential implications. First, the positive state dependence observed in the study appears to reject the hypothesis of the immediate certification function of government funding. That is, subsidies do not appear to provide a signal about borrower quality that would eliminate demand for further subsidies in the future. The signal provided by subsidies may be noisy. Second, the results could remain consistent with the monitoring role of public financiers, however, if the informational asymmetries take time to resolve. Third, the finding that previously subsidized firms are more likely to be subsidized again is consistent with the hypothesis of Lerner (2002) about the learning behavior of firms. Fourth, it remains possible that the state dependence of guarantees could also reflect the behavior of private financial intermediaries; that is, free riding may occur in the monitoring activity in the presence of multiple lenders. Finally, it is worth noting that the unobserved firm-specific heterogeneity also provides an important reason for why some firms are more dependent on government funding than others. Some permanent firm-specific characteristics, such as firm riskiness or quality, could provide a potential explanation for why firms resort to government funding in a repeated fashion.

3.2 Essay II: Credit market imperfections, small business finance, and public policy

The second essay studies the real and financial effects of subsidized loans granted for small businesses. The previous literature has provided conflicting predictions on the effects of lending subsidies and the effectiveness of state-owned financial institutions in the credit allocation. In particular, there remains a controversy over whether government intervention in the credit markets would alleviate financial constraints and improve resource allocation. This essay provides a unique case study on this issue by focusing on the specialized financing company Finnvera plc, whose main objective is to cure credit market imperfections. The study provides new empirical evidence on the effects of policy interventions in the small business loan markets by using an extensive micro-level panel dataset and treatment effect methods in the identification of the policy effects.

The study uses a large, unbalanced panel dataset of approximately 15 000 Finnish manufacturing firms from the 2000-2008 period. This dataset is based on the register data provided by Statistics Finland and is constructed from business register, financial statement panel and business subsidy databases. The dataset has also been supplemented with regional data. The empirical approach of the study applies several alternative econometric methods in the identifica-

tion of the effects of government intervention. First, fixed effects models control for the permanent unobserved firm-specific heterogeneity between the subsidized and nonsubsidized firms. Second, instrumental variables models exploit the regional variation in the supply of government funding arising from regional support areas. Third, the boundary regressions compare the firms located on the opposite sides of the regional support boundary to further control for unobserved factors among the firms.

The findings on the real effects of government funding suggest that the subsidized financing helped the subsidized firms to make more investments, grow faster, and hire more employees. However, the effects on the labor productivity were negative or insignificant, casting doubt on the potential of government funding to promote long-term productivity and economic growth. Overall, these findings are in line with the results of Criscuolo et al. (2012).

The study also evaluates the potential channels through which subsidized financing could affect real activity. First, the findings suggest that the subsidized financing helped to increase the probability that the firms were able to exceed the maximum growth rates that could be financed internally or with a limited access to external finance. Second, the subsidized loans helped the firms to reduce their average financing costs. There is also evidence suggesting that the employment effects and some of the excess growth effects were larger for younger firms. This evidence is in line with the prediction that younger firms are more likely to face binding financial constraints than more mature firms.

Taken together, the study's findings suggest that while government funding can promote the real activity of small businesses, special attention is required to efficiently allocate subsidized financing.

3.3 Essay III: Life-cycle effects in small business finance

The third essay studies the life-cycle profiles of small firms' cost and use of credit. The study pays attention to disentangling age, period, and cohort effects in the analysis of the life-cycle effects. This identification problem has been largely ignored in the earlier corporate finance literature. In particular, the cross-sectional datasets used in the earlier life-cycle studies do not allow the distinguishing of age effects from cohort effects. This study aims to overcome these gaps in the literature by utilizing methods suggested in the previous cohort literature (see, e.g., Hall et al. 2005), and by using an extensive panel dataset of small businesses. The study provides new evidence on the evolution of financing costs and the use of credit over the firm life cycle. The study also analyzes cohort-specific differences in the cost and use of credit, which has been a largely unexplored area in the earlier corporate finance research.

The study uses a large panel dataset of Finnish corporations from the period 1999-2010. The unbalanced panel covers as many as 50 000 to 100 000 firm observations per year. The dataset is based on the financial statements and related data provided by Asiakastieto ltd, a major provider of credit and firm data

in Finland. The paper first studies the life-cycle profiles estimated from yearly cross-sections. These results are then compared to more appropriate methods suggested in the cohort literature, and using the full panel dataset. The study uses several alternative identification assumptions to disentangle age, period, and cohort effects: these assumptions include analyzing the age profiles of the cost and use of credit assuming the absence of either time or cohort effects, grouping the cohorts at the multi-year interval, replacing the time dummies with macroeconomic controls or constraining two year dummies to have equal effects. The observed creditworthiness of the firms is controlled for using commercial credit scores and other controls.

The findings of the paper suggest that the choice of method affects the conclusions drawn about the relationship between firm age and financing costs. The cross-sectional age profiles of financing costs are hump-shaped and consistent with hold-up theories (e.g., Sharpe 1990, Rajan 1992; von Thadden 2004; Kim et al. 2012). In contrast, controlling for cohort or firm fixed effects suggests that the financing costs decrease monotonically when the firms mature, in line with the prediction of Diamond (1989). The findings suggest that these differences in the life-cycle profiles relate to cohort effects. The findings also indicate that firms are more dependent on financial intermediaries in the early periods of their lives.

The essay presents several findings about cohort effects. The younger cohorts of the study face lower financing costs than the older cohorts. While the source of this cohort effect was not formally tested, the long-term trend of decreasing cohort-specific financing costs would generally appear to be consistent with the hypothesis regarding the improvements in the financial system and the informational environment. The younger cohorts also rely less on new bank loans than the older cohorts, whereas the amount of bank loans used suggests a more complex relationship. Finally, the cohorts born during recessions, particularly the Finnish Great Depression and the banking crisis of the 1990s, pay higher financing costs and use less bank financing in a persistent fashion. Notably, this effect is observed even when controlling for the observed creditworthiness of the firms with commercial credit scores. These persistent cohort-specific differences could be related to the stigmatizing effects of being born during weak economic times or to the recession-born entrepreneurs' more conservative attitude towards bank financing.

These findings could also prove useful in the designing of policies to avoid lasting adverse effects from recessions and periods of financial instability. While the financial development and the observed decrease in the cost of credit have diminished the case for government intervention, the findings also imply that the periods of financial instability might call for some policy measures targeted to bank-dependent small businesses, and to young firms in particular. More generally, the findings of the study suggest that the life-cycle profiles estimated from cross-sectional datasets – a common practice in the earlier corporate finance literature – should be interpreted with caution. The existence of cohort effects in the cost and use of credit also suggests that the identification

problem should not be overlooked either in the repeated cross-section or in the panel datasets.

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ORIGINAL ESSAYS

I

PERSISTENCE OF GOVERNMENT FUNDING IN SMALL BUSINESS FINANCE

PERSISTENCE OF GOVERNMENT FUNDING IN SMALL BUSINESS FINANCE

Ilkka Ylhäinen[1]

Abstract

This paper studies the dynamic interaction of Finnish manufacturing firms and a state-owned specialized financing company whose objective is to cure credit market imperfections. The dataset used in the study consists of a balanced panel of Finnish manufacturing firms over the 2000-2008 period. The findings indicate that there are repeat customers among the firms that obtain subsidized financing. The study uses dynamic discrete choice panel models to evaluate whether such persistence originates from true state dependence or from unobserved firm-specific heterogeneity, such as risk characteristics. The results suggest that while the unobserved firm-specific heterogeneity accounts for much of the persistence observed in the data, there is positive state dependence in the granted subsidized loans and guarantees. That is, previously subsidized firms are more likely to be subsidized in the future compared to other firms. Several potential explanations for the findings are discussed, including the slow resolution of informational asymmetries, the learning behavior of firms, and the free-riding behavior of co-financing private financial intermediaries.

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1 INTRODUCTION

Conventional wisdom states that credit markets may not function ideally in the case of small, young firms. In particular, this view suggests that market imperfections could constrain the growth of small and medium-sized firms (e.g., Beck and Demirguc-Kunt 2006). Two rationales have been proposed for government intervention in the markets for small business finance (e.g., Lerner 1999). The first rationale is based on financial constraints. The corporate finance literature suggests that small, young firms are more likely to face financial constraints than large, mature firms (e.g., Beck and Demirguc-Kunt 2006; Beck et al. 2006; Berger and Udell 1998). Such firms tend to be informationally opaque, which makes them vulnerable to the problems of asymmetric information when they try to obtain external finance. The firms may also have few assets to pledge as collateral early in their growth cycles (Berger and Udell 1998.) The second rationale is based on positive externalities. The subsidizing of small high-technology firms could generate R&D spillovers that would benefit other firms and the entire economy (Lerner 1999, 2002). This study concentrates on the financial constraint rationale of government intervention in the credit markets.

Publicly supported lending schemes aim to provide funding for firms that are unable to obtain private financing. However, little is known about how such policies affect the behavior of private sector agents over time. This study aims to overcome this gap in the literature. The paper studies the persistence in subsidized loans and guarantees granted to Finnish manufacturing firms, based on the rationale of market failures. The study employs an extensive register-based panel of manufacturing firms matched to the financing decision data of a major state-owned specialized financing company, Finnvera plc. This company provides a unique case for an evaluation of credit market policies. As stated in the law, the company has been given an objective to cure imperfections in the markets for small business finance. To fulfill this objective, the company provides loans, guarantees, and other financing, particularly for small and medium-sized firms. Given these objectives, a question arises regarding how the presence of such an agency affects the behavior of firms over time. In particular, it is of in-

terest whether previously subsidized firms tend to remain subsidized in the future.

Adverse selection theories provide conflicting predictions on the nature of the credit market failure. Stiglitz and Weiss (1981) show that when banks cannot distinguish good borrowers from bad ones, they may ration credit rather than increase interest rates to avoid adverse selection. In contrast, de Meza and Webb (1987) show that when the good borrowers cross-subsidize the bad ones, too many bad projects obtain funding. Hence, it remains unclear whether too much or too little lending exists at market equilibrium. In addition, a fundamental question remains about whether governments can improve market outcomes (e.g., de Meza 2002; Parker 2002). Diamond (1984), for instance, rationalizes the existence of financial intermediaries, such as banks, by their comparative advantage in the mitigation of informational asymmetries. De Meza (2002) suggests that lending subsidies may draw in lower-quality firms and decrease efficiency. Caballero et al. (2008) provide cautionary evidence of the depressing effects of the 'zombie' lending in Japan that kept credit flowing to insolvent borrowers who crowded out healthier firms.

Lerner (2002), however, suggests a rationale for government intervention: the certification hypothesis. That is, the screening conducted by a public financier could provide a signal to private investors about the quality of the project (Lerner 2002; Takalo and Tanayama 2010). The certification hypothesis suggests that if a government could certify informationally opaque firms for private investors, the financing constraints could be relaxed (Lerner 1999). To be successful, a certification requires that the certifier have incentives to become informed and to credibly convey this information to uninformed investors (Megginson and Weiss 1991; Tirole 2006, 250). The certification hypothesis also implies that the signal value of the subsidies is likely to be most beneficial in high-technology industries, where standard financial statement analysis may be of little use (Lerner 1999, 2002). Importantly, the certification hypothesis implies that the marginal signal value of additional subsidies is decreasing (Lerner 1999). That is, if a firm is revealed to be of a good type, additional subsidies provide little new information content to private financial intermediaries. This study uses that aspect of the certification hypothesis as a starting point and evaluates the dynamics of subsidized financing granted for small businesses.

Lerner (2002) observes that public venture capital programs in the U.S. tend to be associated with underperforming firms that have obtained a stream of public funds. Among other distortions, firms appear to learn from the application process over time, which makes them more likely to obtain additional subsidies in the future (Lerner 2002). Such persistence appears to contradict some of the key aspects of the certification paradigm discussed above: If a government certifies firms by financing them, and the quality of the firms is revealed, private investors would then know which firms are good and would confidently invest in them. This scenario would reduce the likelihood that firms need to remain subsidized in future periods. On the other hand, the theories of reputation formation suggest that the informational asymmetries may take time

to resolve if there is widespread adverse selection (e.g., Diamond 1989). Without proper econometric analysis, one cannot distinguish whether persistence in subsidized financing originates from learning behavior or other explanations, such as unobserved firm-specific risk characteristics. This study investigates these alternative hypotheses using econometric methods.

Diamond (1989) shows that incentive problems are most acute in the early periods of a firm's life and that such problems diminish over time for borrowers who acquire a good reputation. If there is little adverse selection, the reputation effect could work immediately (Diamond 1989). If there is widespread moral hazard, new borrowers begin their reputation acquisition by enlisting a monitor (Diamond 1991). The current study considers the possibility that a public financier could act as such a monitor. An active monitor could help to resolve information problems and allow firms with weak balance sheets to make investments (Tirole 2006, 356-359). The monitor's stake in the firm could certify that the borrower is sound, which would allow the firm to obtain additional capital from less-informed investors (Holmström and Tirole 1997). However, free riding could occur in the monitoring activity if the stake of the co-financing financial intermediaries is too small to induce monitoring effort (cf. Tirole 2006, 480). The monitoring role of the public financier could imply some persistence in the subsidizing financing if the firms need time to build their reputation. However, the permanent risk characteristics of the firms can be taken into account in the empirical analysis by controlling for the unobserved firm-specific heterogeneity.

Finally, Berger et al. (2008) suggest that firms' lending relationships with state-owned financial institutions could be sturdy for several reasons. First, there could be less fear of the withdrawal of funding because these institutions are protected by government support. Second, state-owned financial institutions may be the only institutions willing to finance negative net present value projects given their development mandates. Third, they may also provide below-market interest rates on loans because of subsidies. These factors could together reduce the firms' willingness to seek other lending relationships.

This paper empirically analyzes the role of the government in the mitigation of informational asymmetries in the credit markets by concentrating on the dynamics of subsidized financing. The study focuses on the state-owned specialized financing company Finnvera plc because it provides a unique case for evaluating the certification and monitoring roles of a public financier. First, the main objective of the company is to cure market failures in the small business loan markets. This objective provides a sound rationale for concentrating on the financial constraint argument of government intervention.[2] Second, the company could be considered as having an active role as an information producer; it takes a stake in the firms that it screens, acting as a monitor by providing direct lending to them and by bearing part of the risks of private financial institutions.

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[2] This approach is also taken by Hall and Lerner (2009). They highlight the argument that there is often a wedge between the rates of return required by an entrepreneur and external investors, which could result in the excessive cost of external capital.

This provides a close empirical analogue for the certification and monitoring paradigm.

The findings of the study indicate that there are repeat customers among firms that obtain subsidized financing. The econometric analysis employs dynamic discrete choice panel models to analyze whether such persistence originates from true state dependence or unobserved firm-specific heterogeneity. This distinction is important because a causal relationship would indicate that the subsidized firms behave differently in the future in comparison to otherwise identical non-subsidized firms (cf. Arulampalam et al. 2000). Alternatively, persistence could also arise from permanent unobserved firm-specific heterogeneity, such as risk characteristics. The dataset used in the study covers a large panel of Finnish manufacturing corporations observed over the 2000-2008 period.

The findings suggest that while the unobserved firm-specific heterogeneity accounts for much of the persistence observed in the data, there is still positive state dependence in the granted government funding. That is, previously subsidized firms are more likely to be subsidized in the future compared to other firms. The predicted probability ratios suggest that previous guarantee clients are 2.3- or 3.4-times more likely to obtain guarantees compared to other firms, when the time unit of the panel is one or two years, respectively. When the time unit of the panel is aggregated to two years, previous loan clients are 20% more likely to obtain loans than other firms. The short-term persistence in loans was found to be related to the unobserved firm-specific heterogeneity. Either way, the persistence is magnified rather than diminished over a longer term.

The findings suggest the following potential implications: First, the positive state dependence estimates appear to reject the hypothesis of the immediate certification function of government funding. That is, if subsidies provide an accurate signal ('stamp of approval', see Lerner 2002) that firms are good, there would be no further demand for the subsidies. The subsidized firms would then obtain future funding solely from private financial intermediaries. However, the finding that previously subsidized firms are more likely to apply and receive government funding suggests otherwise. The borrower quality signal may be noisy (see, e.g., Tirole 2006, 250).

Second, the results could remain consistent, however, with the monitoring role of a public financier. If there is widespread adverse selection or moral hazard, the informational asymmetries could take time to resolve (Diamond 1989, 1991). The borrowers that are subject to moral hazard would obtain monitored financing (Diamond 1991). Under this hypothesis, it could take some additional time before the information problems disappear. Either way, the unobserved permanent riskiness of the firms is controlled for in the models, in addition to the key observed firm characteristics, including firm size and age. That is, the unobserved firm quality alone does not seem to explain all the persistence observed in the data.

Third, the finding that previously subsidized firms are more likely to be subsidized again provides empirical support for the prediction of Lerner (2002)

about the learning behavior of the subsidized firms. That is, the subsidized firms may gain insights into the application process of subsidized funding over time (Lerner 2002). This finding suggests that firms may resort to the government funding based on habit, perhaps because such financing could be easier to obtain.

Fourth, the state dependence particularly observed in the case of guarantees suggests that the persistence may also be related to the behavior of private financial intermediaries. In particular, free riding may occur in the monitoring activity in the presence of multiple lenders (e.g., Diamond 1984). That is, banks may reduce their own monitoring effort and free ride on the screening and monitoring effort of the public financier (cf. Diamond 1984; Tirole 2006, 480; see also Lelarge et al. 2008). In related theoretical literature, Gale (1990a) predicts that banks may *increase* credit rationing as an equilibrium response to government intervention in the credit markets. Gale (1990b) also suggests that subsidies allocated to one target group may crowd out other target groups, who then increase their subsidy requests. This scenario could even result in a paradoxical situation where subsidies generate demand for more subsidies (Gale 1990b).

The results suggest that governments should take into account the responses of private sector agents when framing their credit market policies (see also Parker 2002). The expected benefits of a policy intervention could be diluted if firms and banks adjust their behavior in response. Because the fundamental mission of a public financier is to cure credit market imperfections, there is a limited rationale for the persistence in subsidized financing because the information problems should diminish over time (e.g., Diamond 1989). The unobserved firm-specific heterogeneity also remains an important reason for the persistence observed in the data. This finding implies that some permanent firm-specific characteristics, such as firm risk or quality, could affect firms' chances to obtain bank loans in a persistent fashion. These permanent unobserved firm-specific characteristics provide another reason for why some firms are more dependent on government funding than others.

The rest of the paper is organized as follows: Section 2 provides the institutional details. Section 3 describes the dataset. Section 4 presents the empirical framework. Section 5 presents the empirical results, and Section 6 concludes.

2 INSTITUTIONAL ENVIRONMENT

The Finnish financial system has traditionally been bank-based (see, e.g., Hyytinen et al. 2003). Despite the changes in the corporate finance environment, the financing of small and medium-sized firms has continued to rely on intermediated credit and government funding sources (e.g., Hyytinen and Väänänen 2006). In addition to Finnvera plc, the specialized financing company that is the focus of this study, the prominent Finnish state-owned organizations that operate in the markets for small business finance consist of the following organizations (see, e.g., Murray et al. 2009). Tekes, the Finnish Funding Agency for Technology and Innovation, provides R&D financing in the form of subsidies, loans, and capital loans. The Finnish Innovation Fund Sitra provides direct venture capital investments and investments in the venture capital funds. Finnish Industry Investment Ltd also provides investments for venture capital funds and direct venture capital investments. The Centres for Economic Development, Transport, and the Environment (former Employment and Economic Development Centres) provide grants and other support for the firms.

This study utilizes the financing decision data of Finnvera plc. The company is fully owned by the State of Finland. The company provides loans, guarantees, venture capital and export credit guarantees for its client firms. The study focuses on the domestic operations of the company. The objectives of the company are written in the acts 443/1998 and 445/1998. According to the law, the mission of the company is to provide financing especially for small and medium-sized firms to promote the development, internationalization, and exports of the enterprises. The company is also required to promote the regional policy goals of the State. The operations of the company should be focused on overcoming deficiencies in the supply of financial services. Because of state ownership, the company is required to follow the EU state aid regulations.[3] The State, represented by the Ministry of Employment and the Economy, sets the annual operating goals for the company. These goals include, for example, the

[3] The information is based on acts 443/1998 and 445/1998. The original acts (in Finnish) and the English translations are available at http://www.finlex.fi/ (accessed on June 6, 2012).

number of new and growth firms financed, jobs created, and export trades financed. The State also sets the goals for the share of funding allocated to regional support areas. The ownership policy goals define targets for cost efficiency and capital adequacy.[4]

The company provides loans and guarantees especially for small and medium-sized firms. Large firms can obtain funding only for special reasons. The credit can be granted with non-protective collateral or without collateral. The company follows the policy guidelines set by the State. When making a financing decision, the company takes into account the economic, regional and employment aspects of the project. The differences in regional development are taken into account in the contract terms. The client firms can obtain domestic and EU subsidies for the interest rate and guarantee commission expenses. These subsidies are based on various regional and industrial policies.[5] The regional subsidies are available in the assisted areas, whereas the subsidies for the special loans are available in the entire country.[6] The pricing of investment and working capital loans and guarantees depends on credit risk classification, collateral risk, regional area, and maturity, whereas special loans utilize standard pricing based on their typical usage and properties.[7] A majority of the financing provided by Finnvera is granted without full collateral.[8]

The mission of the company is to complement financial markets. Given the objectives written in the law, the principle rule of the company is to share risks with other financiers. The financial policy of the company is to provide up to 50% of the project- or firm-specific funding. The share can be higher than that in working capital financing, micro financing, and projects that are considered significant in terms of industrial policy. Given the state aid regulations, the amount covered by guarantees can be, at maximum, 80% of the total debt commitment.[9] The company should aim for self-sufficiency in its operations in the long run. Still, the State covers part of the credit losses of the company.[10] The amount of credit loss compensation is highest in the assisted regions and varies regionally between 40 and 65% of the realized losses. The credit loss compensation can increase up to 80%, with the compensation provided by the European Regional Development Fund (ERDF). Since 2005, growth firms have also been covered with higher credit loss compensation.[11]

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4 Finnvera Annual Review 2008, 6, 16.

5 Act 445/1998

6 The interest rate subsidies and loan guarantee comission subsidies are defined in the decisions of the Council of the State, which are available at the Ministry of Employment and the Economy. See, e.g., decisions 11/023/2006 and 12/023/2006. The decisions are listed at http://www.finlex.fi/fi/viranomaiset/normi/540001/ (accessed on June 6, 2012).

7 Finnvera plc: An international evaluation. Ministry of Trade and Industry Publications. 1/2004, 179-180.

8 See, e.g., Finnvera Financial Review 2008, 22.

9 Memo of the regulation, signed on 23.1.2009. Obtained from www.finnvera.fi (Accessed on October 22, 2009).

10 Acts 443/1998 and 445/1998

11 The information on the credit loss compensation was obtained from Finnvera's law department.

The company has a network of 15 regional offices dispersed over the country. The firms apply for the loans and guarantees directly from the agency by sending application forms and appendices to Finnvera's office by mail or electronically through Finnvera's website. However, banks apply for micro guarantees on the behalf of the firms. The agency conducts company analysis for the applicant firms, which includes both qualitative analysis and quantitative financial statement analysis. The company analysis evaluates the applicant firm's management, business, and finances. The analysis of the management carries a weight of 30% in the company analysis. This section covers, e.g., the firm's ownership and company structure, as well as other factors, such as the background and experience of key personnel. The analysis of the firm's business also carries a weight of 30% in the company analysis. This section covers, for example, the competitiveness of the firm's business in comparison to the rest of the industry. The analysis also evaluates the firm's market position and internal processes. The analysis of the firm's finances carries a weight of 40% in the company analysis. This section includes the evaluation of the firm's profitability, adequacy of financing, and financial structure.[12]

The credit risk classification of client firms is based on a framework, which aims to keep the risk classifications in the same scale regardless of analysts. The credit risk classification system defines a credit rating for each client firm based on the company analysis. These ratings are based on the long-term observations of the events of insolvency for each risk category. The risk classification scale has seven categories for operating firms and one for insolvent firms. A mechanical risk classification is computed from the numerical data to supplement the analysis. The rating of the very smallest customers relies on the mechanical risk classification alone. In the case of significant deviations between quantitative and qualitative ratings, further reasoning is required. For instance, a potential challenge could relate to situations that require balancing between the industrial policy goals and limitations set by the credit policy. The account manager evaluates the credit risk, applies the risk classification, and prepares the financing proposal when making the financing decision. The credit rating is updated at least every second year. The value of the available collateral is evaluated in a similar fashion. The company monitors its risk taking monthly.[13] The fact that the company screens the applicants, has a wide regional coverage, and uses active risk-management practices[14] suggests that there is practical relevance for both the screening and monitoring roles of this public financier.

In 2008, the total domestic lending volume of Finnvera was 1027.8 million euros. Of this amount, 467.6 million euros were allocated for loans, and 438.3 million euros were allocated for guarantees. The share of the total financing allocated for the manufacturing industry was 599.4 million euros (58.3%). Overall,

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12 The information on the company analysis was obtained from Finnvera's management.

13 Finnvera Financial Review 2008, 19-20. Further information on the risk classifications was obtained from Finnvera's management.

14 See also Finnvera plc: An international evaluation. Ministry of Trade and Industry Publications. 1/2004.

437.6 million euros (42.6%) of the total financing were allocated for the regional support areas. The combined impairment and credit losses were 3.4% (77.8 million euros) and 2.2% (49.5 million euros) of the outstanding loan and guarantee commitments (2265.1 million euros) before and after the credit loss compensation, respectively. Most of the outstanding commitments were rated between B1-B3 on the risk classification scale from A1 to D.[15]

15 Finnvera Annual Review 2008, 7-9, 22-23; Finnvera Financial Review 2008, 6.

3 DATA

3.1 Data sources

The study employs an extensive panel dataset of Finnish manufacturing corporations over the 2000-2008 period. The dataset is based on register data obtained from the research laboratory of Statistics Finland. The dataset is constructed from multiple sources. The loan and guarantee decision data of Finnvera are obtained from the business subsidy database. This database covers the subsidies, loans, and guarantees provided by the Finnish state-owned institutions since 2000. The information in the database is collected directly from the corresponding institutions. The financing decision data of Finnvera contain the amount of granted and rejected loans and guarantees, each summed on a yearly basis, as well as the number of projects, the application period, and indicators for the reason for the funding.[16]

The firm characteristics of net sales, employment, size classification, age, industry, location, exports, and ownership information are obtained from the business register, which covers the population of Finnish enterprises. The business register is based on data provided by administrative data sources. The most important data source is the Tax Administration. The business register data have been supplemented with additional enquiries made by Statistics Finland. Financial statement data on EBITDA, fixed assets, and total assets are obtained from the financial statement panel. The data are based on the information provided by tax authorities and enquiries made by Statistics Finland.

[16] The primary reason is always the "extension of operations". There are also indicators about whether the secondary reason is "regional equality", "equality between men and women" or "environmental effects".

3.2 Construction of the sample

The sample is constructed using the business register as a master dataset. The business subsidy database and financial statement data are match merged with the business register data based on an encrypted company identification code and statistical year. The resulting dataset contains both subsidized and non-subsidized firms. In the case of Finnvera's approved and rejected financing decisions, a match was found in the business register in 76.4% of the firm-year observations. This percentage includes firms of all legal forms and industries. The estimation sample is restricted to corporations that operate in the manufacturing industry. This translates into corporations that have a two-digit Standard Industrial Classification (SIC) 2002 code within the values of 15-37. This industry group is the largest client group of the company in terms of lending volume measured in euros. Given the lack of SIC 2002 codes for the year 2000, the following year's industry code was used for that particular year.

Firms with missing observations or observations coded as unknown in the explanatory variables were dropped. This procedure also removes firm observations with net sales, a sum of entrepreneurs and employees, or total assets coded as zero for any reason over the study period of the variables. The financial statement panel contains some corrections made by Statistics Finland for erroneous and missing values that might have existed in the raw data. To guarantee the representativeness of the sample, these observations are kept in the sample. A few observations with illogical values were dropped accordingly. The study concentrates on the regions of mainland Finland. The autonomous province of Åland was excluded from the sample, given its low number of observations.

The final estimation sample consists of a balanced panel of the remaining firms that existed over the entire 2000-2008 period. The main analysis concentrates on this sample because the econometric models require consecutive time periods and a common entry year into the panel. Of the firms that existed over the entire study period, 238 firms were dropped because of missing data or other restrictions made to the dataset as described above. The robustness tests in section 5.2 show that the transition probabilities remain very similar in the balanced panel relative to the unbalanced one. An alternative balanced panel covering the 2000-2006 period is also used for comparison in the econometric analysis. This alternative sample is used to confirm that the results are not significantly affected by attrition during the later periods. To eliminate the influence of outliers, the calculated financial statement ratios have been winsorized as discussed below.

3.3 Descriptive statistics

The final sample consists of a balanced panel of 7999 manufacturing corporations over the 2000-2008 period.[17] Of these firms, 2095 firms have obtained a loan or a guarantee from Finnvera at least once over the study period. The number of loan clients is 1580, whereas the number of guarantee clients is 1171.[18] The financing decisions are summed for each firm on a yearly basis. Overall, the sample contains 3474 loan observations and 3198 guarantee observations. The analysis focuses on the granting decision rather than on modeling the application and granting decisions separately for the following reasons. First, the amount of rejected applicants is negligible.[19] Second, the actual rejections cannot necessarily be reliably distinguished.[20] When the granted funding is added up on a yearly basis, the median amount of the loans is 120 000 euros, while the median amount of the guarantees is 146 703.5 euros.

An alternative sample covering the 2000-2006 period contains 9036 firms, of which 2206 firms have obtained loans or guarantees from Finnvera. In this sample, the number of loan and guarantee clients is 1652 and 1193, respectively. While the overall number of firms declines in the main sample, these figures show that the number of lost client firms is not large in relative terms. The alternative sample uses alternative financial statement data for EBITDA, fixed assets, and total assets.

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17 Based on the business register statistics, 13 732 manufacturing corporations existed in 2001. Of these firms, 8237 existed over the entire 2000-2008 period. In total, 238 firms were removed from the balanced panel for data reasons, including firms that were located in Åland. This results in a balanced panel of 7999 firms.

18 The unbalanced panel of manufacturing corporations over the 2000-2008 period covers in total 4175 client firms, of whom 2971 and 2321 have obtained loans and guarantees, respectively, after the data cleaning. This process removed 63 client firms, of whom 46 and 29 had obtained loans and guarantees, respectively.

19 There were only 17 observations in the sample for the rejected applicants that did not receive any funding during the rejection year.

20 The data on the rejected applications are not completely reliable given the structure of the source data and the methods used by Statistics Finland to derive that information. Because of these limitations, this information is not used in the estimations. It is particularly difficult to distinguish rejections if only some of the applications have been rejected. While one should be careful not to draw too strong conclusions from the rejected applicants data, it remains possible that the limited number of rejections observed in the data might also point toward some demand side constraints. Potential explanations could include application costs (including the opportunity cost of time and any bureaucracy that might be required) or the self-rejection of discouraged borrowers who anticipate the rejection and do not apply (see, e.g., Takalo et al. 2013).

TABLE 1 Variable definitions and descriptive statistics

Variable	Definition	Mean	Sd	Obs
Obtained loan	Dummy for whether the firm was granted a positive amount of loans at t	0.048	0.214	71991
Obtained guarantee	Dummy for whether the firm was granted a positive amount of guarantees at t	0.044	0.206	71991
Obtained loan or guarantee	Dummy for whether the firm was granted a positive amount of loans or guarantees at t	0.082	0.275	71991
Age	Age in years at t	16.458	11.437	71991
ln(Sales)	Natural logarithm of net sales in euros at t-1	13.257	1.818	63992
Profitability	Ratio of EBITDA (earnings before interest, taxes, depreciation and amortization) to total assets at t-1 *	0.147	0.22	63992
Tangibility	Ratio of fixed assets to total assets at t-1 *	0.387	0.243	63992
Exporter	Dummy for firms with export activities at t-1	0.075	0.264	63992
Foreign	Dummy for foreign ownership at t-1	0.028	0.164	63992
Group	Dummy for belonging to a business group at t-1	0.122	0.327	55993
Growth	Log growth of net sales from t-2 to t-1 *	0.037	0.284	55993

Note: Pooled data on the estimation sample for the 2000-2008 period. Source of data: Statistics Finland. * Winsorized at the 1st and 99th percentiles

Table 1 reports the variable definitions and descriptive statistics for the pooled estimation sample over the 2000-2008 period. The financing decision indicators take a value equal to unity in the period the firm is granted a positive amount of funding and zero otherwise. The sample averages of obtaining loans, guarantees, or either of them are 4.8%, 4.4% and 8.2%, respectively. The age of the firms is measured in years at the current period. The sample firms are, on average, 16.5 years old. The rest of the control variables are measured at the end of the previous period. The firm size is measured as a natural logarithm of net sales. The median net sales is 487 970 euros. Alternative size measures are also provided here for comparison. The median number of personnel is 4.7. Based on the official EU size classifications, 66.7% of the observations belong to micro firms, 20.6% to small firms, 7% to medium-sized firms, and 5.7% to large firms.

Profitability is measured as a ratio of EBITDA to total assets. The mean profitability is 14.7%. The tangibility of assets is measured as a ratio of fixed to total assets. The mean ratio of fixed to total assets is 38.7%. An indicator for exporter firms denotes firms that had export activities as defined in the business register. In total, 7.5% of the firms had export activities. An indicator for foreign ownership measures firms that had a foreign ownership as defined in the business register. The percentage of firms that had foreign ownership is 2.8%. The growth of the firms is measured as a log growth of net sales from period t-2 to period t-1. The mean sales growth is 3.7%. An indicator for firms that belong to a business group is also included. The percentage of the sample firms that belong to a business group is 12.2%. The calculated financial ratios are winsorized at the 1st and 99th percentiles as indicated in the table. The sample firms look like what one would expect from a sample of smallish manufacturing firms.

TABLE 2 Obtained loans

Number of time periods	Number of firms	% of financed firms
0	6419	
1	723	45.76%
2	393	24.87%
3	200	12.66%
4	118	7.47%
5	54	3.42%
6	46	2.91%
7	26	1.65%
8	15	0.95%
9	5	0.32%

TABLE 3 Obtained guarantees

Number of time periods	Number of firms	% of financed firms
0	6828	
1	533	45.52%
2	189	16.14%
3	126	10.76%
4	88	7.51%
5	59	5.04%
6	62	5.29%
7	45	3.84%
8	46	3.93%
9	23	1.96%

TABLE 4 Obtained loans or guarantees

Number of time periods	Number of firms	% of financed firms
0	5904	
1	825	39.38%
2	415	19.81%
3	248	11.84%
4	190	9.07%
5	111	5.30%
6	98	4.68%
7	80	3.82%
8	77	3.68%
9	51	2.43%

Tables 2-4 report the statistics for obtaining positive financing decisions from Finnvera for a balanced panel of manufacturing corporations observed over the 2000-2008 period. The tables report the number of time periods (years) the firm was granted funding, the number of firms in each group, and the percentage of such firms

Tables 2-4 report the patterns for obtaining positive financing decisions from Finnvera for the sample firms over the 2000-2008 period. Table 2 shows that 45.8% of the loan clients obtained loans in only one period, 29.4% obtained loans in at least three periods, 9.2% obtained loans in at least five periods, and 2.9% obtained loans in at least seven periods. Approximately 0.3% of the loan clients obtained loans in every period.

Table 3 shows the patterns for obtaining positive guarantee decisions from Finnvera over the same period. The findings indicate that 45.5% of the guarantee clients obtained a single contract during the study period, 38.3% obtained guarantees in at least three periods, 20.1% obtained guarantees in at least five periods, and 9.7% obtained guarantees in at least seven periods. Overall, 2% of the guarantee clients obtained guarantees in every period.

Table 4 shows the patterns for obtaining positive loan or guarantee decisions from Finnvera over the sample period. These patterns cover the entire client group in the sample because the firms can obtain both loans and guarantees. In the case of the client firms, 39.4% of the firms obtained funding in only one period, 40.8% obtained funding in at least three periods, 19.9% obtained funding in at least five periods, 9.9% obtained funding in at least seven periods, and 2.4% obtained funding in every period. The findings confirm that there are regular customers in the client group.

TABLE 5 Transition probabilities

Panel A: Loans

	0	1
0	96.66 (58773)	3.34 (2032)
1	70.22 (2238)	29.78 (949)

Panel B: Guarantees

	0	1
0	97.91 (59777)	2.09 (1279)
1	47.48 (1394)	52.52 (1542)

Panel C: Pooled loans and guarantees

	0	1
0	95.62 (55990)	4.38 (2565)
1	52.20 (2838)	47.80 (2599)

Table 5 reports the transition probabilities for the funding granted by Finnvera for a balanced panel of manufacturing corporations over the 2000-2008 period. The results are reported for (i) loans, (ii) guarantees, and (iii) pooled loans and guarantees. The transitions are calculated for two consecutive years. ″1″ denotes that the firm has obtained a positive financing decision at the given time period, whereas ″0″ denotes that it has not. Frequencies are shown in the parenthesis. Source of data: Statistics Finland.

TABLE 6 Transition probabilities (aggregated panel)

Panel A: Loans

	0	1
0	96.08 (28135)	3.92 (1147)
1	61.35 (1665)	38.65 (1049)

Panel B: Guarantees

	0	1
0	97.63 (29133)	2.37 (707)
1	47.96 (1034)	52.04 (1122)

Panel C: Pooled loans and guarantees

	0	1
0	95.22 (26540)	4.78 (1333)
1	48.73 (2009)	51.27 (2114)

Table 6 reports the transition probabilities for the funding granted by Finnvera for a balanced panel of manufacturing corporations over the 2000-2008 period. The panel is aggregated at the two-year level. The results are reported for (i) loans, (ii) guarantees, and (iii) pooled loans and guarantees. The transitions are calculated for two consecutive periods. ”1” denotes that the firm has obtained a positive financing decision at the given time period, whereas ”0” denotes that it has not. Frequencies are shown in the parenthesis. Source of data: Statistics Finland.

Table 5 reports the transition probabilities for obtaining funding, conditional on the state of the previous period. The frequencies are shown in parentheses. Based on the consecutive years, the previous period’s loan customers are 8.9-times more likely to obtain loans in the current period than the rest of the firms. The firms that received guarantees in the previous period are 25.1-times more likely to receive guarantees in the current period than the others. In the case of the entire client group, those firms that obtained any funding in the previous period are 10.9-times more likely to obtain funding in the current period than the other firms. The findings indicate considerable persistence in the data.

Table 6 shows the transition probabilities for the aggregated panel that combines two individual years into a single period. In this case, the loan and guarantee clients from the previous period are 9.9- and 22-times more likely to obtain funding in the current period than the other firms, respectively. In the case of the entire client group, those firms that obtained funding in the previous period are 10.7-times more likely to obtain funding in the current period than the other firms. The results are very similar to those obtained from the yearly data. The findings show that there is persistence in the data regardless of the time unit of the panel.

Notably, the financing decision indicators measure new granted funding. Discussions with the personnel of Finnvera indicate that concerns about mechanical correlation in the financing decisions could be largely relaxed. The

guarantee contracts usually cover the entire loan period. In the case of permanent-term credit lines, two-year contracts are typically used. A non-negligible amount of financing is related to credit limits, which may be renewed in future periods. While the dataset does not allow heterogeneous financing instruments to be distinguished from each other, this might provide one explanation for the persistence observed in the data. The firms still need to reapply for each new contract. In addition, no serial decisions are made in the case of loan contracts. However, if the contract details need changes afterwards, it is possible that a new financing decision is made instead of an adjustment to the current contract if fundamental changes in the risk level appear.[21] Of course, during the granting process, the agency or firms could anticipate that the credit could be extended in the future. The staged financing type of behavior should be less of a concern because the firms could also apply for the future funding from the private financial intermediaries. Still, it is important to take into account the firm-specific heterogeneity. The econometric analysis can control for both the observed and permanent, unobserved firm-specific characteristics.

[21] This information is based on the communication with the management of Finnvera.

4 EMPIRICAL MODEL AND ESTIMATION

4.1 Hypotheses and econometric specification

The econometric approach applies dynamic probit models to analyze the dynamic behavior of the subsidized firms. The model is defined as follows:

$$y_{it}^{*} = \underbrace{x_{it}'\beta}_{controls} + \underbrace{\gamma y_{it-1}}_{state\ dependence} + \underbrace{\alpha_i}_{\substack{unobserved \\ heterogeneity}} + \underbrace{u_{it}}_{error\ term} \quad (1)$$

$$y_{it} = \begin{cases} 1 & if\ y_{it}^{*} > 0 \\ 0 & else \end{cases}$$

$$i = 1, \dots, N$$

$$t = 2, \dots, T$$

where y_{it} is an indicator of whether the firm i obtained government funding at the time period t, x_{it} is a vector of control variables, α_i is an unobserved time-invariant firm-specific effect, and u_{it} is a random error term. The random effects specification assumes that the composite error term $v_{it} = \alpha_i + u_{it}$ is correlated between the periods as $\lambda = corr(v_{it}, v_{it-1}) = \sigma_\alpha^2/(\sigma_\alpha^2 + \sigma_u^2)$ for $t = 2, \dots, T$.

Several methodological issues arise in the identification of state dependence. Persistence could arise because of true state dependence, unobserved heterogeneity, or a serially correlated error term (Greene 2002, 708). It is important to distinguish between the persistence caused by true state dependence and unobserved heterogeneity. Ignoring the persistence that arises from unobserved heterogeneity would result in an overstatement of the state dependence (Stewart 2007).

The existence of state dependence in the financing decisions can be tested with the lagged dependent variable. The null hypothesis $\gamma = 0$ states that the current participation in the subsidized lending schemes does not affect the propensity to participate in the future. According to the null hypothesis, persistence in the subsidized financing could be accounted for the firm-specific heterogeneity, rather than a causal effect. Such persistence could be interpreted as

spurious state dependence (cf. Chay and Hyslop 2000, 2001). For instance, some potential explanations for such persistence could include unobserved riskiness of the firms or the nature of their projects. The null hypothesis states that these firm-specific characteristics alone could explain why some firms have a higher dependence on the financing provided by a public financier.

The alternative hypothesis states that persistence arises because of true state dependence. In this case, current participation has a causal effect on the likelihood to participate in the future. Two alternative predictions arise about the sign of the lagged dependent variable once the firm-specific factors are controlled for. In the first hypothesis, the government certifies firms by financing them, and this provides an accurate signal about the quality of the financed firms to private financial intermediaries (cf. Lerner 1999, 2002; Tirole 2006, 250). These private financial intermediaries would then know which firms are good and would confidently invest in them in the future. Currently subsidized firms would be less likely to resort to government funding in the following period. This hypothesis would predict *negative* state dependence, which indicates that $\gamma < 0$. Simply put, previous participation decreases the likelihood of the current participation.

In the second hypothesis, government funding does not provide an accurate signal about the borrower quality and alleviate the financial constraints in the future. Because of the noisy signal, private financial intermediaries do not know whether the firms are good or bad. Even if government funding does provide an accurate signal, entrepreneurs still prefer subsidized financing to solely private financing. Because the entrepreneurs learn from the application process over time, past funding experiences increase the probability that the entrepreneurs apply and receive more government funding in the current period (cf. Lerner 2002). This hypothesis would predict *positive* state dependence, which indicates that $\gamma > 0$. Simply put, current participation increases the propensity for future participation.

The control variables are motivated by the earlier literature on financial constraints and capital structure. Beck et al. (2006) suggest that size, age, and ownership are the most useful predictors of financial constraints. Hyytinen and Pajarinen (2008) show that age provides a close empirical proxy for the informational opacity of firms. Age squared is also included in the models to take into account potential nonlinearities relating to firm age following the previous literature (see, e.g., Hyytinen and Toivanen 2005; Hyytinen and Pajarinen 2007). The variables for profitability and tangibility of assets are motivated by Rajan and Zingales (1995), who show that these variables tend to be correlated with leverage ratios. Myers and Majluf (1984) predict a negative association between leverage and profitability because firms are likely to prefer internal funds to debt. The tangibility of assets is used as a measure of collateralizable assets. The definitions of firm size, profitability and tangibility of assets used in this study follow the ones used by Rajan and Zingales (1995). Two ownership controls are included in the model. The first ownership control is an indicator of foreign ownership. Foreign-owned firms could be more likely to have better access to

external finance. The second ownership control is an indicator of firms that belong to a business group. Hoshi et al. (1991) suggest that firms in the Japanese *keiretsu* business groups are less likely to suffer from capital constraints. The current study applies a similar idea, but uses an indicator on whether the firm belongs to a consolidated corporation. An indicator for firms with export activities is also included because exporter firms are more likely to face capital needs. Past sales growth is used as a control for the growth orientation of firms.

4.2 Unobserved heterogeneity and estimation

Dynamic random effects probit models require an assumption about the relationship between the initial observation y_{i1} and the heterogeneity term α_i. If the initial conditions are exogenous, then standard random effects methodology could be used (Stewart 2007). However, a problem arises when the initial conditions are correlated with the unobserved heterogeneity. If the initial conditions are misspecified, the resulting estimate would be inconsistent and would tend to overstate the amount of state dependence (Chay and Hyslop 2000; Stewart 2007). The bias is inversely related to the length of the panel. It could be a particularly acute issue in the panels with only a short time dimension (Chay and Hyslop 2000). This is likely to be a relevant issue in the current case. First, the pre-sample financing history is unobservable for most of the sample firms, with the exception of the start-up firms. Second, even when the entire sample history of the process is known, the assumption about the exogenous initial conditions is still very strong (Wooldridge 2005, 40).

The study applies the dynamic probit estimator of Wooldridge (2005) to control for the initial condition problem. This approach is based on a conditional maximum likelihood estimator, which conditions on the initial observation y_{i1} in addition to the exogenous variables. The approach specifies a model for the unobserved heterogeneity as $\alpha_i = a_0 + a_1 y_{i1} + z_i' a_2 + \xi_i$, where y_{i1} is the initial value of the lagged dependent variable, z_i contains variables correlated with α_i and ξ_i is an unobserved heterogeneity term uncorrelated with the initial condition. The advantage of this estimator is that it can be implemented with standard econometric software. It is also computationally less burdensome than the alternative estimator of Heckman (1981). Wooldridge suggests using x_i in all time periods for z_i, while other specifications are also possible (see Arulampalam and Stewart 2009). Substituting the above into equation (1) gives:

$$y_{it}^* = x_{it}'\beta + \gamma y_{it-1} + a_0 + a_1 y_{i1} + z_i' a_2 + \xi_i + u_{it} \qquad (2)$$

A number of region and industry dummies are included in z_i to control for the observed firm-specific heterogeneity that could be correlated with α_i. These dummies are likely to be relevant controls because the subsidies are rationalized by regional and industrial policy reasons. Because there is little time variation in these dummies, the initial period values are used for the entire study

period. The random effects methodology assumes a strict exogeneity of the rest of the control variables. This is a rather strong assumption; however, there is not a simple solution for the issue in the applied literature. It is also worth noting that fixed effects estimation would not lead to consistent estimates in dynamic nonlinear models with unobserved heterogeneity (Wooldridge 2002). A rich set of covariates is included in the model to confirm that the persistence is not driven by observed firm-specific characteristics.[22]

The marginal effects for the lagged dependent variable are calculated in a conventional fashion (cf. Stewart 2007; Wooldridge 2002, 2005). In the case of the Wooldridge estimator, the counterfactual outcome probabilities are estimated taking y_{it-1} as fixed at 1 and 0 as follows:

$$\hat{p}_1 = \frac{1}{N}\sum_{i=1}^{N} \Phi\left\{\left(x_{it}'\hat{\beta} + \hat{\gamma} + \hat{a}_0 + \hat{a}_1 y_{i1} + z_i'\hat{a}_2\right)\left(1-\hat{\lambda}\right)^{1/2}\right\},$$
$$\hat{p}_0 = \frac{1}{N}\sum_{i=1}^{N} \Phi\left\{\left(x_{it}'\hat{\beta} + \hat{a}_0 + \hat{a}_1 y_{i1} + z_i'\hat{a}_2\right)\left(1-\hat{\lambda}\right)^{1/2}\right\} \quad (3)$$

Two comparisons are then computed based on these estimates as follows: the *average marginal effects* $(AME) = \hat{p}_1 - \hat{p}_0$ and the *predicted probability ratios* $(PPR) = \hat{p}_1/\hat{p}_0$. The multiplier $\left(1-\hat{\lambda}\right)^{1/2}$ scales the random-effects probit coefficients into the same scale as the pooled probit coefficients (see Arulampalam 1999). The reported computations are averages across all the time periods.

[22] It is worth noting that an otherwise potential control for obtaining new loans, such as leverage ratio, obviously does not seem likely to satisfy the strict exogeneity requirements of the models and is not considered for this reason.

5 EMPIRICAL RESULTS

5.1 Main results

The dynamic probit estimates are reported in tables 7-9. The estimates are reported for the pooled probit, standard random effects probit, and Wooldridge's random effects probit estimator. The average marginal effects (AME) and predicted probability ratios (PPRs) are computed for the lagged dependent variable. The coefficient estimates are unscaled, while the AMEs and PPRs are comparable between the estimators. All the specifications include two-digit industry dummies, provincial-level region dummies and year dummies, which are not reported. The Wald tests that the industry and region dummies are jointly equal to zero are provided in the tables. The random effects models are estimated using the adaptive Gauss-Hermite quadrature with 36 integration points. The accuracy of the quadrature approximation is confirmed for each specification. The standard errors of the pooled probit models are clustered at the firm level.

TABLE 7 Dynamic probit estimates: loans

	(1)	(2)	(3)	(4)	(5)
	Pooled probit	Random effects probit	Wooldridge's random effects probit	Pooled probit	Wooldridge's random effects probit
Dependent variable	Obtained loan	Obtained loan	Obtained loan	Obtained loan	Obtained loan
Lagged dependent variable (t-1)	0.979***	0.144***	0.0465	0.953***	0.0453
	(0.0376)	(0.0378)	(0.0370)	(0.0400)	(0.0411)
Age	-0.002	-0.006	-0.004	-0.001	-0.005
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)
Age squared[a]	-0.044	-0.002	-0.017	-0.036	0.002
	(0.034)	(0.056)	(0.055)	(0.035)	(0.057)

ln(Sales)	0.150***	0.222***	0.187***	0.189***	0.219***
	(0.00698)	(0.0116)	(0.0112)	(0.00870)	(0.0130)
Profitability	-0.285***	-0.233***	-0.196***	-0.377***	-0.237***
	(0.0520)	(0.0741)	(0.0735)	(0.0581)	(0.0821)
Tangibility	0.407***	0.363***	0.275***	0.442***	0.350***
	(0.0507)	(0.0726)	(0.0714)	(0.0543)	(0.0757)
Exporter	0.214***	0.226***	0.216***	0.189***	0.184***
	(0.0320)	(0.0437)	(0.0433)	(0.0344)	(0.0465)
Foreign	-0.972***	-1.283***	-1.126***	-0.922***	-1.097***
	(0.116)	(0.154)	(0.149)	(0.133)	(0.164)
Initial condition			1.235***		1.222***
			(0.0582)		(0.0614)
Growth				0.123***	0.0486
				(0.0413)	(0.0494)
Group				-0.445***	-0.465***
				(0.0487)	(0.0591)
_cons	-4.549***	-6.349***	-5.839***	-5.077***	-6.229***
	(0.122)	(0.200)	(0.191)	(0.142)	(0.212)
Wald test:					
Industry dummies	71.62	80.07	68.01	61.46	51.64
[p-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Region dummies	414.7	441.72	356.19	377.39	313.37
[p-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AME	0.144	0.009	0.003	0.134	0.003
PPR	5.08	1.22	1.06	4.91	1.06
NT	63992	63992	63992	55993	55993
rho		0.465	0.428		0.415
ll	-9833.1	-9265.6	-9011.7	-8306.4	-7700.5

The table reports the dynamic probit estimates for a balanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is an indicator of whether the firm was granted a positive amount of loans by Finnvera at period t. The control variables are defined as follows: *age* is the age of the firm at t, *ln(sales)* is a natural logarithm of net sales at t-1, *profitability* is a ratio of EBITDA to total assets at t-1, *tangibility* is a ratio of fixed to total assets at t-1, *exporter* is an indicator for firms with export activities at t-1, *foreign* is an indicator for foreign ownership at t-1, *initial condition* is the initial value of the lagged dependent variable, *growth* is the growth of net sales from t-2 to t-1, and *group* is an indicator for firms belonging to a business group at t-1. AME measures the average marginal effects for the lagged dependent variable. PPR measures the predicted probability ratio for the lagged dependent variable. NT is the number of observations in the sample. Rho measures the intraclass error correlation. The log-likelihood is denoted as ll. All the specifications include time, area, and industry dummies, which are not reported. The Chi^2-statistics for the Wald test that the industry and area dummies are jointly equal to zero are reported in the table [p-values in brackets]. Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors for the specifications (1) and (4) are corrected for the firm-level clustering. Source of data: Statistics Finland. [a] The coefficients and standard errors of *age squared* have been multiplied by 1000.

The estimates for the loan decisions are reported in table 7. The pooled probit estimator provides a positive and highly significant estimate of the lagged dependent variable. The AME is 0.144. However, this simple estimator ignores the unobserved heterogeneity. The standard random effects estimator results in a positive and highly significant state dependence estimate, while the magnitude of the effect diminishes considerably. The AME is reduced down to 0.009. This estimator still assumes exogenous initial conditions. The Wooldridge estimator relaxes this assumption. Once the initial conditions are controlled for, the lagged dependent variable is no longer statistically significant. The initial condition of the lagged dependent variable is highly significant and has a large coefficient. This suggests that there is considerable correlation between the initial condition and unobserved heterogeneity. Taken together, the observed persistence in loans between two consecutive periods could be accounted for the unobserved firm-specific heterogeneity. The measure rho shows that the unobserved heterogeneity accounts for between 41.5 and 46.5% of the total error variance in the case of loan decisions. The further analysis in section 5.2 captures longer-term dynamics and provides evidence of positive state dependence. However, the short-term persistence analyzed here is dominated by unobserved permanent firm characteristics.

TABLE 8 Dynamic probit estimates: guarantees

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	Pooled probit	Random effects probit	Wooldridge's random effects probit	Pooled probit	Wooldridge's random effects probit
Dependent variable	Obtained guarantee	Obtained guarantee	Obtained guarantee	Obtained guarantee	Obtained guarantee
Lagged dependent variable (t-1)	1.828*** (0.0381)	0.863*** (0.0456)	0.680*** (0.0427)	1.838*** (0.0403)	0.667*** (0.0478)
Age	-0.009*** (0.003)	-0.015*** (0.005)	-0.015*** (0.005)	-0.010*** (0.003)	-0.020*** (0.005)
Age squared[a]	0.037 (0.039)	0.081 (0.060)	0.066 (0.062)	0.068* (0.040)	0.148** (0.061)
ln(Sales)	0.171*** (0.00739)	0.291*** (0.0142)	0.238*** (0.0137)	0.203*** (0.00925)	0.256*** (0.0158)
Profitability	-0.512*** (0.0500)	-0.549*** (0.0838)	-0.495*** (0.0841)	-0.618*** (0.0555)	-0.590*** (0.0927)
Tangibility	0.176*** (0.0532)	0.258*** (0.0838)	0.227*** (0.0837)	0.196*** (0.0565)	0.263*** (0.0891)
Exporter	0.245*** (0.0342)	0.268*** (0.0484)	0.251*** (0.0485)	0.229*** (0.0362)	0.219*** (0.0523)
Foreign	-0.698*** (0.109)	-1.109*** (0.150)	-0.907*** (0.147)	-0.696*** (0.116)	-0.957*** (0.165)

Initial condition			1.648***		1.758***
			(0.0802)		(0.0842)
Growth				0.110***	0.107*
				(0.0427)	(0.0550)
Group				-0.342***	-0.420***
				(0.0489)	(0.0648)
_cons	-4.593***	-7.206***	-6.463***	-4.991***	-6.628***
	(0.124)	(0.253)	(0.239)	(0.145)	(0.263)
Wald test:					
Industry dummies	106.19	106.54	80.88	92.98	68.94
[p-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Region dummies	109.45	110.04	79.33	104.67	70.84
[p-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AME	0.356	0.062	0.043	0.351	0.041
PPR	17.10	3.01	2.27	17.55	2.23
NT	63992	63992	63992	55993	55993
Rho		0.518	0.495		0.476
Ll	-7654.2	-7289.0	-7010.9	-6474.1	-5948.3

The table reports the dynamic probit estimates for a balanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is an indicator for whether the firm was granted a positive amount of guarantees by Finnvera at period t. The control variables are defined as follows: *age* is the age of the firm at t, *ln(sales)* is a natural logarithm of net sales at t-1, *profitability* is a ratio of EBITDA to total assets at t-1, *tangibility* is a ratio of fixed to total assets at t-1, *exporter* is an indicator for firms with export activities at t-1, *foreign* is an indicator for foreign ownership at t-1, *initial condition* is the initial value of the lagged dependent variable, *growth* is the growth of net sales from t-2 to t-1, and *group* is an indicator for firms belonging to a business group at t-1. AME measures the average marginal effects for the lagged dependent variable. PPR measures the predicted probability ratio for the lagged dependent variable. NT is the number of observations in the sample. Rho measures the intraclass error correlation. The log-likelihood is denoted as ll. All the specifications include time, area, and industry dummies, which are not reported. The Chi^2-statistics for the Wald test that the industry and area dummies are jointly equal to zero are reported in the table [p-values in brackets]. Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors for the specifications (1) and (4) are corrected for the firm-level clustering. Source of data: Statistics Finland. [a] The coefficients and standard errors of *age squared* have been multiplied by 1000.

The estimates for the guarantee decisions are reported in table 8. The results provide consistent support for the existence of positive state dependence. The pooled probit estimator provides a highly significant coefficient for the lagged dependent variable. The AME is 0.356. The standard random effects estimator reduces the AME down to 0.062. The Wooldridge estimator further reduces the AME down to 0.043, while the PPR is 2.27. The guarantee estimates show that funding experience from the previous period increases the probability of being subsidized by 4.3%. Previously subsidized firms are 2.3-times more likely to be subsidized in the current period than non-subsidized firms. The unobserved heterogeneity captures a significant fraction of the dynamics, as the comparison between the different specifications reveals. The initial condition variable has a large and highly significant coefficient. The measure rho shows that the unob-

served firm-specific heterogeneity accounts for between 47.6 and 51.8% of the total error variance in the case of guarantee decisions.

The control variable estimates provide details on the characteristics of subsidized firms. Because these estimates are similar for the entire client group, they are discussed together here. The coefficient of age is negative but insignificant in the case of loans. It is negative and highly significant in the case of guarantees. The results provide only partial support for the prediction that subsidized firms would be younger than average. However, note that the panel design restricts the entry of new firms into the panel after the initial time period. The coefficient of net sales is positive and highly significant. That is, the probability of obtaining government funding increases with size. The coefficient of profitability is negative and highly significant. In other words, less profitable firms are more likely to resort to government funding. The tangibility of assets has a positive and highly significant coefficient. This proxy for collateralizable assets indicates that subsidized firms have more tangible assets in their balance sheets than non-subsidized firms. The finding that subsidized firms are larger and have more tangible assets seems to contradict the predictions about the nature of firms that are more likely to suffer from asymmetric information. It remains possible that the findings could reflect differences in the financial growth cycle of firms.

The indicator for exporter firms is positive and highly significant. That is, export-orientated firms are more likely to apply and receive government funding. The indicator for foreign ownership is negative and highly significant. The indicator for belonging to a business group has a negative and highly significant coefficient. Taken together, the data indicate that subsidized firms tend to have an ownership structure that may provide fewer chances for access to the capital markets. The coefficient of past sales growth is positive but weakly significant in the case of guarantees and insignificant in the case of loans. There appears to be no robust evidence on the growth orientation of subsidized firms once unobserved characteristics are controlled for. The Wald tests that the area and industry dummies are jointly equal to zero are both rejected at the 1% level.[23] That is, region and industry characteristics are found to be significant factors behind the financing decisions.[24] In summary, the control variable estimates appear to be sensible and largely correspond to the expectations.

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23 The comparison point for the area dummies is Uusimaa. The comparison point for the industry dummies is the group ”manufacturing of foods, beverages and tobacco”. The groups ”tobacco” and ”foods and beverages” are combined, while the group ”coke, refined petroleum products and nuclear fuel” is combined with the group ”chemical products and man-made fibers” because of the low amount of observations in the former groups.

24 Strictly speaking, these time-invariant dummies cannot necessarily be given a causal interpretation in the Wooldridge estimator because they are indistinguishable from the model of the unobserved heterogeneity.

5.2 Robustness tests

The corporate finance literature predicts that firms with weak balance sheets or entrepreneurs with optimistic expectations tend to borrow on a short-term basis (e.g., Tirole 2006, 204; Landier and Thesmar 2009). However, the yearly horizon might not capture the full dynamics because the maturity of the loans could be several years. The following analysis addresses these concerns. Here, the time unit of the panel is aggregated at the two-year level by combining two individual years together as a single period. The financing decision indicators now take a value equal to unity if the firm was granted funding during any of the two years that were combined together. A similar treatment is used for the indicators of exporter status and foreign ownership. A period-specific average is taken of the continuous covariates. The firm age is measured at the middle of the period. The aggregated panel provides a possibility to study the lag between the funding decisions of up to four years at most. The analysis focuses on the Wooldridge estimator because the initial condition issue is particularly acute in the short panels. The simulations of Arulampalam and Stewart (2009) show that this estimator continues to perform well in terms of bias in the panels with a similar time dimension.

TABLE 9 Dynamic probit estimates: loans and guarantees (aggregated panel)

	(1)	(2)	(3)	(4)
	Pooled probit	Wooldridge's random effects probit	Pooled probit	Wooldridge's random effects probit
Dependent variable	Obtained loan	Obtained loan	Obtained guarantee	Obtained guarantee
Lagged dependent variable (t-1)	1.153***	0.159***	1.806***	0.960***
	(0.0367)	(0.0530)	(0.0392)	(0.0693)
Age	-0.003	-0.004	-0.012***	-0.019***
	(0.003)	(0.005)	(0.003)	(0.005)
Age squared[a]	-0.024	-0.021	0.077*	0.127**
	(0.037)	(0.066)	(0.041)	(0.062)
ln(Sales)	0.142***	0.182***	0.151***	0.189***
	(0.00778)	(0.0137)	(0.00801)	(0.0148)
Profitability	-0.240***	-0.211**	-0.386***	-0.415***
	(0.0589)	(0.0936)	(0.0538)	(0.0901)
Tangibility	0.441***	0.441***	0.121*	0.163*
	(0.0588)	(0.0903)	(0.0651)	(0.0938)
Exporter	0.157***	0.142***	0.226***	0.247***
	(0.0356)	(0.0511)	(0.0402)	(0.0525)
Foreign	-1.052***	-1.321***	-0.695***	-0.884***

	(0.145)	(0.194)	(0.118)	(0.163)
Initial condition		1.365***		1.231***
		(0.0722)		(0.100)
_cons	-4.073***	-5.279***	-4.013***	-5.049***
	(0.130)	(0.231)	(0.135)	(0.256)
Wald test:				
Industry dummies	61.94	49.92	68.76	58.9
[p-value]	[0.000]	[0.000]	[0.000]	[0.000]
Region dummies	356.66	247.72	96.66	65.6
[p-value]	[0.000]	[0.000]	[0.000]	[0.000]
AME	0.206	0.013	0.367	0.090
PPR	5.80	1.20	15.50	3.35
NT	31996	31996	31996	31996
rho		0.446		0.387
ll	-6030.2	-5707.0	-4506.3	-4391.3

The table reports the dynamic probit estimates for a balanced panel of Finnish manufacturing corporations over the 2000-2008 period. The panel is aggregated at the two-year level where one period consists of two individual years. The indicator variables are defined as equal to unity if the condition holds in any of the two combined years. The continuous covariates are period-specific averages. The dependent variable in the specifications 1-2 (3-4) is an indicator for whether the firm was granted a positive amount of loans (guarantees) by Finnvera at period t. The control variables are defined as follows: *age* is the age of the firm at the middle of the period t, *ln(sales)* is a natural logarithm of net sales at t-1, *profitability* is a ratio of EBITDA to total assets at t-1, *tangibility* is a ratio of fixed to total assets at t-1, *exporter* is an indicator for firms with export activities at t-1, *foreign* is an indicator for foreign ownership at t-1, and *initial condition* is the initial value of the lagged dependent variable. AME measures the average marginal effects for the lagged dependent variable. PPR measures the predicted probability ratio for the lagged dependent variable. NT is the number of observations in the sample. Rho measures the intraclass error correlation. The log-likelihood is denoted as ll. All the specifications include time, area and industry dummies, which are not reported. The Chi^2-statistics for the Wald test that the industry and area dummies are jointly equal to zero are reported in the table [p-values in brackets]. Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors for the specifications (1) and (3) are corrected for the firm-level clustering. Source of data: Statistics Finland.
[a] The coefficients and standard errors of *age squared* have been multiplied by 1000.

The results for the aggregated panel are reported in table 9. The estimates for the loan decisions now reveal evidence of the existence of positive state dependence. The lagged dependent variable is highly significant. The AME is 0.013, while the PPR is 1.20. Previous funding experience increases the probability for obtaining loans in the current period by 1.3%. Past loan clients are 1.2-times more likely to be subsidized in the current period than the other firms. The unobserved firm-specific heterogeneity remains an important factor behind the financing decisions. It would be beneficial to allow longer lag adjustment to capture a wider maturity range for the loans. However, the panel dimension does not provide such an opportunity. It seems likely that at least some of the differences between loans and guarantees are maturity-related. The state dependence estimates for the guarantee decisions remain highly significant. The AME is 0.09, while the PPR is 3.35. That is, previous funding experience increases the probability for obtaining guarantees in the current period by 9%. Previous guarantee clients are 3.35-times more likely to be subsidized in the

current period than the other firms. The findings suggest that the persistence is magnified rather than diminished over a longer term.

TABLE 10 Transition probabilities (unbalanced panel)

Panel A: Loans

	0	1
0	96.92 (91309)	3.08 (2904)
1	72.43 (3510)	27.57 (1336)

Panel B: Guarantees

	0	1
0	97.90 (92387)	2.10 (1978)
1	49.51 (2324)	50.49 (2370)

Panel C: Pooled loans and guarantees

	0	1
0	95.82 (86799)	4.18 (3791)
1	54.26 (4595)	45.74 (3874)

Table 10 reports the transition probabilities for the funding granted by Finnvera for a rectangularized unbalanced panel of manufacturing corporations over the 2000-2008 period. The results are reported for (i) loans, (ii) guarantees and (iii) pooled loans and guarantees, respectively. The transitions are calculated for two consecutive years. ”1” denotes that the firm has obtained a positive financing decision at the given time period, whereas ”0” denotes that it has not. Frequencies are shown in the parenthesis. Source of data: Statistics Finland.

The econometric results are conditional on the firm existing over the entire study period. This might raise a concern about potential sample selection because of a survivorship bias. To check whether the dynamics are sensitive to the requirement of a balanced panel, the transition probabilities for a rectangularized unbalanced panel are provided in table 10. The data allow the entry and exit in and out of the panel, while the other sample selection criteria remain identical. The differences are minor, as the comparison between tables 5 and 10 reveal. The findings suggest that the dynamics are not significantly affected by the panel design.

For further robustness tests, the econometric results for the balanced panel covering the 2000-2006 period are also provided for comparison. This alternative dataset provides a further possibility to check whether the econometric results are sensitive to the study period or to attrition during the later periods. This analysis focuses on the yearly horizon given the limited panel dimension of the dataset.

TABLE 11 Dynamic probit estimates: loans

	(1)	(2)	(3)	(4)	(5)
	Pooled probit	Random effects probit	Wooldridge's random effects probit	Pooled probit	Wooldridge's random effects probit
Dependent variable	Obtained loan	Obtained loan	Obtained loan	Obtained loan	Obtained loan
Lagged dependent variable (t-1)	0.948***	0.176***	0.0137	0.913***	0.00986
	(0.0386)	(0.0437)	(0.0419)	(0.0417)	(0.0486)
Age	-0.005*	-0.010**	-0.007*	-0.005*	-0.009**
	(0.003)	(0.004)	(0.004)	(0.003)	(0.004)
Age squared[a]	-0.011	0.042	0.028	0.006	0.060
	(0.037)	(0.060)	(0.060)	(0.037)	(0.061)
ln(Sales)	0.141***	0.211***	0.179***	0.179***	0.214***
	(0.00678)	(0.0112)	(0.0109)	(0.00876)	(0.0130)
Profitability	-0.406***	-0.429***	-0.373***	-0.493***	-0.426***
	(0.0550)	(0.0766)	(0.0767)	(0.0625)	(0.0870)
Tangibility	0.390***	0.389***	0.295***	0.425***	0.375***
	(0.0504)	(0.0719)	(0.0718)	(0.0552)	(0.0767)
Exporter	0.212***	0.236***	0.228***	0.186***	0.194***
	(0.0336)	(0.0459)	(0.0459)	(0.0367)	(0.0499)
Foreign	-0.862***	-1.187***	-1.024***	-0.824***	-1.003***
	(0.116)	(0.150)	(0.148)	(0.131)	(0.161)
Initial condition			1.240***		1.207***
			(0.0584)		(0.0638)
Growth				0.109***	0.0369
				(0.0420)	(0.0517)
Group				-0.448***	-0.498***
				(0.0505)	(0.0615)
_cons	-4.152***	-5.681***	-5.241***	-4.651***	-5.673***
	(0.116)	(0.189)	(0.181)	(0.139)	(0.209)
Wald test:					
Industry dummies	69.81	72.59	59.83	56.95	43.74
[p-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.002]
Region dummies	412.29	407.53	331.07	352.27	267.6
[p-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AME	0.142	0.012	0.001	0.131	0.001
PPR	4.83	1.28	1.02	4.61	1.01
NT	54216	54216	54216	45180	45180
rho		0.434	0.411		0.394
ll	-8710.6	-8390.8	-8120.4	-7059.0	-6672.2

The table reports the dynamic probit estimates for a balanced panel of Finnish manufacturing corporations over the 2000-2006 period. The dependent variable is an indicator for whether the firm was granted a positive amount of loans by Finnvera at period t. The control variables are defined as follows: *age* is the age of the firm at t, *ln(sales)* is a natural logarithm of net sales at t-1, *profitability* is a ratio of EBITDA to total assets at t-1, *tangibility* is a ratio of fixed to total assets at t-1, *exporter* is an indicator for firms with export activities at t-1, *foreign* is an indicator for foreign ownership at t-1, *initial condition* is the initial value of the lagged dependent variable, *growth* is the growth of net sales from t-2 to t-1, and *group* is an indicator for firms belonging to a business group at t-1. AME measures the average marginal effects for the lagged dependent variable. PPR measures the predicted probability ratio for the lagged dependent variable. NT is the number of observations in the sample. Rho measures the intraclass error correlation. The log-likelihood is denoted as ll. All the specifications include time, area and industry dummies, which are not reported. The Chi^2-statistics for the Wald test that the industry and area dummies are jointly equal to zero are reported in the table [p-values in brackets]. Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors for the specifications (1) and (4) are corrected for the firm-level clustering. Source of data: Statistics Finland. [a] The coefficients and standard errors of *age squared* have been multiplied by 1000.

Table 11 shows that the state dependence estimates in the case of loan decisions are similar to the ones obtained from the main sample. The short-term persistence in the loans is related to the unobserved firm-specific heterogeneity. In the case of the control variables, the coefficient of age now reveals some weak evidence of statistical significance. However, the inference otherwise remains the same as earlier.

TABLE 12 Dynamic probit estimates: guarantees

	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	Pooled probit	Random effects probit	Wooldridge's random effects probit	Pooled probit	Wooldridge's random effects probit
Dependent variable	Obtained guarantee	Obtained guarantee	Obtained guarantee	Obtained guarantee	Obtained guarantee
Lagged dependent variable (t-1)	1.881*** (0.0402)	0.957*** (0.0566)	0.607*** (0.0492)	1.902*** (0.0436)	0.574*** (0.0584)
Age	-0.010*** (0.003)	-0.018*** (0.005)	-0.017*** (0.005)	-0.011*** (0.003)	-0.023*** (0.005)
Age squared[a]	0.042 (0.045)	0.099 (0.070)	0.073 (0.077)	0.082* (0.045)	0.181** (0.076)
ln(Sales)	0.165*** (0.00736)	0.292*** (0.0152)	0.249*** (0.0148)	0.200*** (0.00982)	0.274*** (0.0178)
Profitability	-0.659*** (0.0551)	-0.784*** (0.0900)	-0.692*** (0.0937)	-0.777*** (0.0630)	-0.803*** (0.108)
Tangibility	0.209*** (0.0539)	0.294*** (0.0873)	0.253*** (0.0917)	0.245*** (0.0580)	0.339*** (0.101)
Exporter	0.205*** (0.0362)	0.251*** (0.0525)	0.228*** (0.0546)	0.181*** (0.0396)	0.195*** (0.0611)

Foreign	-0.685***	-1.216***	-1.045***	-0.735***	-1.165***
	(0.113)	(0.164)	(0.170)	(0.125)	(0.201)
Initial condition			1.930***		2.080***
			(0.0932)		(0.106)
Growth				0.129***	0.110*
				(0.0467)	(0.0613)
Group				-0.395***	-0.519***
				(0.0521)	(0.0745)
_cons	-4.289***	-6.796***	-6.379***	-4.832***	-6.859***
	(0.122)	(0.270)	(0.255)	(0.154)	(0.299)
Wald test:					
Industry dummies	111.32	107.19	84.36	98.85	68.63
[p-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Region dummies	86.83	89.2	61.86	80.54	54.16
[p-value]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
AME	0.382	0.074	0.037	0.378	0.032
PPR	17.48	3.26	1.95	18.17	1.85
NT	54216	54216	54216	45180	45180
rho		0.524	0.547		0.541
ll	-6757.5	-6556.0	-6218.7	-5411.8	-5005.0

The table reports the dynamic probit estimates for a balanced panel of Finnish manufacturing corporations over the 2000-2006 period. The dependent variable is an indicator for whether the firm was granted a positive amount of guarantees by Finnvera at period t. The control variables are defined as follows: *age* is the age of the firm at t, *ln(sales)* is a natural logarithm of net sales at t-1, *profitability* is a ratio of EBITDA to total assets at t-1, *tangibility* is a ratio of fixed to total assets at t-1, *exporter* is an indicator for firms with export activities at t-1, *foreign* is an indicator for foreign ownership at t-1, *initial condition* is the initial value of the lagged dependent variable, *growth* is the growth of net sales from t-2 to t-1, and *group* is an indicator for firms belonging to a business group at t-1. AME measures the average marginal effects for the lagged dependent variable. PPR measures the predicted probability ratio for the lagged dependent variable. NT is the number of observations in the sample. Rho measures the intraclass error correlation. The log-likelihood is denoted as ll. All the specifications include time, area and industry dummies, which are not reported. The Chi^2-statistics for the Wald test that the industry and area dummies are jointly equal to zero are reported in the table [p-values in brackets]. Standard errors in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors for the specifications (1) and (4) are corrected for the firm-level clustering. Source of data: Statistics Finland. [a] The coefficients and standard errors of *age squared* have been multiplied by 1000.

Table 12 shows that the state dependence estimates in the case of guarantee decisions are similar to the ones obtained from the main sample. The estimates are only slightly more conservative in the shorter sample. In this sample, those firms that obtained guarantees in the previous period are 1.95-times more likely to obtain more guarantees in the current period than the other firms. The control variable estimates remain robust in the alternative sample. In summary, the robustness tests confirm that the results are not significantly affected by the study period or the attrition during the later periods.

5.3 Discussion

The econometric results suggest that while the unobserved heterogeneity accounts for a large fraction of the persistence observed in the data, there is still positive state dependence in the loan and guarantee decisions. The previous guarantee clients are approximately 2.3- or 3.4-times more likely to obtain guarantees than the other firms when the time unit of the panel is one or two years, respectively. The previous loan clients are 20% more likely to obtain loans than the rest of the firms when the time unit of the panel was aggregated to two years. The short-term persistence in loans observed in the yearly data was found to relate to unobserved firm-specific heterogeneity. Either way, the persistence was magnified rather than diminished over a longer term.

The findings suggest several potential implications that are related to the previous corporate finance literature. First, the finding that previously subsidized firms are more likely to be subsidized appears to reject the hypothesis of the immediate certification function of government funding. That is, if the government certifies firms and this 'stamp of approval' (Lerner 2002) has an immediate effect, private financial intermediaries would then know which firms are good and would confidently invest in them in the future. However, the findings suggest that subsidized financing does not eliminate a firm's need to resort to more subsidized financing in the future. Even if it does, firms still prefer to resort to subsidized financing. One interpretation of this finding is that subsidized financing may not provide an accurate signal about the quality of the firms. That is, the quality of the signal may be noisy (cf. Tirole 2006, 250).[25]

Second, the results could remain consistent with the monitoring role of a public financier. In particular, the information revelation could take some time in the presence of widespread adverse selection or moral hazard (Diamond 1989, 1991). However, the unobserved permanent firm-specific risk characteristics are controlled for in the model, in addition to the observed firm characteristics such as firm age and size. The existence of positive state dependence in government funding suggests that permanent firm-specific characteristics alone do not drive all the findings.

Third, the finding that previously subsidized firms are more likely to be subsidized is consistent with the hypothesis about the learning behavior of the firms. This hypothesis suggests that firms could resort repeatedly to government funding out of habit, perhaps because such funding could be easier to obtain. In the context of public venture capital awards, Lerner (2002) observed that firms gain insight into the application process over time. Lerner (2002) suggests that this and other distortions could make previously subsidized firms more

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[25] It is possible to make another argument against the certification hypothesis based on the suggestion that there are few rejected applicants in the data and that certification is likely to require that not every applicant should receive the stamp of approval. Even though one should be careful not to make too strong conclusions from the rejected applications given the data limitations (see section 3.3), this is another potential factor to consider when analyzing why the quality of the signal may be noisy.

likely to be subsidized in the future. The current study provides empirical support for this prediction in the credit market context, after controlling for firm-specific factors, such as risk characteristics.

Fourth, the positive state dependence particularly observed for guarantees suggests that the persistence observed in this study may also be related to the behavior of private financial intermediaries. In particular, banks may reduce their own monitoring effort and free ride on the screening and monitoring effort of a public financier (cf. Diamond 1984; Tirole 2006, 480; see also Lelarge et al. 2008). In related theoretical literature, Gale (1990a) also predicts that banks may *increase* credit rationing as an equilibrium response to government intervention in the credit markets. Gale (1990b) suggests that credit subsidies allocated to one target group may crowd out other target groups, which then increase their subsidy requests. This scenario could even result in a paradoxical situation where subsidies generate demand for more subsidies (Gale 1990b).

Finally, it is worth noting that the unobserved firm-specific heterogeneity also captured a considerable fraction of the persistence observed in the data. A potential explanation for this could be that some unobserved firm-specific risk or quality characteristics make private bank financing more challenging to obtain. These permanent firm-specific characteristics provide another reason why some firms resort to government funding in a repeated fashion.

6 CONCLUSIONS

This paper studied the dynamics of subsidized loans and guarantees granted to Finnish manufacturing firms based on the rationale of credit market imperfections. The findings of the paper indicate that there are repeat customers among firms that obtain subsidized financing. The econometric analysis evaluated whether such persistence originates from true state dependence or unobserved firm-specific heterogeneity, such as risk characteristics. The findings suggest that while the unobserved heterogeneity accounts for a large fraction of the persistence observed in the data, there is still positive state dependence in subsidized financing granted to firms. That is, previously subsidized firms are more likely to be subsidized in the future, even after taking into account the observed and permanent unobserved firm-specific characteristics.

The findings suggest the following potential implications. First, the positive state dependence appears to contradict the hypothesis of the immediate certification function of government funding. That is, subsidies do not appear to provide a signal about borrower quality that would eliminate the demand for the further subsidies in future periods (cf. Lerner 1999, 2002). Signals provided by subsidies may be noisy. Second, the results could, however, remain consistent with the monitoring role of a public financier if the informational asymmetries take time to resolve. Third, the finding that previously subsidized firms are more likely to be subsidized in the future is consistent with the hypothesis about the learning behavior of the firms predicted by Lerner (2002). Fourth, it remains possible that the state dependence particularly observed for guarantees could also reflect the behavior of private financial intermediaries. In particular, free riding may occur in the monitoring activity in the presence of multiple lenders (Diamond 1984).

The results suggest that governments should take into account the responses of private sector agents when framing their credit market policies (see also Parker 2002). The expected benefits from the policy intervention could be diluted if firms and banks adjust their behavior in response, implying that an extensive intervention is not likely to be a desirable policy direction. The role of government is limited and related to the marginal sectors of the credit markets

(Gale 1991). Because the fundamental mission of a public financier is to cure credit market imperfections, there is a limited rationale for the persistence in subsidized financing because the information problems should diminish over time (e.g., Diamond 1989). The unobserved firm-specific heterogeneity remains an important source of persistence observed in the data. Some permanent firm-specific characteristics, such as firm risk or quality, could affect firms' chances to obtain bank loans in a persistent fashion. These permanent firm-specific characteristics provide another reason for why some firms are more dependent on government funding than others.

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II

CREDIT MARKET IMPERFECTIONS, SMALL BUSINESS FINANCE, AND PUBLIC POLICY

CREDIT MARKET IMPERFECTIONS, SMALL BUSINESS FINANCE, AND PUBLIC POLICY

Ilkka Ylhäinen[1]

Abstract

This paper studies the real and financial effects of subsidized loans granted to small businesses. The study uses a large panel of Finnish manufacturing firms covering the 2000-2008 period. The firm data have been matched with the financing decision data of a major state-owned specialized financing company whose objective is to cure credit market imperfections. The policy effects are evaluated using the following methods: fixed effects models, instrumental variables models that exploit the regional variation in the supply of government funding; and boundary regressions, which compare firms located next to each other on the opposite sides of the regional support boundary. The findings suggest that the subsidized financing helped firms to expand their operations by allowing them to make more investments, grow faster, and hire more employees than the nonsubsidized firms. However, the effects on labor productivity were negative or insignificant, suggesting that the subsidized financing did not make the firms more efficient. Two potential channels were identified through which the subsidized financing promoted real activity. First, the subsidized financing helped the firms to exceed the maximum growth rates that could be financed internally or with a limited access to external finance. Second, the financing also helped to reduce the average financing costs of the firms.

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1 INTRODUCTION

Conventional wisdom in corporate finance suggests that the problems of asymmetric information could be acute among informationally opaque small businesses. Such borrowers are often bank-dependent, and credit market imperfections that arise from informational asymmetries could constrain their investments and growth by making external finance costly or difficult to obtain (e.g., Berger and Udell 1998; Fazzari et al. 1988; Hubbard 1998). However, while there is an extensive body of literature on financing constraints and corporate investments, there is a limited amount of evidence on whether subsidized loans and other forms of government intervention could alleviate credit market imperfections (see also Lerner 2009). This paper analyzes this understudied issue using a rich register-based dataset of Finnish SMEs and treatment effects methods. The dataset covers a large panel of manufacturing firms and contains the financing decision data of a major state-owned specialized financing company whose objective is to cure credit market imperfections. The study evaluates the real effects of subsidized loans and the role of financial factors in promoting the real activity.

In perfect capital markets, internal capital and external capital are perfect substitutes. However, in imperfect markets, external capital is more costly because of an external financing premium. If external financing is too expensive or unavailable, firms may need to rely more on internal financing resources to finance their investments and growth (e.g., Fazzari et al. 1988; Carpenter and Petersen 2002). The development of financial markets also matters for growth because efficient financial markets allocate capital to the most productive uses and reduce the cost of external finance available to firms (Rajan and Zingales 1998). The theoretical literature suggests that the existence of banks can be traced to their comparative advantage in the resolution of information problems (e.g., Diamond 1984). Therefore, it is not clear whether bureaucrats with no informational advantage over the private sector could improve the market allocation of capital through subsidies. However, imperfectly functioning financial markets could negatively affect the real economy and cause distortions in resource allocation (e.g., Shleifer and Vishny 2010). There is also evidence suggesting that

lending by state-owned banks could be less pro-cyclical than lending by private banks (e.g., Bertay et al. 2012; Micco and Panizza 2006). Bertay et al. (2012) suggest that there might be a potential stabilization role for state-owned financial institutions over the business cycle or during the times of financial instability. However, they also note that the questionable track record of state-owned financial institutions in credit allocation challenges their use as a short-term countercyclical tool.

Small business lending has traditionally relied on the local availability of capital, although the importance of distance between the banks and firms has diminished over time (Petersen & Rajan 2002). However, Guiso et al. (2004) argue that the local availability of capital could remain important if the financial markets are segmented locally. They also suggest that this may be the case in Italy. Not surprisingly, the local availability of capital is one of the key aspects of government policies that often aim to allocate funds evenly across regions. Beck and Demirguc-Kunt (2006), however, suggest that the competitive business environment is likely to be the most efficient way to relax the constraints faced by SMEs. Additionally, de Meza (2002) argues that subsidizing lending may decrease efficiency by drawing in lower-quality firms. While the theoretical case for government intervention in the small business loan markets appears to be mixed at best, the existing empirical evidence on the potential effectiveness of such policies also remains rather inconclusive.

Several existing micro-level studies imply that there might be some room for a well-designed intervention. Lerner (1999) observes that public venture capital awardees in the U.S. grew faster and were more likely to obtain private financing than control firms. Lelarge et al. (2008) study the effectiveness of loan guarantees in a context of a French natural experiment and show that subsidized firms were able to grow faster and pay a lower cost of capital. However, they also found evidence that banks and entrepreneurs exhibited risk-shifting behavior because of the guarantees. Hyytinen and Toivanen (2005) use the survey data of Finnish SMEs to show that government funding disproportionately enabled the growth of firms in the industries that are more dependent on external finance. Girma (2007) shows that subsidies increased the total factor productivity of firms in Ireland, demonstrating that firms that were classified as financially constrained benefited the most from such grants. Criscuolo et al. (2012) study a business subsidy program implemented in the UK, finding positive investment and employment effects but no productivity improvements.

The country-level studies illustrate a rather pessimistic view of government involvement in the allocation of capital. La Porta et al. (2002) suggest that state-owned financial institutions allocate capital inefficiently. Their findings indicate that the state ownership of financial institutions is associated with slower subsequent economic and productivity growth, in line with the political view of government intervention (see Shleifer and Vishny 1994). That is, while the development view would suggest that state-owned financial institutions cure market failures, the political view argues instead that politicians control these institutions to maximize their own political objectives (e.g., La Porta et al.

2002). Furthermore, Calindo and Micco (2004) find no evidence that state-owned banks would promote the growth of the manufacturing industry. Demirguc-Kunt and Maksimovic (1998) show that government subsidies do not increase the proportion of firms that exceed the growth rates that could be financed internally. Andrianova et al. (2012), however, challenge the earlier view and argue that factors such as institutional quality could explain the previously observed negative association between state-owned financial institutions and economic growth in the cross-country studies.

The pessimistic view of La Porta et al. (2002) receives support from a few micro-level studies. The findings of Sapienza (2004), for instance, suggest that the lending behavior of state-owned banks in Italy is motivated by political goals rather than by market failures (see also Dinc 2005; Khwaja and Mian 2005; Carvalho 2010). Cole (2009) finds that bank nationalizations in India increased the quantity and decreased the quality of lending, lowered the interest rates, and affected the sectoral allocation of credit, but had no impact on the real economy. The earlier literature generally suggests that state-owned banks are less profitable than privately owned banks (e.g., Mian 2003; Berger et al. 2005; Micco et al. 2007; Iannotta et al. 2007; Baum et al. 2010). However, it remains unclear to what extent this reflects the development goals of state-owned institutions, whose existence is often rationalized by market failures. Additionally, a large fraction of the studies on state-owned financial institutions focus on developing markets, which raises the question about whether the findings are generalizable to more developed institutional environments. Overall, the earlier literature does not appear to provide conclusive evidence on whether government intervention overcomes credit market imperfections and improves resource allocation. This paper aims to deliver further evidence on this issue and to provide a unique case study based on the Finnish micro-level panel data.

The current study evaluates the real and financial effects of subsidized loans granted to small businesses. The study also analyzes the effects of loan guarantees as a comparison point, while the focus remains on subsidized loans given the choice of identification strategies provided by them. The evaluation of policy interventions is often complicated by the lack of a control group of non-treated firms that would have been eligible for the treatment. The current empirical approach addresses this issue by matching the financing decision data of a major state-owned specialized financing company, Finnvera plc, to the data of Finnish manufacturing corporations observed over the 2000-2008 period. This panel dataset is constructed from register sources and contains both subsidized and nonsubsidized firms. Another common issue in the earlier literature relates to the difficulty of evaluating the causal effects of a policy treatment in the absence of randomized experiments. This study addresses this issue by using several alternative econometric methods to identify the causal effects of the policy, including fixed effects models, instrumental variables models, and boundary regressions.

The alternative econometric methods provide a possibility of evaluating the robustness of the findings and comparing the results obtained from differ-

ent empirical approaches. The fixed effects analysis employs both the standard fixed effects analysis and the flexible time-varying treatment effects model of Laporte and Windmeijer (2005). The instrumental variables models utilize the fact that regional support boundaries provide regional variation in the supply of government funding, which is exploited in the identification of the policy effect. The model uses the regional support area indicators as instruments, together with a large set of regional control variables. The boundary regressions analyze firms located next to each other on the opposite sides of the regional support boundary. Firms located very close to each other should share similar regional environments on both sides of the boundary, whereas those inside a higher support area are more likely to be subsidized. This method reduces the possibility that unobserved factors would confound the results.

The findings of this paper suggest that the government funding helped the subsidized firms to expand their operations by allowing them to make more investments, grow faster, and hire more employees than the nonsubsidized firms. However, the effects on labor productivity were negative or insignificant, which suggests that the subsidized financing did not make the firms more efficient. Regarding the financial effects, two potential channels were identified through which the subsidized financing promoted real activity. First, the subsidized financing helped the firms to exceed the maximum growth rates that could be financed internally or with a limited access to external finance. Second, the subsidized loans also helped the firms to reduce their average financing costs. These findings suggest that the wedge between the cost of external and internal finance was diminished. In addition, there is also evidence suggesting that the employment effects and some of the excess growth effects were larger for younger firms. This finding seems consistent with the prediction that such firms are more likely to face binding financial constraints than mature firms.

Overall, the results suggest that while government funding can promote the real activity of small businesses, it is important to pay special attention to the efficient allocation of subsidized financing. The previous literature suggests that a key mechanism through which banks and other financial intermediaries could promote long-term economic growth is improved productivity growth (Beck et al. 2000). That is, well-functioning financial markets improve capital allocation by increasing investments in projects with high expected returns and by decreasing funds from projects with poor prospects (Wurgler 2000). In this way, the financial markets allocate scarce resources for the most productive uses (see also Levine 2005). The disciplinary role of external finance has an important function in this process because it forces inefficient incumbents to exit the markets and allows the resources to be allocated to more efficient firms (see, e.g., Bertrand et al. 2007; Kerr and Nanda 2009).

The remainder of the paper is organized as follows: Section 2 provides the institutional details. Section 3 discusses the econometric methods. Section 4 describes the dataset. Section 5 presents the empirical results, and Section 6 concludes.

2 INSTITUTIONAL DETAILS

The Finnish financial system has traditionally been bank-based (e.g., Hyytinen et al. 2003). Despite the development of the financial markets, the financing of small and medium-sized firms has continued to rely on intermediated credit and government funding sources (e.g., Hyytinen and Väänänen 2006). The current study concentrates on the financing provided by the state-owned specialized financing company Finnvera plc, which is the most dominant of the government-owned financial institutions that operate in the markets for small business finance in Finland.

Finnvera provides loans, guarantees, venture capital, and export credit guarantees for its client firms. According to the law that governs the operations of Finnvera, the mission of the company is to provide financing especially for small and medium-sized firms to promote the development, internationalization, and exports of the enterprises.[2] The company is also required to promote the regional policy goals of the State. The law states that the operations of the company should be focused on rectifying deficiencies in the supply of financial services.

The State, represented by the Ministry of Employment and the Economy, sets the annual operating goals for the company. These goals include, for example, the number of new and growth firms financed, jobs created, and export trades financed. The State also sets goals for the share of funding allocated to regional support areas. The ownership policy goals define targets for cost efficiency and capital adequacy.

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[2] The objectives of the company are written in the Acts 443/1998 and 445/1998. This chapter is based on the information provided in those Acts, which are available at www.finlex.fi, and in the following documents: Memo of the regulation (date: January 23, 2009) obtained from www.finnvera.fi (accessed October 22, 2009), decisions of the Council of the State on interest rate subsidies (December 29, 2009) and credit loss compensation regulation (October 22, 2009) obtained from Finnvera's law department, Finnvera Annual Review (2008) and Finnvera Financial Review (2008), available at www.finnvera.fi/eng. Finally, additional information on the credit rating methodology and risk management of the company was obtained directly from Finnvera's management.

The mission of the company is to complement the financial markets. Financing is allocated mainly for small and medium-sized firms, whereas large firms can obtain funding only for special reasons. Credit can be granted with non-protective collateral or without collateral. In its operations, the company's principle rule is to share risks with other financiers. The financial policy of the company is to provide up to 50% of the project- or firm-specific funding. The share can be higher than that in working capital financing, micro financing, and projects that are considered significant in terms of industrial policy. Guarantees can cover up to 80% of the total debt commitment.

Following the policy guidelines set by the State, the company considers the economic, regional and employment aspects of the projects when making financing decisions. The differences in the regional development are also taken into account in the contract terms. The client firms can obtain domestic and EU subsidies for the interest rate and guarantee commission expenses. These subsidies are based on various regional and industrial policies. The regional subsidies are available in the assisted areas, whereas the subsidies for special loans are available in the entire country.[3]

Finnvera has been given an objective to aim for self-sufficiency in its operations in the long run. However, the State covers a part of the realized credit losses to boost the risk-bearing capacity of the company. The amount of State compensation varies regionally between 40 and 65% of the realized losses and is highest in the assisted regions. The credit loss compensation can increase up to 80%, with the compensation provided by the European Regional Development Fund. Since 2005, growth firm financing has also been covered with higher credit loss compensation.

Firms apply for financing directly from Finnvera with the exception of micro guarantees, which are applied for directly from the co-operating banks. The agency conducts a company analysis for the applicant firms, and the pricing of the loans and guarantees is based on the perceived risk. The analysis evaluates the firms' management, business, and finances using both quantitative financial statement analysis and qualitative analysis. The risk classification of the firms is based on the sum of the risk-ranking scores obtained from the different subsections of the analysis. All the client firms are assigned a credit rating at the eight-category scale (A1, A2, A3, B1, B2, B3, C, and D) based on the overall risk-ranking scores. The credit ratings are updated regularly on one- or two-year intervals and when deemed necessary. The company reports that it actively monitors its risk taking[4].

Finnvera has a network of 15 regional offices distributed throughout the country. In 2008, the total domestic lending volume of the company was 1027.8 million euros. Overall, 467.6 million euros were allocated for loans, and 438.3 million euros were allocated for guarantees. The share of the total financing allocated for the manufacturing industry was 599.4 million euros. Overall, 437.6

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3 Appendix B tables 1-3 provide details on the subsidy rates and credit loss compensation.

4 Finnvera Financial Review 2008, 19-20.

million euros of the total lending volume were allocated for the regional support areas.[5]

[5] Finnvera Annual Review 2008, 22-23

3 ECONOMETRIC METHODS

This study uses several different empirical approaches to study the real and financial effects of government funding. The problem of estimating these treatment effects relates to the issue that the firms that apply and receive subsidized financing are not likely to be a randomly selected group. The following sections describe each of these methods.

3.1 Fixed effects estimation

The fixed effects estimation addresses the selection bias problem by controlling for permanent unobserved differences between subsidized and nonsubsidized firms. The fixed effects regression model is defined as follows:

$$y_{it} = x'_{it}\beta + \gamma D_{it} + \alpha_i + u_{it} \quad (1)$$

where y_{it} is an outcome measuring real outcomes (investments, sales growth, employment, labor productivity) or financial outcomes (excess growth, financing costs) for the firm i at time t, x_{it} is a vector of control variables, and D_{it} is a binary treatment indicator that takes a value equal to one in the period the firm is subsidized and all the subsequent periods, and zero otherwise. The total error term is composed into firm-specific fixed effect α_i and time-varying error term u_{it}. The business cycle effects are controlled with year dummies.

The above specification implicitly assumes that the treatment effects are constant over time. Specifically, the treatment indicator is defined as a step variable, which takes a value equal to zero in all periods before the treatment and one in all periods after the treatment. This implies that the impact from the treatment is assumed to be immediate, full and permanent (Laporte and Windmeijer 2005). That is, there would be no anticipated or delayed effects. A more flexible approach allows the treatment effects to be time varying by in-

cluding a set of pulse variables into the model (see Laporte and Windmeijer 2005):

$$y_{it} = x'_{it}\beta + \ldots + \gamma_{-1}P_{i,-1} + \gamma D_{it} + \kappa_0 P_{i,0} + \kappa_1 P_{i,1} + \kappa_2 P_{i,2} + \ldots + \alpha_i + u_{it} \quad (2)$$

where γ_{-j} (κ_j) is the treatment effect j periods before (after) the introduction of the treatment and $\kappa_j = y_j - \gamma$ for $j = 0,1, \ldots$ The pulse variables $P_{i,j}$ ($P_{i,-j}$) are indicators that take a value equal to unity in the j-th period after (before) the treatment, and zero otherwise. Allowing for time-varying treatment effects provides a possibility to explicitly capture lagged or anticipated treatment effects.

The fixed effects estimator can control for the permanent unobserved differences between the treated and nontreated firms. However, a problem would remain if there are unobserved transitory shocks correlated with the treatment status. This is likely to be a relevant concern because firms that have previously experienced a negative shock could be more likely to resort to government funding. This could either bias the estimate of the treatment effect γ downwards (Criscuolo et al. 2012) or alternatively upwards because of the so-called Ashenfelter's dip (see, e.g., Angrist and Pischke 2008). Alternatively, bureaucrats may have a tendency to 'pick winners' and finance firms that would have performed well regardless of public support (e.g., Lerner 2002; Wallsten 2000). This, in turn, could bias the estimate of γ upwards (e.g., Criscuolo et al. 2012). The correlation between the treatment indicator and error term would result in inconsistent estimates in either case.

3.2 Instrumental variables estimation

The endogeneity problem described above could be addressed with instrumental variables Z_{it} that are correlated with the treatment decision but uncorrelated with the error term conditional on the covariates. The identification strategy of this paper's instrumental variable analysis exploits the regional variation in the supply of government funding. Firms located in the regional assistance areas are eligible for higher interest rate subsidies, and the credit loss compensation of Finnvera is also higher in these regions (see appendix B, tables 1-3). These institutional details suggest that the probability that firms will obtain subsidized funding is likely to be higher in the regional assistance areas. The instrumental variables used in this study consist of indicators for whether the firms were located in Tier I, II or III domestic support areas (see appendix A, figures 1 and 2).[6] The eligibility for the regional subsidies is based on the location of the

[6] A similar approach is employed by Criscuolo et al. (2012), who exploit the changes in the area-specific eligibility criteria based on regional support areas to identify the impact of the UK business subsidy program. Because the assisted areas were revised near the end of the study period, the current study relies largely on the cross-sectional variation in the supply of government funding. Nevertheless, the change in

financed project. However, the data are reported at the firm level rather than plant level, which induces measurement error into the instruments if the firm has multiple plants (e.g., Criscuolo et al. 2012). The robustness tests also provide analysis for the single-plant firms alone because for them, there is no uncertainty about the location of the plant.

The allocation of the state aid is regulated by the EU-level allocation rules (see appendix B). Because the assisted areas tend to be less-developed regions, it is important to address the potential endogeneity of the policy rule. In the current case, addressing the endogeneity is relatively straightforward because the selection criteria of the assisted areas are known. Therefore, these measures can be used as control variables in the estimation.[7] The regional controls include NUTS 4 level regional GDP per capita and municipality level measures of unemployment rates, the shares of youth and long-term unemployment, economic dependency ratios and indicators for rural and semiurban municipalities[8]. The identification is based on the assumption that conditional on these and other covariates, the instruments are exogenous. This assumption can be tested with Hansen's J test for overidentification restrictions.

3.3 Boundary regression

The boundary regression compares firms located next to each other on the opposite sides of the EU Objective I borderline (see appendix A, figure 3).[9] This regional support boundary provides a discontinuity that can be used in the identification of the policy effect.[10] The study exploits the fact that there is a dis-

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the assisted areas that occurred in 2007 was driven by the EU-level policy rule and could as such be considered as a plausibly exogenous event. Note that given the limited time variation in the instruments, the firm fixed effects have to be dropped in the instrumental variables models.

7 See appendix B for a detailed description on the selection criteria

8 The population density is proxied with the dummies for rural and semiurban municipalities. The use of these dummies diminishes the multicollinearity problem related to the direct population density measure, which has a high correlation (up to 0.76) with some of the regional controls. The measures for net migration and the share of agricultural workforce are not used in the estimations because the incomplete data would have decreased the sample size. Nevertheless, the other regional controls used in the regressions have a high correlation with these measures (up to 0.54-0.75).

9 Black (1999) uses a similar approach in a different context. Other studies that utilize regional discontinuities include Becker et al. (2010), Huang (2008), Lalive (2008), Lavy (2006) and Pence (2006). Becker et al. (2010) study the effectiveness of the EU subsidies using country-level data and exploit the EU Objective I threshold for identification. Their EU-level analysis is based on aggregate country-level regional data rather than firm-level microdata.

10 Other discontinuities were also considered. An initially promising case was the change in the Finnvera law in 2004, which made the consumer service firms larger than 10 employees also eligible to obtain loans from Finnvera. Before the change, only micro firms and business service firms were eligible for loan financing in the service sector. While this change would, in theory, provide a discontinuity and have close similarities to a randomized experiment, the analysis revealed that it was difficult to identify the discontinuity from the data. Specifically, a large number of firms

crete jump in the probability for obtaining subsidized loans inside the higher regional support area. However, firms located very close to the borderline should share similar regional environments on both sides of the boundary. To minimize the distance to the boundary, only the municipalities attached to the borderline are included in the estimation sample. The model is defined as follows:

$$y_{it} = \alpha + x'_{it}\beta + k'_b\emptyset + \gamma D_{it} + \varepsilon_{it} \quad (3)$$

where k_b is a vector of boundary dummies, which indicate firms located in the opposite municipalities on the different sides of the EU Objective I borderline. The boundary dummies control for any unobserved characteristics shared by the firms located next to each other on the opposite sides of the boundary. This method reduces the possibility that some omitted variables, such as regional characteristics, would affect the results.

The EU Objective I borderline provides a well-reasoned boundary for the analysis. The allocation of the state aid is directed by the EU regulation, and the borderline of the higher support area is not directly manipulatable by the firms. The assisted areas are revised periodically, which should diminish concerns that the area division would significantly affect the location choices of the firms. The assumption that the firms cannot *precisely* manipulate the forcing variable for the treatment is crucial for valid inference (see Lee & Lemieux 2009). Meanwhile, because the domestic Tier I support area in the 2007-2013 program period was based on the boundaries of the former EU Objective I area, this borderline also provides a well-reasoned boundary in the post-2007 period.

that had obtained loans from Finnvera did not seem to satisfy the rule in the pre-change period based on the business register and financial statement data.

4 DATA

4.1 Description of the dataset

This study uses a register-based panel dataset of Finnish manufacturing corporations from the 2000-2008 period. The data are obtained from Statistics Finland, and the dataset is constructed from multiple sources. The firm characteristics, including age, industry, location, employment, net sales, and foreign ownership, are obtained from the business register, which covers the population of Finnish enterprises. The business register data are based on the information provided by administrative authorities, such as the Tax Authority. The financial statement data are obtained from the financial statement panel, which is based on the tax register data and additional enquiries made by Statistics Finland. The financing decision data of Finnvera are obtained from the business subsidy database, which covers the subsidies, loans, and guarantees provided by the Finnish state-owned institutions. The business subsidy database is based on the financing data obtained directly from the corresponding institutions. The business group affiliation of the firms in this dataset is obtained from the global firm ownership dataset. The municipality-level regional data are obtained from the Statfin and Altika databases of Statistic Finland. The producer price indices are obtained from the Statfin database.

The dataset is constructed using the business register as a master dataset. The firm-level datasets are match merged with the business register data based on an encrypted company identification code and statistical year. The regional data are matched to the firm data based on the home municipality of the firm and statistical year. In the case of Finnvera's financing decisions, a match was found in the business register in 76.4% of the firm-year observations. This covers firms of all legal forms and industries. The estimation sample is restricted to corporations that operate in the manufacturing industry. This industry group is the largest client group of Finnvera in terms of overall lending volume measured in euros. The manufacturing industry provides a natural and well-defined

control group of non-treated firms that would have been eligible for the treatment.

The study concentrates on the regions of mainland Finland. The autonomous province of Åland is excluded from the dataset because of the low number of observations. In addition, firms with less than one employee were dropped from the sample. The financial statement panel contains some corrections made by Statistics Finland for erroneous and missing values that might have existed in the raw data. These corrected observations are kept in the sample to avoid diminishing the representativeness of the sample. Several key variables were trimmed at the 1st and 99th percentiles to control for potential outliers as indicated in table 1.

TABLE 1 Variable definitions

Variable	**Definition**
Dependent variables	
Investments/capital	A ratio of net investments in tangible and intangible assets at t divided by fixed assets at t-1*
Sales growth	Log sales growth from t-1 to t defined as $ln(sales_t/sales_{t-1})$*
ln(Employment)	A natural logarithm of employment
ln(Labor productivity)	A natural logarithm of real value added divided by employment*
Excess growth #1 (IG)	An indicator for whether the firm's realized growth rate exceeded the maximum internally financed growth rate
Excess growth #2 (SFG)	An indicator for whether the firm's realized growth rate exceeded the maximum short-term financed growth rate
Excess growth #3 (SG)	An indicator for whether the firm's realized growth rate exceeded the maximum sustainable growth rate
Financing costs	Financial expenses at t divided by the average long-term debt between t-1 and t*
Financing decision variables	
Loan decision	An indicator equal to one in the period the firm is granted subsidized loans and zero otherwise
Treatment	An indicator equal to one in all the periods in and after the firm is granted subsidized loans, and zero otherwise
Firm-level control variables	
Age	Age of the firm in years at t
ln(Total assets)	A natural logarithm of total assets at t-1
ln(Capital intensity)	A natural logarithm of fixed assets divided by employment at t-1*
Profitability	A ratio of EBITDA (earnings before interest, taxes, depreciation and amortization) to total assets at t-1*
Tangibility	A ratio of fixed assets to total assets at t-1*
Group	An indicator for firms that belonged to a business group at t-1
Foreign	An indicator for foreign ownership at t-1
Regional control variables	
GDP	Regional GDP per capita measured at the NUTS 4 -level in million

	euros at t-1
Unemployment	Unemployment rate in the municipality at t-1 measured in April
Youth unemployment	The share of youth unemployment of the total unemployment in the municipality at t-1
Long-term unemployment	The share of long-term unemployment of the total unemployment in the municipality at t-1
ln(Population density)	A natural logarithm of the municipality-level population density at t-1
Rural	An indicator for rural municipalities measured at the beginning of period t
Semiurban	An indicator for semiurban municipalities measured at the beginning of period t
Urban	An indicator for urban municipalities measured at the beginning of period t
Dependency ratio	Economic dependency ratio, i.e., a ratio of non-employed to employed persons in the municipality at t-2
Net migration	Municipality-level net migration at t-1**

*Trimmed at the 1st and 99th percentiles. **Winsorized at the 1st and 99th percentiles.

4.2 Variable definitions

The variable definitions are provided in table 1. The analyzed outcomes cover both real and financial variables. The measures are motivated both by the financial constraint literature and the policy objectives set for the public financier. The real outcomes consist of investments, sales growth, employment, and labor productivity. The financial outcomes include excess growth and financial costs.

The real outcomes are defined as follows: Investments are measured using variable *Investments/capital*, which is defined as net investments in tangible and intangible assets at period t divided by the fixed assets at period t-1. *Sales growth* between periods t and t-1 is defined in logarithmic form as $ln(Sales_t / sales_{t-1})$. The employment measure *ln(Employment)* is defined as a natural logarithm of the firm-level employment consisting of a sum of entrepreneurs and employees working in the firm. The productivity effects of government funding are analyzed in terms of labor productivity, which is a close micro-level counterpart for GDP per capita. The labor productivity measure *ln(Labor productivity)* is defined as a natural logarithm of real value added divided by employment. The value added data have been deflated using two-digit industry-level producer price indices.

The financial variables are defined as follows: Three alternative *excess growth* indicators measure whether the firms were able to exceed the maximum growth rates that could be financed internally or with a limited access to external financing. These measures include the internally financed growth rate (IG), the maximum short-term financed growth rate (SFG) and the maximum sustainable growth rate (SG), respectively. The predicted maximum growth rates are estimated following the financial planning framework (see Demirguc-Kunt & Maksimovic 1998, 2002; Higgins 1977; Hyytinen and Pajarinen 2004). Accord-

ing to the financial planning model, the external financing need for a firm growing at the rate g is given by:

$$EFN_t = g_t * Assets_t - (1 + g_t) * Earnings_t * b_t \quad (4)$$

The first term on the right-hand side measures the investments required for the firm growing at the rate g, and the second term measures the internal capital available for investments. The proportion of reinvested earnings is given by b_t. The maximum growth rate that can be financed internally under the assumption that the firm retains all of its earnings is as follows:

$$IG_t = ROA_t/(1 - ROA_t), \quad (5)$$

where ROA_t is the ratio of earnings after taxes and interest to total assets. Next, the short-term financed growth rate is an estimate of the maximum growth rate for the firm that reinvests all its earnings and maintains the ratio of short-term borrowing to assets. The short-term financed growth rate is defined as follows:

$$SFG_t = ROLTC_t/(1 - ROLTC_t), \quad (6)$$

where $ROLTC_t$ is a ratio of earnings after taxes and interest to long-term capital, which is defined as total assets multiplied by one minus a ratio of short-term liabilities to total assets. Finally, the maximum sustainable growth rate for the firm that does not pay dividends and maintains a constant debt to assets ratio is defined as follows:

$$SG_t = ROE_t/(1 - ROE_t), \quad (7)$$

where ROE_t is the ratio of net income to equity. The realized growth rates of the firms are then compared to these theoretical maximum internal growth rates. The excess growth indicators used in the analysis take a value equal to one if the firms' realized growth rate exceeds the given predicted internal growth rate, and zero otherwise. Another financial measure, *financing costs*, is defined as financial expenses at t divided by the average long-term debt between periods t-1 and t.[11] In this definition, the average long-term debt is used in the denominator as a proxy for interest-bearing debt given the lack of more exact measures.

The indicators for obtaining government funding are defined as follows: The *treatment* indicator used in the econometric analysis takes a value equal to one in all periods in and after the firm was granted subsidized loans by Finnvera, and zero otherwise. The *loan decision* indicator used in the descriptive sta-

[11] It is worth noting that the financing costs are computed from financial statement data and that they do not differentiate between fixed and floating loan rates. A remaining limitation is also that the maturity of the loans is not known. Finally, note that the time fixed effects capture the overall market level of interest rates during the period.

tistics takes a value equal to one in the period the firm is granted subsidized loans, and zero otherwise.

The firm-level controls used in the estimations depend on the outcomes of interest and are defined as follows: *Age* is the age of the firm in years since incorporation. Firm size is measured by *ln(Total assets)*, which is a natural logarithm of total assets at t-1. Capital intensity, measured by *ln(Capital intensity)*, is defined as a natural logarithm of fixed assets divided by employment at t-1. *Profitability* is a ratio of EBITDA (earnings before interest, taxes, depreciation and amortization) to total assets at t-1. *Tangibility* is a ratio of fixed to total assets at t-1 and provides a proxy for collateralizable assets. *Group* is an indicator for firms belonging to a business group at t-1. *Foreign* is an indicator for foreign ownership at t-1. A relatively conservative firm-level control variable set is motivated by the desire to avoid the problem of bad controls (cf. Angrist and Pischke 2009, 64-68).

The regional controls based on the selection criteria of the assisted areas are defined as follows: *GDP* is defined as a regional GDP per capita measured at the NUTS 4 -level in million euros at t-1. *Unemployment* measures an unemployment rate in the municipality at t-1. *Youth unemployment* is a ratio of youth unemployment to total unemployment in the municipality at t-1. *Long-term unemployment* is a ratio of long-term unemployment to total unemployment in the municipality at t-1. *Ln(Population density)* measures the population density in the municipality at t-1. Indicators for *urban*, *semiurban,* and *rural* municipalities are based on the statistical municipality classifications defined at the beginning of the period t. *Dependency ratio* measures the municipality-level economic dependency ratios measured at t-2 because of data availability reasons. *Net migration* is a ratio of net migration to the population in the municipality at t-1.

4.3 Descriptive statistics

The descriptive statistics for the sample of treated and nontreated firms are provided in table 2. Overall, there are 5194 positive loan decisions in the sample. The median loan size is 117 000 euros. The comparison of the descriptive statistics suggests that the treated firms are on average younger and larger than the nontreated firms. Many of the treated firms could still be classified as established firms because the median age in the before-the-treatment sample is approximately 10 years. The treated firms have higher investment to capital ratios and sales growth than the nontreated firms. The treated firms are also more likely to exceed the predicted maximum internally financed growth rates. The profitability and productivity measures indicate that the treated firms are less profitable and less productive than the nontreated firms. The treated firms have more tangible assets in their balance sheet and are more capital intensive than the nontreated firms.

TABLE 2 Descriptive statistics

Variable	Sample	mean	sd	p25	p50	p75	NT
Dependent variables							
Investments/capital	Treated: before	0.264	0.520	0.012	0.087	0.289	2632
	Treated: after	0.276	0.549	0.008	0.086	0.292	13138
	Nontreated	0.236	0.524	0.000	0.052	0.240	60213
Sales growth	Treated: before	0.069	0.268	-0.060	0.050	0.196	2607
	Treated: after	0.071	0.277	-0.060	0.066	0.209	13089
	Nontreated	0.035	0.264	-0.083	0.031	0.159	60810
ln(Employment)	Treated: before	2.244	1.287	1.281	2.104	3.142	4292
	Treated: after	2.411	1.247	1.482	2.351	3.303	14674
	Nontreated	1.864	1.458	0.742	1.589	2.632	78069
ln(Labor productivity)	Treated: before	10.535	0.396	10.328	10.548	10.758	4127
	Treated: after	10.603	0.430	10.378	10.610	10.855	13966
	Nontreated	10.611	0.479	10.351	10.610	10.892	74394
Excess growth #1 (IG)	Treated: before	0.344	0.475	0.000	0.000	1.000	2666
	Treated: after	0.397	0.489	0.000	0.000	1.000	13400
	Nontreated	0.281	0.450	0.000	0.000	1.000	62000
Excess growth #2 (SFG)	Treated: before	0.267	0.442	0.000	0.000	1.000	2665
	Treated: after	0.325	0.468	0.000	0.000	1.000	13400
	Nontreated	0.249	0.433	0.000	0.000	0.000	61953
Excess growth #3 (SG)	Treated: before	0.402	0.490	0.000	0.000	1.000	2664
	Treated: after	0.441	0.497	0.000	0.000	1.000	13394
	Nontreated	0.337	0.473	0.000	0.000	1.000	61949
Financing costs	Treated: before	0.136	0.202	0.061	0.086	0.133	2363
	Treated: after	0.106	0.125	0.054	0.076	0.114	13036
	Nontreated	0.142	0.234	0.050	0.078	0.133	40752
Firm-level control variables							
Age	Treated: before	11.836	9.287	5.000	10.000	17.000	4292
	Treated: after	14.664	10.850	7.000	13.000	19.000	14674
	Nontreated	14.590	11.827	7.000	12.000	19.000	78069
ln(Total assets)	Treated: before	13.263	1.554	12.124	13.113	14.338	4292
	Treated: after	13.699	1.518	12.621	13.683	14.793	14674
	Nontreated	12.961	1.935	11.644	12.656	13.892	78069
Tangibility	Treated: before	0.430	0.224	0.255	0.434	0.604	4252
	Treated: after	0.454	0.223	0.284	0.463	0.628	14557
	Nontreated	0.360	0.242	0.151	0.334	0.549	77255
ln(Capital intensity)	Treated: before	9.980	1.139	9.312	10.081	10.726	4259
	Treated: after	10.307	1.117	9.683	10.396	11.044	14530
	Nontreated	9.752	1.340	8.900	9.834	10.661	74967
Profitability	Treated: before	0.159	0.191	0.066	0.155	0.261	4243
	Treated: after	0.119	0.191	0.042	0.128	0.223	14508
	Nontreated	0.162	0.219	0.051	0.162	0.286	76344
Exporter	Treated: before	0.127	0.333	0.000	0.000	0.000	4292

	Treated: after	0.126	0.332	0.000	0.000	0.000	14674
	Nontreated	0.064	0.245	0.000	0.000	0.000	78069
Group	Treated: before	0.082	0.275	0.000	0.000	0.000	4292
	Treated: after	0.132	0.338	0.000	0.000	0.000	14674
	Nontreated	0.143	0.350	0.000	0.000	0.000	78069
Foreign	Treated: before	0.009	0.095	0.000	0.000	0.000	4292
	Treated: after	0.010	0.099	0.000	0.000	0.000	14674
	Nontreated	0.040	0.195	0.000	0.000	0.000	78069
Regional control variables							
GDP	Treated: before	0.023	0.007	0.018	0.022	0.026	4292
	Treated: after	0.026	0.007	0.020	0.025	0.030	14674
	Nontreated	0.029	0.009	0.023	0.028	0.037	78069
Unemployment	Treated: before	0.135	0.043	0.104	0.134	0.162	4259
	Treated: after	0.117	0.041	0.088	0.116	0.142	14557
	Nontreated	0.107	0.038	0.081	0.100	0.133	77719
Youth unemployment	Treated: before	0.115	0.034	0.088	0.116	0.137	4259
	Treated: after	0.108	0.035	0.082	0.107	0.129	14557
	Nontreated	0.103	0.033	0.076	0.100	0.126	77719
Long-term unemployment	Treated: before	0.264	0.067	0.223	0.271	0.309	4259
	Treated: after	0.251	0.065	0.210	0.260	0.299	14557
	Nontreated	0.274	0.060	0.238	0.285	0.319	77719
ln(Population density)	Treated: before	3.841	1.811	2.456	3.508	5.137	2671
	Treated: after	3.750	1.800	2.409	3.356	4.992	13423
	Nontreated	4.813	2.049	3.029	4.704	6.569	62210
Rural	Treated: before	0.285	0.451	0.000	0.000	1.000	4292
	Treated: after	0.306	0.461	0.000	0.000	1.000	14674
	Nontreated	0.183	0.387	0.000	0.000	0.000	78069
Semiurban	Treated: before	0.225	0.417	0.000	0.000	0.000	4292
	Treated: after	0.218	0.413	0.000	0.000	0.000	14674
	Nontreated	0.185	0.388	0.000	0.000	0.000	78069
Urban	Treated: before	0.490	0.500	0.000	0.000	1.000	4292
	Treated: after	0.476	0.499	0.000	0.000	1.000	14674
	Nontreated	0.632	0.482	0.000	1.000	1.000	78069
Dependency ratio	Treated: before	1.504	0.293	1.320	1.477	1.667	4292
	Treated: after	1.472	0.281	1.276	1.440	1.621	14674
	Nontreated	1.325	0.265	1.099	1.318	1.488	78069
Net migration	Treated: before	-0.002	0.009	-0.008	-0.002	0.005	3926
	Treated: after	-0.002	0.008	-0.006	-0.002	0.003	11425
	Nontreated	0.001	0.007	-0.004	0.000	0.005	63611

The table reports the descriptive statistics for the full unbalanced sample of Finnish manufacturing corporations observed over the 2000-2008 period. The reported statistics include mean, standard deviation, as well as the 25th, 50th and 75th percentiles of the variable. NT is the number of observations. The statistics are reported separately for the treated firms, before and after the treatment, and the nontreated firms. The treatment refers to obtaining subsidized loans from Finnvera. Source of data: Statistics Finland.

TABLE 3 Differences between the boundary firms

	Inside	**Outside**	**Difference in means**			
Variable	Mean	Mean	Difference	Sd	t-stat	Obs
Financing decision variables						
Loan decision	0.098	0.067	0.031***	0.011	2.68	7729
Treatment	0.266	0.170	0.096***	0.027	3.56	7729
Firm characteristics						
Investments/capital	0.255	0.268	-0.013	0.016	-0.83	6103
Sales growth	0.054	0.051	0.003	0.008	0.43	6085
ln(Employment)	1.747	1.771	-0.023	0.067	-0.35	7729
ln(Labor productivity)	10.561	10.605	-0.044**	0.021	-2.09	7396
*with boundary dummies			-0.028	0.022	-1.26	7396
Excess growth #1 (IG)	0.298	0.309	-0.011	0.014	-0.80	6230
Excess growth #2 (SFG)	0.261	0.261	0.001	0.017	0.03	6228
Excess growth #3 (SG)	0.360	0.350	0.010	0.017	0.56	6228
Financing costs	0.108	0.119	-0.012	0.008	-1.51	4713
Age	13.161	13.461	-0.300	0.489	-0.61	7729
ln(Total assets)	12.810	12.887	-0.078	0.079	-0.98	7729
ln(Capital intensity)	10.008	9.895	0.112	0.088	1.27	7571
Profitability	0.168	0.168	0.001	0.010	0.06	7581
Tangibility	0.419	0.388	0.030	0.019	1.62	7657
Group	0.090	0.083	0.007	0.020	0.33	7729
Foreign	0.008	0.022	-0.014**	0.006	-2.36	7729
Regional characteristics						
GDP	0.018	0.025	-0.007***	0.002	-4.23	7729
Unemployment	0.135	0.123	0.013*	0.007	1.70	7729
Youth unemployment	0.103	0.119	-0.016	0.018	-0.90	7729
Long-term unemployment	0.224	0.251	-0.028	0.018	-1.56	7729
ln(Population density)	2.027	3.334	-1.307**	0.596	-2.19	6254
Rural	0.697	0.335	0.361**	0.162	2.22	7729
Semiurban	0.195	0.3	-0.104	0.142	-0.74	7729
Urban	0.108	0.365	-0.257	0.195	-1.32	7729
Dependency ratio	1.784	1.538	0.246***	0.071	3.46	7729
Net migration	-0.008	-0.001	-0.007***	0.002	-3.12	6545

The table reports the differences in the means of the variables for the boundary firms located next to each other on the opposite sides of the Objective I regional assistance boundary. The sample consists of an unbalanced panel of single-plant manufacturing corporations that were located in the municipalities that were physically connected to the Objective I borderline during the 2000-2008 period. The table reports the means of the variables for the firms inside and outside the regional support boundary, the difference in the means, corresponding standards errors and t-statistics, and the number of observations. The standard errors have been clustered regionally at the municipality level. The statistical significance of the differences is defined as follows: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Source of data: Statistics Finland.

Table 3 reports the differences in the means for the boundary firms located next to each other on the opposite sides of the EU Objective I borderline. The differences are evaluated with a t-test to study whether the boundary provides a well-balanced sample of firms. The standard errors are adjusted for the municipality-level regional clustering. The results show that the firms inside the EU Objective I area have a significantly higher probability of obtaining subsidized loans. That is, there is a significant discrete jump in the probability of obtaining subsidized financing inside the higher support area.[12]

The firm characteristics show few differences on the opposite sides of the regional support boundary. The raw differences suggest that the firms inside the boundary have lower labor productivity than the firms outside. However, the difference disappears once the boundary-specific characteristics are controlled for with the boundary dummies. The indicator for foreign ownership is significant and suggests that the firms outside the boundary are more likely to be foreign-owned than those inside the boundary. However, the rest of the differences in the firm-level variables are statistically insignificant. Taken together, the findings suggest that the regional support boundary provides a reasonably balanced sample in terms of firm characteristics. That is, the firms located very close to the borderline are similar to each other on either side.

A few differences are observed in the regional characteristics based on the boundary firms' home municipalities. The areas inside the boundary have lower NUTS 4–level regional GDP per capital. Furthermore, the municipalities inside the boundary have somewhat higher unemployment rates, and this difference is weakly significant. The municipalities inside the boundary are also more rural than the municipalities outside, as indicated by the statistical municipality classifications. The population density measure provides a similar picture. Finally, the areas inside the boundary have higher economic dependency ratios and higher negative net migration than the areas outside the boundary.[13]

Despite the observed regional differences, it seems unlikely that the corporate finance environment would dramatically differ in a tightly defined regional area, aside from the availability of government funding. Because the boundary firms are located close to each other, they should be able to access the same local sources of private capital on both sides of the boundary. The boundary fixed effects control for any unobserved differences shared by the firms located on the opposite sides of the boundary. The municipality-level regional controls are also included in the models as a robustness check to confirm that the regional factors are not driving the results. The estimation results suggest that the regional differences have little effect on the treatment effect estimates.

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12 Based on the mean values of the loan decision indicator in the boundary sample, the probability for obtaining subsidized loans inside the EU Objective I boundary is about 45% higher than outside the boundary. The treatment indicator, which takes a value equal to one in and after the period that the funding is granted (and zero otherwise), shows an approximately 57% higher probability for obtaining subsidized loans inside the boundary.

13 The migration data are based on the year 2010 municipality divisions and do not cover all municipalities that exist in the dataset.

5 EMPIRICAL RESULTS

5.1 Real effects of subsidized loans

The first part of the empirical analysis focuses on the real effects of government funding. The underlying hypothesis states that if there are imperfections in the credit markets and the government funding relaxes financial constraints, the treatment would be expected to have positive real effects. The results are reported for the fixed effects model (FE), the Laporte-Windmeijer (2005) fixed effects model (LWFE), the instrumental variables model (IV) and the boundary regression (RD), respectively. The FE and IV models are estimated for both the full sample and single-plant firms. The boundary regressions focus on single-plant firms alone. The standard errors are clustered at the firm level. A fixed effects specification with an interaction term between firm age and treatment indicator is also considered. This specification evaluates whether the subsidized loans disproportionately helped younger firms that could be more likely to face binding financial constraints than mature firms.

TABLE 4 Investments

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	FE	FE	FE	LWFE	IV	IV	RD	RD	RD
Dependent variable	Invest-vest-ments/ capital	Invest-vest-ments/ capital	Invest-vest-ments/ capital	Invest-vest-ments/ Capital	Invest-vest-ments/ capital	Invest-vest-ments/ capital	Invest-vest-ments/ capital	Invest-vest-ments/ capital	Invest-vest-ments/ capital
Treatment	0.135***	0.141***	0.147***	0.092***	0.145**	0.136**	0.086***	0.088***	0.089***
	(0.016)	(0.018)	(0.022)	(0.029)	(0.060)	(0.065)	(0.020)	(0.019)	(0.019)
Age	-0.004**	-0.006***	-0.003**	-0.004**	-0.008***	-0.008***	-0.011***	-0.011***	-0.011***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.0004)	(0.0004)	(0.002)	(0.002)	(0.002)
Age squared/ 100	0.004***	0.007***	0.004***	0.004***	0.007***	0.008***	0.012***	0.012***	0.012***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.0005)	(0.001)	(0.003)	(0.003)	(0.003)
Profitability	0.187***	0.180***	0.187***	0.186***	0.293***	0.286***	0.304***	0.303***	0.297***
	(0.018)	(0.019)	(0.018)	(0.018)	(0.015)	(0.016)	(0.046)	(0.046)	(0.046)
Group	0.006	0.010	0.006	0.010	-0.055***	-0.053***	-0.026	-0.024	-0.020
	(0.013)	(0.016)	(0.013)	(0.013)	(0.005)	(0.006)	(0.027)	(0.027)	(0.026)

Foreign	0.004	0.034	0.004	0.004	-0.021*	0.003	-0.048	-0.052	-0.055
	(0.026)	(0.036)	(0.026)	(0.025)	(0.011)	(0.015)	(0.057)	(0.058)	(0.054)
GDP	-0.639	-1.472	-0.667	-1.050	0.533	0.466	-4.207*		
	(1.395)	(1.561)	(1.394)	(1.389)	(0.439)	(0.467)	(2.252)		
Unemployment	-0.141	0.0523	-0.148	-0.237	-0.155	-0.170	0.0910		
	(0.294)	(0.322)	(0.294)	(0.293)	(0.121)	(0.131)	(0.582)		
Youth unemployment	0.288**	0.299*	0.287**	0.284**	0.206**	0.208**	-0.0631		
	(0.141)	(0.154)	(0.141)	(0.141)	(0.084)	(0.093)	(0.332)		
Long-term unemployment	0.078	0.110	0.079	0.074	0.031	0.036	0.452***		
	(0.071)	(0.077)	(0.071)	(0.071)	(0.044)	(0.047)	(0.166)		
Rural	-0.048	-0.028	-0.048	-0.043	-0.003	-0.003	-0.008		
	(0.053)	(0.060)	(0.053)	(0.053)	(0.009)	(0.010)	(0.051)		
Semiurban	-0.007	-0.007	-0.007	-0.008	0.005	0.005	0.048		
	(0.025)	(0.028)	(0.025)	(0.025)	(0.007)	(0.007)	(0.039)		
Dependency ratio	0.111*	0.127*	0.109	0.100	-0.001	0.003	0.037		
	(0.067)	(0.074)	(0.067)	(0.067)	(0.023)	(0.024)	(0.079)		
p_1				-0.004					
				(0.022)					
p0				0.115***					
				(0.027)					
p1				0.090***					
				(0.027)					
p2				-0.047**					
				(0.023)					
p3				-0.051**					
				(0.023)					
p4				-0.046**					
				(0.023)					
p5				-0.023					
				(0.022)					
Age*Treatment			-0.001						
			(0.001)						
_cons	0.122	0.107	0.124	0.159*	0.220***	0.221***	0.158	0.268***	0.293***
	(0.095)	(0.106)	(0.095)	(0.095)	(0.036)	(0.039)	(0.186)	(0.047)	(0.037)
NT	74539	65637	74539	74539	74539	65637	6025	6025	6025
rho	0.334	0.335	0.334	0.333					
r2	0.009	0.009	0.009	0.011	0.023	0.022	0.046	0.044	0.040
F-test for excl. instruments					33.750	30.640			
Hansen's J-test					1.750	1.768			
					[0.417]	[0.413]			
Boundary FE	-	-	-	-	-	-	YES	YES	NO
Firm FE	YES	YES	YES	YES	NO	NO	NO	NO	NO
Industry FE	NO	NO	NO	NO	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

The table reports the effects of Finnvera's subsidized loans on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is net investments at t divided by fixed assets at t-1. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted subsidized loans by Finnvera, and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *Profitability* measures EBITDA to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 - level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipali-

ties, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2 and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. F-test for the excluded instruments tests for weak instruments. Hansen's J-test evaluates the null that the overidentification restrictions are valid [p-values in brackets]. Boundary FE, Firm FE, Industry FE and Year FE indicate whether the boundary, firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, full sample with interaction effects and time-varying treatment effects model for the full sample, respectively. Columns 5 and 6 report the instrumental variables estimates for the full sample and single-plant firms, respectively. Columns 7-9 report the boundary regression estimates with alternative regional controls. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

5.1.1 Investments

The effects of government funding on investments are reported in table 4. The fixed effects estimates indicate that the treatment had a positive and highly significant effect on investments. The coefficient estimate is 0.135. The interaction term between the firm age and the treatment dummy in specification (3) is negative but insignificant, implying that the investment effects do not depend significantly on the firm age. The LWFE model focuses on the dynamics of the treatment effects. The pulse variables are positive and highly significant in the treatment period and the following period but switch to negative in the remaining periods.

The instrumental variables estimates suggest a positive and highly significant effect on the investments. The coefficient for the treatment indicator is 0.145, which is similar to the FE estimates. The F-statistics for the excluded instruments are 33.75. This is well above the rule of thumb value of 10 suggested by Stock and Watson (2003), which alleviates concerns about weak instruments. The unreported first stage regressions suggest that the firms located in the Tier I, II and III assisted areas have 14.4%, 7.8% and 1.5% higher probabilities for being subsidized than the firms in the non-assisted areas, respectively.[14] Hansen's J-test provides support for the validity of the instruments because the null that the overidentification restrictions are valid cannot be rejected.

The boundary regressions that focus on the firms close to the Objective I boundary provide additional evidence that the subsidized loans have a positive and significant effect on investments. The coefficient of the treatment indicator is 0.088. This is a somewhat lower estimate than the ones obtained from the other models, but overall, all the alternative estimation methods provide evidence of positive investment effects. The findings appear to be sizable in economic terms because the full sample average for the investments variable (scaled by capital) is 0.24. This implies that the conservative estimate of 0.088 would suggest an increase of approximately 37% in the investments.

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[14] The first-stage regressions are omitted from the tables for convenience because of space reasons, while the F-statistics for the excluded instruments and Hansen's J test for overidentification restrictions are reported.

TABLE 5 Sales growth

	(1) FE	(2) FE	(3) FE	(4) LWFE	(5) IV	(6) IV	(7) RD	(8) RD	(9) RD
Dependent variable	Sales growth	Sales growth	Sales growth	Sales growth	Sales growth	Sales growth	Sales growth	Sales growth	Sales growth
Treatment	0.031***	0.029***	0.022*	0.057***	0.044	0.042	0.019**	0.020**	0.021**
	(0.008)	(0.009)	(0.012)	(0.014)	(0.028)	(0.030)	(0.009)	(0.009)	(0.009)
Age	-0.002***	-0.002**	-0.002***	-0.002***	-0.004***	-0.004***	-0.006***	-0.006***	-0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0002)	(0.0002)	(0.001)	(0.001)	(0.001)
Age squared/100	0.002***	0.002**	0.002***	0.002***	0.004***	0.004***	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0003)	(0.0003)	(0.002)	(0.002)	(0.002)
ln(Total assets)	-0.097***	-0.103***	-0.097***	-0.097***	-0.001	-0.002	-0.001	-0.001	0.000268
	(0.004)	(0.005)	(0.004)	(0.004)	(0.001)	(0.002)	(0.003)	(0.003)	(0.003)
Tangibility	0.127***	0.132***	0.127***	0.126***	0.022***	0.023***	0.062***	0.063***	0.062***
	(0.011)	(0.011)	(0.011)	(0.011)	(0.006)	(0.007)	(0.016)	(0.016)	(0.016)
Group	0.013*	0.015*	0.013*	0.013*	0.004	0.001	0.013	0.013	0.012
	(0.007)	(0.009)	(0.007)	(0.007)	(0.005)	(0.005)	(0.012)	(0.012)	(0.012)
Foreign	-0.015	-0.011	-0.015	-0.014	-0.013*	-0.007	-0.001	-0.002	-0.006
	(0.015)	(0.022)	(0.015)	(0.015)	(0.007)	(0.009)	(0.027)	(0.027)	(0.026)
GDP	1.095	1.258	1.114	1.167	0.283	0.207	0.393		
	(0.713)	(0.792)	(0.713)	(0.714)	(0.209)	(0.220)	(1.033)		
Unemployment	-0.188	-0.179	-0.184	-0.177	-0.166***	-0.203***	0.268		
	(0.142)	(0.155)	(0.142)	(0.143)	(0.060)	(0.066)	(0.289)		
Youth unemployment	0.115*	0.128*	0.116*	0.119*	0.159***	0.160***	0.250		
	(0.070)	(0.077)	(0.070)	(0.070)	(0.041)	(0.045)	(0.165)		
Long-term unemployment	0.065*	0.066*	0.065*	0.065*	0.027	0.032	0.109		
	(0.035)	(0.038)	(0.035)	(0.035)	(0.021)	(0.022)	(0.087)		
Rural	-0.025	-0.021	-0.025	-0.024	0.005	0.004	0.022		
	(0.021)	(0.023)	(0.021)	(0.021)	(0.004)	(0.005)	(0.025)		
Semiurban	-0.003	-0.006	-0.003	-0.003	0.007**	0.008**	0.026		
	(0.013)	(0.015)	(0.013)	(0.013)	(0.003)	(0.003)	(0.019)		
Dependency ratio	0.122***	0.111***	0.123***	0.124***	0.031***	0.037***	0.021		
	(0.032)	(0.035)	(0.032)	(0.032)	(0.011)	(0.011)	(0.031)		
p_1				0.010					
				(0.011)					
p0				-0.034***					
				(0.012)					
p1				-0.008					
				(0.013)					
p2				-0.019					
				(0.013)					
p3				-0.025**					
				(0.012)					
p4				-0.012					
				(0.012)					
p5				-0.020					
				(0.013)					
Age*Treatment			0.0005						
			(0.0004)						
_cons	1.103***	1.165***	1.102***	1.101***	0.025	0.040	-0.029	0.113***	0.110***
	(0.071)	(0.076)	(0.071)	(0.071)	(0.025)	(0.029)	(0.078)	(0.040)	(0.038)
NT	75536	66594	75536	75536	75536	66594	6038	6038	6038
rho	0.545	0.532	0.545	0.546					
r2	0.028	0.029	0.028	0.028	0.027	0.027	0.037	0.036	0.033
F-test for excl. instruments					36.037	34.192			

Hansen's J-test					3.363 [0.186]	1.089 [0.580]			
Boundary FE	-	-	-	-	-	-	YES	YES	NO
Firm FE	YES	YES	YES	YES	NO	NO	NO	NO	NO
Industry FE	NO	NO	NO	NO	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

The table reports the effects of Finnvera's subsidized loans on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is the log growth of net sales from t-1 to t. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted subsidized loans by Finnvera and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Total assets)* is a natural logarithm of total assets at t-1, *Tangibility* is a ratio of fixed assets to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semi-urban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2, and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. F-test for the excluded instruments tests for weak instruments. Hansen's J-test evaluates the null that the overidentification restrictions are valid [p-values in brackets]. Boundary FE, Firm FE, Industry FE and Year FE indicate whether the boundary, firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, full sample with interaction effects and time-varying treatment effects model for the full sample, respectively. Columns 5 and 6 report the instrumental variables estimates for the full sample and single-plant firms, respectively. Columns 7-9 report the boundary regression estimates with alternative regional controls. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

5.1.2 Sales growth

Table 5 analyzes whether the government funding relaxed the growth constraints and promoted the sales growth of the firms. The FE estimates indicate that the treatment had a positive and highly significant growth effect. The treatment indicator coefficient of 0.031 suggests that the treatment increased the sales growth of the firms by approximately three percentage points. The interaction term between firm age and treatment is insignificant. The LWFE model provides a somewhat higher estimate for the treatment indicator than the baseline FE model. Nevertheless, the pulse variables are negative, and the interpretation regarding the dynamics appears to be unclear in this case.

The IV model results in a positive albeit statistically insignificant estimate of 0.044. The estimate for the sub-sample consisting of single-plant firms alone is similar in magnitude and remains insignificant. It is worth noting that the regional development of the area, which could potentially affect the growth rates, is controlled using the level of regional GDP per capita among other controls. Hansen's J test does not reject the null hypothesis that the overidentification restrictions are valid.

The boundary regression shows a positive and highly significant effect on growth. The coefficient for the treatment indicator is 0.020, suggesting an increase of approximately two percentage points in the sales growth. Taken together, the fixed effects and boundary regressions suggest that the treatment had a positive effect on sales growth. The instrumental variables model provides a positive albeit insignificant effect. The point estimates suggest that the treatment has a sizable effect on the growth of the firms. The full sample average growth rate of the yearly sales is approximately 4.2%. This implies that the growth effect estimates of 2 to 4% appear to be rather large because they would imply sales growth that was approximately 1.5-times to 2-times as large because of the treatment.

TABLE 6 Employment

	(1) FE	(2) FE	(3) FE	(4) LWFE	(5) IV	(6) IV	(7) RD	(8) RD	(9) RD
Dependent variable	ln(Employment)	ln(Employment)	ln(Employment)	ln(Employment)	ln(Employment)	ln(Employment)	ln(Employment)	ln(Employment)	ln(Employment)
Treatment	0.072***	0.078***	0.110***	0.122***	0.419***	0.472***	0.155***	0.157***	0.159***
	(0.013)	(0.013)	(0.020)	(0.028)	(0.154)	(0.157)	(0.043)	(0.043)	(0.043)
Age	0.004*	0.005**	0.004**	0.004**	0.002	0.004***	0.0004	0.001	0.0003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)
Age squared/100	-0.005***	-0.007***	-0.006***	-0.005***	-0.001	-0.004*	0.002	0.001	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.008)	(0.007)	(0.008)
ln(Total assets)	0.284***	0.260***	0.284***	0.284***	0.619***	0.566***	0.608***	0.608***	0.611***
	(0.007)	(0.007)	(0.007)	(0.007)	(0.009)	(0.010)	(0.015)	(0.015)	(0.015)
Group	0.017	0.028**	0.018	0.017	0.294***	0.213***	0.207***	0.212***	0.218***
	(0.013)	(0.013)	(0.013)	(0.013)	(0.029)	(0.030)	(0.079)	(0.079)	(0.079)
Foreign	0.038	0.062	0.039	0.039	0.291***	0.297***	0.330**	0.343**	0.347**
	(0.027)	(0.039)	(0.027)	(0.027)	(0.050)	(0.059)	(0.149)	(0.148)	(0.144)
GDP	-2.333*	-1.812	-2.422**	-2.261*	-1.023	-1.862	3.633		
	(1.191)	(1.162)	(1.197)	(1.188)	(1.172)	(1.188)	(5.453)		
Unemployment	-0.366*	-0.400*	-0.387*	-0.352*	-0.476	-0.511	0.502		
	(0.213)	(0.215)	(0.213)	(0.213)	(0.307)	(0.319)	(1.092)		
Youth unemployment	-0.041	0.029	-0.044	-0.038	0.580***	0.498**	-0.335		
	(0.096)	(0.098)	(0.096)	(0.096)	(0.204)	(0.211)	(0.524)		
Long-term unemployment	0.037	0.028	0.040	0.035	0.308***	0.265***	0.441		
	(0.047)	(0.048)	(0.047)	(0.047)	(0.097)	(0.100)	(0.283)		
Rural	-0.021	0.001	-0.021	-0.021	-0.094***	-0.083***	-0.165		
	(0.037)	(0.035)	(0.037)	(0.037)	(0.024)	(0.024)	(0.104)		
Semiurban	0.026	0.029	0.026	0.026	-0.011	-0.0002	0.002		
	(0.023)	(0.022)	(0.023)	(0.023)	(0.018)	(0.019)	(0.079)		
Dependency ratio	0.006	-0.017	0.002	0.009	0.113*	0.106*	0.283*		
	(0.053)	(0.054)	(0.053)	(0.053)	(0.058)	(0.058)	(0.152)		
p_1				0.061***					
				(0.014)					
p0				-0.015					
				(0.023)					
p1				-0.022					
				(0.022)					
p2				-0.031					

				(0.021)					
p3				-0.018					
				(0.020)					
p4				-0.012					
				(0.019)					
p5				-0.008					
				(0.016)					
Age*Treatment			-0.002**						
			(0.001)						
_cons	-1.562***	-1.421***	-1.557***	-1.576***	-6.472***	-5.878***	-6.689***	-6.014***	-6.072***
	(0.123)	(0.120)	(0.123)	(0.123)	(0.136)	(0.151)	(0.381)	(0.208)	(0.197)
NT	77903	68806	77903	77903	77903	68806	6254	6254	6254
rho	0.932	0.922	0.932	0.932					
r2	0.126	0.119	0.127	0.127	0.743	0.657	0.681	0.679	0.674
F-test for excl. instruments					35.193	33.534			
Hansen's J-test					1.472	.847			
					[0.479]	[0.655]			
Boundary FE	-	-	-	-	-	-	YES	YES	NO
Firm FE	YES	YES	YES	YES	NO	NO	NO	NO	NO
Industry FE	NO	NO	NO	NO	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

The table reports the effects of Finnvera's subsidized loans on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is a natural logarithm of employment. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted subsidized loans by Finnvera, and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Total assets)* is a natural logarithm of total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 - level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2, and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. F-test for the excluded instruments tests for weak instruments. Hansen's J-test evaluates the null that the overidentification restrictions are valid [p-values in brackets]. Boundary FE, Firm FE, Industry FE and Year FE indicate whether the boundary, firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, full sample with interaction effects and time-varying treatment effects model for the full sample, respectively. Columns 5 and 6 report the instrumental variables estimates for the full sample and single-plant firms, respectively. Columns 7-9 report the boundary regression estimates with alternative regional controls. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

5.1.3 Employment

The employment effects of government funding are studied in table 6. The FE model shows a positive and highly significant estimate of 0.072. This indicates that the subsidized firms had an increase of approximately 7.2 percent in employment. The interaction term between firm age and treatment dummy is negative and highly significant. This suggests that the employment effects are higher for younger firms. Based on the estimated average marginal effects, the

firms aged one, five, ten and 20 years have employments effects of 0.108, 0.098, 0.087 and 0.063, respectively. That is, the employment effects are approximately 55.6% higher for the 5-year-old firms than for the 20-year-old firms. The LWFE model shows a positive and highly significant pre-treatment period spike in employment, whereas the rest of the pulse variables are insignificant. This indicates that employment begins to increase even before the treatment, and there are no lagged employment effects after the treatment period impact. The positive pre-treatment spike appears to be consistent with the prediction that the bureaucrats aim to 'pick winners' and to finance firms that are already growing (cf. Lerner 2002).

The IV model provides a substantially higher estimate of 0.419, suggesting an increase of approximately 42 percent in employment. The estimate seems rather large, but it is not very different from the estimates obtained in the earlier literature in different data samples (see, e.g., Lelarge et al. 2008; Criscuolo et al. 2012). Additionally, it is important to recall that the firms are mostly very small. If taken literally, the IV estimate together with the sample median firm size of 5.6 persons would indicate an increase of approximately 2.4 employees. However, the lack of firm fixed effects and the pre-treatment employment spike observed in the earlier analysis suggest that caution is warranted in the interpretation. In any case, it is worth noting that the control variables include various measures that control for the local labor market environment. Hansen's J-test does not reject the null that the overidentification restrictions are valid.

The boundary regression provides a more conservative estimate of 0.157, which suggests that the treatment had a 15.7-percent increase in the firm-level employment. This estimate is still approximately twice as large as the full sample FE estimate. Taken together, the models provide evidence that the treatment had positive effects on the number of employees. The conservative boundary regression estimate of 0.157, together with the median firm size of 5.6 persons, indicates that the treatment increased the employment of the subsidized firms by approximately 0.88 employees.

TABLE 7 Labor productivity

Dependent variable	(1) FE ln(Labor productivity)	(2) FE ln(Labor productivity)	(3) FE ln(Labor productivity)	(4) LWFE ln(Labor productivity)	(5) IV ln(Labor productivity)	(6) IV ln(Labor productivity)	(7) RD ln(Labor productivity)	(8) RD ln(Labor productivity)	(9) RD ln(Labor productivity)
Treatment	-0.012	-0.011	-0.027*	0.039**	-0.160**	-0.214***	-0.043*	-0.046**	-0.046**
	(0.010)	(0.011)	(0.015)	(0.019)	(0.073)	(0.078)	(0.022)	(0.022)	(0.022)
Age	0.001	0.002	0.001	0.001	0.004***	0.005***	0.007***	0.008***	0.007***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Age squared/100	-0.002*	-0.003*	-0.002*	-0.002*	-0.006***	-0.007***	-0.011**	-0.011**	-0.011**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.004)	(0.004)	(0.004)
ln(Capital intensity)	0.015***	0.015***	0.015***	0.014***	0.098***	0.097***	0.086***	0.085***	0.086***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.009)	(0.009)	(0.009)
Group	0.006	0.001	0.005	0.004	0.100***	0.107***	0.125***	0.124***	0.132***
	(0.011)	(0.012)	(0.011)	(0.011)	(0.009)	(0.011)	(0.032)	(0.032)	(0.032)
Foreign	-0.004	-0.002	-0.004	-0.003	0.164***	0.138***	0.094	0.099	0.100
	(0.024)	(0.032)	(0.024)	(0.024)	(0.019)	(0.024)	(0.088)	(0.090)	(0.091)
GDP	0.217	-0.199	0.247	0.421	0.227	0.149	-0.738		
	(0.870)	(0.933)	(0.871)	(0.871)	(0.563)	(0.599)	(2.820)		
Unemployment	-0.386**	-0.310	-0.378**	-0.346*	-0.221	-0.296*	-1.113*		
	(0.186)	(0.199)	(0.185)	(0.185)	(0.152)	(0.162)	(0.668)		
Youth unemployment	-0.008	-0.033	-0.007	-0.003	0.144	0.216*	0.055		
	(0.080)	(0.084)	(0.080)	(0.080)	(0.104)	(0.112)	(0.297)		
Long-term unemployment	-0.036	-0.012	-0.037	-0.037	0.005	0.029	0.122		
	(0.043)	(0.046)	(0.043)	(0.043)	(0.052)	(0.054)	(0.159)		
Rural	-0.003	-0.028	-0.003	-0.005	-0.015	-0.013	-0.070		
	(0.027)	(0.028)	(0.027)	(0.027)	(0.012)	(0.012)	(0.061)		
Semiurban	-0.013	-0.026	-0.013	-0.012	-0.009	-0.007	-0.065		
	(0.017)	(0.018)	(0.017)	(0.017)	(0.009)	(0.009)	(0.047)		
Dependency ratio	0.006	-0.027	0.007	0.013	-0.015	0.002	0.047		
	(0.042)	(0.045)	(0.042)	(0.042)	(0.029)	(0.031)	(0.089)		
p_1				0.006					
				(0.011)					
p0				-0.066***					
				(0.016)					
p1				-0.058***					
				(0.016)					
p2				-0.038**					
				(0.016)					
p3				-0.022					
				(0.015)					
p4				-0.011					
				(0.015)					
p5				-0.014					
				(0.015)					
Age*Treatment			0.001						
			(0.001)						
_cons	10.50***	10.53***	10.50***	10.48***	9.617***	9.611***	9.701***	9.594***	9.630***
	(0.065)	(0.070)	(0.065)	(0.066)	(0.059)	(0.064)	(0.212)	(0.107)	(0.101)
NT	73146	64539	73146	73146	73146	64539	5942	5942	5942
rho	0.715	0.711	0.715	0.716					
r2	0.011	0.011	0.011	0.011	0.171	0.144	0.170	0.168	0.157
F-test for excl. instruments					35.476	32.478			

Hansen's J-test					2.647 [0.266]	4.430 [0.109]			
Boundary FE	-	-	-	-	-	-	YES	YES	NO
Firm FE	YES	YES	YES	YES	NO	NO	NO	NO	NO
Industry FE	NO	NO	NO	NO	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

The table reports the effects of Finnvera's subsidized loans on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is a natural logarithm of value added divided by employment. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted subsidized loans by Finnvera and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Capital intensity)* is a natural logarithm of fixed assets divided by employment at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2, and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. F-test for the excluded instruments tests for weak instruments. Hansen's J-test evaluates the null that the overidentification restrictions are valid [p-values in brackets]. Boundary FE, Firm FE, Industry FE and Year FE indicate whether the boundary, firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Columns 5 and 6 report the instrumental variables estimates for the full sample and single-plant firms, respectively. Columns 7-9 report the boundary regression estimates with alternative regional controls. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

5.1.4 Labor productivity

The effects of the treatment on labor productivity are analyzed in table 7. The capital intensity of the firms, a key factor in labor productivity, is controlled for in the regressions. The FE estimates show a negative albeit insignificant effect of -0.012 on labor productivity. The interaction effects between the firm age and the treatment dummy are insignificant and suggest that the effects do not change significantly with firm age. The LWFE model explicitly takes into account that the impact may require several time periods to materialize. This model shows a positive treatment dummy, whereas the pulse variables are negative (and larger in magnitude) in the treatment period and in the two following periods. The pulse variables remain negative but are insignificant in the later periods. The findings indicate negative cumulative effects over the study horizon.

The instrumental variables model addresses the concerns of potential selection bias, which could arise if the subsidized firms have faced a shock before the treatment. The IV model provides a negative and highly significant coefficient of -0.160, which is higher in absolute terms than the one obtained from the fixed effects model. This result seems to suggest that the FE estimates could be

upwards biased, perhaps because of 'cherry picking' by the bureaucrats. However, a direct comparison of the models is once again complicated by the fact that the firm fixed effects must be dropped in the IV model. The regional controls address the fact that the firms located in the less-developed areas, such as Eastern Finland, may be less productive. Hansen's J test provides support for the instruments and does not reject the null that the overidentification restrictions are valid.

The boundary estimates reduce the possibility that unobserved factors, such as regional characteristics, would affect the results. The model provides a negative and highly significant treatment coefficient of -0.046, which is more conservative than the estimate obtained from the IV model. In summary, the findings suggest that the labor productivity effects are negative or insignificant. That is, subsidized loans were not found to make the firms more efficient, at least given the study horizon.

5.2 Financial effects of subsidized loans

The second part of the empirical analysis focuses on financial outcomes and evaluates the potential channels through which financing could promote real activity. The analysis focuses on two commonly referenced financial obstacles, limited internal financing resources and costly external finance. As suggested in the earlier literature, the lack of access to external financing could make firms dependent on retained earnings to finance their investments and growth (e.g., Fazzari et al. 1988; Carpenter and Petersen 2002). Additionally, a high external finance premium could have a detrimental effect on the real activity of firms (e.g., Bernanke and Gertler 1995; Fazzari et al. 1988). A lower cost of external finance could in turn disproportionally help firms that are more dependent on external finance (e.g., Rajan and Zingales 1998). The underlying hypothesis predicts that if there are imperfections in the credit markets and the government funding relaxes financing constraints, the treatment would be expected to have a positive effect on the excess growth and a negative effect on the financial costs. The following analysis also evaluates whether the financial effects are higher for younger firms that may face more binding financial constraints.

TABLE 8 Excess growth #1 (IG)

	(1) FE	(2) FE	(3) FE	(4) LWFE	(5) IV	(6) IV	(7) RD	(8) RD	(9) RD
Dependent variable	Excess growth (IG)	Excess growth (IG)	Excess growth (IG)	Excess growth (IG)	Excess growth (IG)	Excess growth (IG)	Excess growth (IG)	Excess growth (IG)	Excess growth (IG)
Treatment	0.086***	0.085***	0.077***	0.083***	0.103*	0.119*	0.116***	0.116***	0.116***
	(0.013)	(0.015)	(0.019)	(0.026)	(0.062)	(0.065)	(0.019)	(0.019)	(0.019)
Age	-0.004**	-0.003*	-0.004**	-0.004**	-0.007***	-0.008***	-0.012***	-0.012***	-0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.0004)	(0.0005)	(0.002)	(0.002)	(0.002)
Age squared/100	0.005***	0.004**	0.005***	0.005***	0.009***	0.010***	0.017***	0.017***	0.017***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.005)	(0.005)	(0.006)
ln(Total assets)	-0.071***	-0.076***	-0.071***	-0.072***	-0.008***	-0.011***	-0.015**	-0.015**	-0.014**
	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)	(0.004)	(0.006)	(0.006)	(0.006)
Tangibility	0.125***	0.109***	0.125***	0.125***	-0.006	-0.007	0.096***	0.095***	0.081**
	(0.016)	(0.017)	(0.016)	(0.016)	(0.014)	(0.014)	(0.033)	(0.033)	(0.033)
Group	0.011	0.012	0.011	0.012	0.058***	0.064***	0.011	0.011	0.014
	(0.013)	(0.015)	(0.013)	(0.013)	(0.011)	(0.011)	(0.032)	(0.032)	(0.031)
Foreign	-0.007	0.026	-0.007	-0.007	-0.003	0.028	0.062	0.059	0.047
	(0.027)	(0.038)	(0.027)	(0.027)	(0.018)	(0.021)	(0.066)	(0.066)	(0.065)
GDP	1.161	1.624	1.181	1.151	1.006**	0.904*	-2.542		
	(1.072)	(1.177)	(1.072)	(1.075)	(0.462)	(0.481)	(2.256)		
Unemployment	0.328	0.149	0.334	0.330	0.105	0.106	0.748		
	(0.233)	(0.250)	(0.233)	(0.233)	(0.129)	(0.137)	(0.559)		
Youth unemployment	0.341***	0.293**	0.342***	0.343***	0.061	0.011	0.089		
	(0.115)	(0.123)	(0.115)	(0.115)	(0.086)	(0.092)	(0.274)		
Long-term unemployment	0.144**	0.126**	0.144**	0.144**	0.094**	0.079*	0.285*		
	(0.057)	(0.061)	(0.057)	(0.057)	(0.043)	(0.045)	(0.156)		
Rural	0.004	0.012	0.004	0.005	0.003	-0.001	-0.012		
	(0.032)	(0.034)	(0.032)	(0.032)	(0.009)	(0.010)	(0.048)		
Semiurban	-0.016	-0.022	-0.016	-0.016	0.003	0.004	0.033		
	(0.020)	(0.022)	(0.020)	(0.020)	(0.007)	(0.007)	(0.038)		
Dependency ratio	0.066	0.094*	0.067	0.064	0.007	0.011	-0.028		
	(0.051)	(0.055)	(0.051)	(0.051)	(0.024)	(0.025)	(0.071)		
p_1				0.017					
				(0.019)					
p0				-0.006					
				(0.023)					
p1				0.037					
				(0.023)					
p2				0.015					
				(0.023)					
p3				0.003					
				(0.023)					
p4				0.018					
				(0.023)					
p5				0.001					
				(0.024)					
Age*Treatment			0.001						
			(0.001)						
_cons	0.969***	0.980***	0.968***	0.979***	0.416***	0.467***	0.563***	0.641***	0.621***
	(0.104)	(0.110)	(0.104)	(0.104)	(0.056)	(0.063)	(0.173)	(0.093)	(0.084)
NT	77040	67998	77040	77040	77040	67998	6180	6180	6180
rho	0.398	0.399	0.398	0.398					
r2	0.011	0.011	0.011	0.011	0.029	0.030	0.048	0.047	0.039
F-test for excl.					36.567	34.642			

instruments									
Hansen's J-test					6.078	2.829			
					[0.048]	[0.243]			
Boundary FE	-	-	-	-	-	-	YES	YES	NO
Firm FE	YES	YES	YES	YES	NO	NO	NO	NO	NO
Industry FE	NO	NO	NO	NO	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

The table reports the effects of Finnvera's subsidized loans on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is an indicator for whether the firm's realized sales growth exceeded the maximum internally financed growth rate at t. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted subsidized loans by Finnvera, and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Total assets)* is a natural logarithm of total assets at t-1, *Tangibility* is a ratio of fixed assets to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2, and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. F-test for the excluded instruments tests for weak instruments. Hansen's J-test evaluates the null that the overidentification restrictions are valid [p-values in brackets]. Boundary FE, Firm FE, Industry FE and Year FE indicate whether the boundary, firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Columns 5 and 6 report the instrumental variables estimates for the full sample and single-plant firms, respectively. Columns 7-9 report the boundary regression estimates with alternative regional controls. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

TABLE 9 Excess growth #2 (SFG)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	FE	FE	FE	LWFE	IV	IV	RD	RD	RD
Dependent variable	Excess growth (SFG)	Excess growth (SFG)	Excess growth (SFG)	Excess growth (SFG)	Excess growth (SFG)	Excess growth (SFG)	Excess growth (SFG)	Excess growth (SFG)	Excess growth (SFG)
Treatment	0.078***	0.080***	0.084***	0.066***	0.053	0.088	0.088***	0.089***	0.086***
	(0.013)	(0.014)	(0.019)	(0.025)	(0.062)	(0.064)	(0.019)	(0.019)	(0.019)
Age	-0.004**	-0.003*	-0.004**	-0.004**	-0.006***	-0.007***	-0.011***	-0.011***	-0.012***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.0004)	(0.0005)	(0.002)	(0.002)	(0.002)
Age squared/100	0.004***	0.004**	0.004***	0.004***	0.008***	0.009***	0.015**	0.014**	0.015**
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.006)	(0.006)	(0.006)
ln(Total assets)	-0.047***	-0.049***	-0.047***	-0.047***	-0.019***	-0.023***	-0.024***	-0.023***	-0.022***
	(0.005)	(0.006)	(0.005)	(0.006)	(0.003)	(0.004)	(0.006)	(0.006)	(0.006)
Tangibility	0.078***	0.055***	0.078***	0.078***	0.005	-0.0005	0.065*	0.067*	0.057*
	(0.016)	(0.017)	(0.016)	(0.016)	(0.014)	(0.014)	(0.034)	(0.034)	(0.034)
Group	0.025**	0.021	0.025**	0.026**	0.119***	0.122***	0.068**	0.067**	0.072**
	(0.013)	(0.014)	(0.013)	(0.013)	(0.011)	(0.011)	(0.032)	(0.032)	(0.032)
Foreign	0.017	0.034	0.017	0.017	0.004	0.027	0.074	0.070	0.058
	(0.026)	(0.035)	(0.026)	(0.026)	(0.018)	(0.021)	(0.076)	(0.075)	(0.071)
GDP	1.926*	2.199*	1.914*	1.874*	1.409***	1.356***	-1.969		
	(1.039)	(1.136)	(1.039)	(1.041)	(0.464)	(0.480)	(2.193)		

Unemployment	0.278	0.190	0.275	0.267	0.206	0.258*	0.265		
	(0.227)	(0.245)	(0.227)	(0.227)	(0.129)	(0.136)	(0.550)		
Youth unemployment	0.223**	0.179	0.222**	0.225**	-0.023	-0.072	0.063		
	(0.108)	(0.117)	(0.108)	(0.108)	(0.086)	(0.092)	(0.276)		
Long-term unemployment	0.099*	0.083	0.099*	0.098*	0.053	0.038	0.133		
	(0.054)	(0.057)	(0.054)	(0.054)	(0.042)	(0.043)	(0.150)		
Rural	0.017	0.028	0.017	0.018	-0.006	-0.008	0.032		
	(0.031)	(0.035)	(0.031)	(0.031)	(0.009)	(0.010)	(0.050)		
Semiurban	-0.020	-0.024	-0.020	-0.020	-0.002	0.0001	0.027		
	(0.020)	(0.021)	(0.020)	(0.020)	(0.007)	(0.007)	(0.039)		
Dependency ratio	0.014	0.033	0.013	0.010	0.008	0.005	-0.027		
	(0.050)	(0.055)	(0.050)	(0.050)	(0.024)	(0.025)	(0.072)		
p_1				0.004					
				(0.018)					
p0				0.001					
				(0.022)					
p1				0.050**					
				(0.021)					
p2				0.013					
				(0.022)					
p3				-0.018					
				(0.022)					
p4				0.014					
				(0.022)					
p5				-0.004					
				(0.022)					
Age*Treatment			-0.0003						
			(0.001)						
_cons	0.685***	0.688***	0.686***	0.696***	0.518***	0.575***	0.651***	0.666***	0.624***
	(0.100)	(0.107)	(0.100)	(0.101)	(0.055)	(0.063)	(0.167)	(0.089)	(0.080)
NT	76992	67951	76992	76992	76992	67951	6178	6178	6178
rho	0.418	0.421	0.418	0.418					
r2	0.007	0.006	0.007	0.007	0.029	0.031	0.051	0.050	0.040
F-test for excl. instruments					36.549	34.625			
Hansen's J-test					1.278	.549			
					[0.528]	[0.760]			
Boundary FE	-	-	-	-	-	-	YES	YES	NO
Firm FE	YES	YES	YES	YES	NO	NO	NO	NO	NO
Industry FE	NO	NO	NO	NO	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

The table reports the effects of Finnvera's subsidized loans on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is an indicator for whether the firm's realized sales growth exceeded the maximum short-term financed growth rate at t. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted subsidized loans by Finnvera, and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Total assets)* is a natural logarithm of total assets at t-1, *Tangibility* is a ratio of fixed assets to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2 and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho

measures intraclass error correlation. R2 stands for R-squared. F-test for the excluded instruments tests for weak instruments. Hansen's J-test evaluates the null that the overidentification restrictions are valid [p-values in brackets]. Boundary FE, Firm FE, Industry FE and Year FE indicate whether the boundary, firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Columns 5 and 6 report the instrumental variables estimates for the full sample and single-plant firms, respectively. Columns 7-9 report the boundary regression estimates with alternative regional controls. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

TABLE 10 Excess growth #3 (SG)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	FE	FE	FE	LWFE	IV	IV	RD	RD	RD
Dependent variable	Excess growth (SG)	Excess growth (SG)	Excess growth (SG)	Excess growth (SG)	Excess growth (SG)	Excess growth (SG)	Excess growth (SG)	Excess growth (SG)	Excess growth (SG)
Treatment	0.063***	0.070***	0.088***	0.030	0.020	0.084	0.106***	0.109***	0.109***
	(0.014)	(0.015)	(0.021)	(0.027)	(0.068)	(0.071)	(0.022)	(0.021)	(0.021)
Age	-0.003	-0.002	-0.002	-0.003	-0.005***	-0.006***	-0.008***	-0.008***	-0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.0005)	(0.001)	(0.002)	(0.002)	(0.002)
Age squared/100	0.004**	0.003	0.004**	0.004**	0.006***	0.007***	0.011**	0.011**	0.012**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.005)	(0.005)	(0.005)
ln(Total assets)	-0.030***	-0.033***	-0.030***	-0.030***	-0.019***	-0.025***	-0.036***	-0.036***	-0.035***
	(0.006)	(0.006)	(0.006)	(0.006)	(0.004)	(0.004)	(0.007)	(0.007)	(0.007)
Tangibility	0.144***	0.125***	0.144***	0.145***	0.153***	0.143***	0.207***	0.207***	0.194***
	(0.017)	(0.018)	(0.017)	(0.017)	(0.015)	(0.016)	(0.036)	(0.036)	(0.036)
Group	0.019	0.015	0.020	0.021	0.129***	0.136***	0.082**	0.082**	0.086**
	(0.014)	(0.015)	(0.014)	(0.014)	(0.012)	(0.012)	(0.036)	(0.036)	(0.036)
Foreign	-0.028	-0.023	-0.028	-0.028	0.013	0.026	0.045	0.045	0.044
	(0.030)	(0.039)	(0.030)	(0.030)	(0.021)	(0.023)	(0.072)	(0.071)	(0.072)
GDP	0.660	0.829	0.605	0.505	0.890*	1.020*	0.215		
	(1.140)	(1.258)	(1.142)	(1.143)	(0.511)	(0.523)	(2.516)		
Unemployment	0.238	0.214	0.225	0.210	0.174	0.247*	0.582		
	(0.249)	(0.268)	(0.249)	(0.249)	(0.144)	(0.149)	(0.609)		
Youth unemployment	0.269**	0.238*	0.267**	0.269**	-0.058	-0.104	-0.231		
	(0.120)	(0.128)	(0.120)	(0.120)	(0.095)	(0.099)	(0.309)		
Long-term unemployment	0.038	0.039	0.040	0.038	0.050	0.036	0.069		
	(0.061)	(0.064)	(0.061)	(0.061)	(0.048)	(0.049)	(0.166)		
Rural	0.009	0.033	0.009	0.010	-0.005	-0.004	-0.012		
	(0.035)	(0.038)	(0.035)	(0.035)	(0.010)	(0.011)	(0.055)		
Semiurban	-0.033	-0.032	-0.032	-0.033	0.006	0.006	0.006		
	(0.022)	(0.024)	(0.022)	(0.021)	(0.008)	(0.008)	(0.043)		
Dependency ratio	0.032	0.041	0.029	0.025	0.019	0.009	0.080		
	(0.056)	(0.062)	(0.056)	(0.056)	(0.027)	(0.027)	(0.081)		
p_1				0.009					
				(0.020)					
p0				0.039*					
				(0.023)					
p1				0.072***					
				(0.023)					
p2				0.022					
				(0.024)					
p3				0.011					
				(0.023)					

p4				0.024					
				(0.023)					
p5				-0.008					
				(0.024)					
Age*Treatment			-0.0015*						
			(0.0009)						
_cons	0.573***	0.585***	0.576***	0.585***	0.544***	0.633***	0.651***	0.892***	0.870***
	(0.109)	(0.117)	(0.109)	(0.109)	(0.062)	(0.069)	(0.200)	(0.097)	(0.087)
NT	76981	67940	76981	76981	76981	67940	6178	6178	6178
rho	0.391	0.393	0.391	0.391					
r2	0.004	0.003	0.004	0.004	0.026	0.032	0.055	0.053	0.046
F-test for excl. instruments					36.670	34.753			
Hansen's J-test					.897	.167			
					[0.639]	[0.920]			
Boundary FE	-	-	-	-	-	-	YES	YES	NO
Firm FE	YES	YES	YES	YES	NO	NO	NO	NO	NO
Industry FE	NO	NO	NO	NO	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

The table reports the effects of Finnvera's subsidized loans on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is an indicator for whether the firm's realized sales growth exceeded the maximum sustainable growth rate at t. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted subsidized loans by Finnvera and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Total assets)* is a natural logarithm of total assets at t-1, *Tangibility* is a ratio of fixed assets to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2 and the pulse variables *p_1, p0, p1, p2, p3, p4,* and *p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. F-test for the excluded instruments tests for weak instruments. Hansen's J-test evaluates the null that the overidentification restrictions are valid [p-values in brackets]. Boundary FE, Firm FE, Industry FE and Year FE indicate whether the boundary, firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, full sample with interaction effects and time-varying treatment effects model for the full sample, respectively. Columns 5 and 6 report the instrumental variables estimates for the full sample and single-plant firms, respectively. Columns 7-9 report the boundary regression estimates with alternative regional controls. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

5.2.1 Excess growth

Tables 8-10 analyze whether the government funding increased the probability that the firms were able to exceed the maximum growth rates that could be financed internally or with a limited access to external capital. The measures studied include the maximum internally financed growth rate (IG), the maximum short-term financed growth rate (SFG) and the maximum sustainable growth rate (SG).

Summarizing the results from all three tables, the fixed effects estimates show that the subsidized loans have a positive and highly significant effect on the probability for excess growth. The estimates suggest that the treatment increases the probability for exceeding the IG, SFG and SG by 0.086, 0.078, and 0.063, respectively. The interaction term between the firm age and the treatment dummy is insignificant in the case of IG and SFG. It is negative and weakly significant in the case of SG. This latter estimate suggests that the excess growth effects are larger for younger firms; the average marginal effects indicate the probability of exceeding the constrained growth rate is approximately 38.7% higher for the 5-year-old firms than for the 20-year-old firms. The LWFE estimates show that none of the pulse variables is significant in the case of IG, suggesting no lagged excess growth effects after the treatment period. In the case of SFG, only the first pulse variable after the treatment period is significant. In the case of SG, there is a significant positive effect in the treatment period and in the following period, whereas the rest of the pulse variables are insignificant. The treatment indicator itself is insignificant in this case. In sum, the dynamic effects appear to be relatively short term.

The instrumental variables estimation provides a positive and weakly significant coefficient of 0.103 for the excess growth indicator for IG. In the case of SFG and SG, the coefficients are positive but insignificant. In the case of IG, Hansen's J test rejects the null of valid overidentification restrictions at the 10 % level when the full sample is studied. In the case of the sub-sample of single-plant firms, the null hypothesis cannot be rejected. In the case of SFG and SG, Hansen's J test does not reject the null hypothesis that the overidentification restrictions are valid.

The boundary sample indicates that the treatment has a positive and highly significant effect on all three excess growth measures. The estimates suggest that the treatment increased the probability that the firm exceeded the IG, SFG, and SG by 0.116, 0.089, and 0.109, respectively. In summary, the fixed effects and boundary regressions suggest that the treatment increased the probability for excess growth. The instrumental variables models suggest a positive but weakly significant or insignificant effect, while there remain some concerns that the overidentification restrictions may not be fully satisfied. Overall, the findings suggest that the subsidized firms were able to exceed the maximum growth rates that could be financed internally or with a limited access to external capital.

TABLE 11 Financing costs

Dependent variable	(1) FE Financing costs	(2) FE Financing costs	(3) FE Financing costs	(4) LWFE Financing costs	(5) IV Financing costs	(6) IV Financing costs	(7) RD Financing costs	(8) RD Financing costs	(9) RD Financing costs
Treatment	-0.026***	-0.028***	-0.031***	-0.021*	-0.056**	-0.054**	-0.013*	-0.012*	-0.014**
	(0.005)	(0.006)	(0.007)	(0.011)	(0.025)	(0.027)	(0.007)	(0.007)	(0.007)
Age	0.0002	-0.001	0.0001	0.0002	-0.001***	-0.001***	-0.00001	0.0001	-0.0001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0002)	(0.0003)	(0.001)	(0.001)	(0.001)
Age squared/100	0.0003	0.001	0.0003	0.0003	0.0005	0.0001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.0003)	(0.0004)	(0.002)	(0.002)	(0.001)
ln(Total assets)	-0.009***	-0.009***	-0.009***	-0.009***	0.005***	0.002	0.0002	0.0002	0.0004
	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Profitability	0.012	0.012	0.012	0.011	-0.015**	-0.019**	-0.015	-0.015	-0.014
	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)	(0.007)	(0.018)	(0.018)	(0.017)
Tangibility	-0.080***	-0.075***	-0.080***	-0.080***	-0.111***	-0.105***	-0.092***	-0.094***	-0.093***
	(0.009)	(0.010)	(0.009)	(0.009)	(0.006)	(0.006)	(0.020)	(0.020)	(0.019)
Group	0.017**	0.026***	0.017**	0.017**	0.023***	0.024***	0.009	0.009	0.007
	(0.008)	(0.008)	(0.008)	(0.008)	(0.006)	(0.006)	(0.013)	(0.013)	(0.013)
Foreign	-0.019	-0.035	-0.019	-0.019	0.007	-0.003	0.021	0.024	0.018
	(0.022)	(0.029)	(0.022)	(0.022)	(0.013)	(0.014)	(0.027)	(0.026)	(0.028)
GDP	-0.502	-0.780	-0.489	-0.487	0.0523	-0.139	0.787		
	(0.670)	(0.734)	(0.670)	(0.671)	(0.277)	(0.283)	(1.022)		
Unemployment	0.054	-0.024	0.057	0.057	0.065	0.096	0.122		
	(0.127)	(0.138)	(0.127)	(0.127)	(0.067)	(0.072)	(0.269)		
Youth unemployment	-0.111**	-0.127**	-0.111**	-0.111**	-0.103**	-0.0691	-0.197		
	(0.053)	(0.057)	(0.053)	(0.053)	(0.047)	(0.051)	(0.157)		
Long-term unemployment	-0.003	-0.011	-0.004	-0.004	-0.022	-0.018	-0.064		
	(0.031)	(0.033)	(0.031)	(0.031)	(0.024)	(0.026)	(0.071)		
Rural	0.009	0.003	0.009	0.008	-0.002	-0.0004	-0.038		
	(0.018)	(0.021)	(0.018)	(0.018)	(0.005)	(0.005)	(0.025)		
Semiurban	-0.012	-0.027*	-0.012	-0.012	-0.003	-0.002	-0.024		
	(0.014)	(0.016)	(0.014)	(0.014)	(0.004)	(0.004)	(0.020)		
Dependency ratio	-0.062**	-0.043	-0.061**	-0.060**	-0.025**	-0.031**	0.042		
	(0.030)	(0.029)	(0.030)	(0.030)	(0.012)	(0.012)	(0.028)		
p_1				0.009					
				(0.008)					
p0				0.003					
				(0.008)					
p1				-0.005					
				(0.007)					
p2				-0.006					
				(0.007)					
p3				-0.004					
				(0.006)					
p4				0.006					
				(0.007)					
p5				0.010					
				(0.007)					
Age* Treatment			0.0003						
			(0.0003)						

_cons	0.405***	0.401***	0.405***	0.399***	0.188***	0.223***	0.129*	0.186***	0.166***
	(0.066)	(0.067)	(0.066)	(0.066)	(0.028)	(0.031)	(0.077)	(0.041)	(0.036)
NT	54695	47694	54695	54695	54695	47694	4614	4614	4614
rho	0.568	0.575	0.567	0.567					
r2	0.008	0.009	0.008	0.008	0.028	0.024	0.046	0.044	0.031
F-test for excl. instruments					36.801	35.273			
Hansen's J-test					3.035	1.333			
					[0.219]	[0.514]			
Boundary FE	-	-	-	-	-	-	YES	YES	NO
Firm FE	YES	YES	YES	YES	NO	NO	NO	NO	NO
Industry FE	NO	NO	NO	NO	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES	YES

The table reports the effects of Finnvera's subsidized loans on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is financial expenses at t divided by the average long-term debt measured between t-1 and t. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted subsidized loans by Finnvera, and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Total assets)* is a natural logarithm of total assets at t-1, *Profitability* is EBITDA divided by total assets at t-1, *Tangibility* is a ratio of fixed assets to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2, and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. F-test for the excluded instruments tests for weak instruments. Hansen's J-test evaluates the null that the overidentification restrictions are valid [p-values in brackets]. Boundary FE, Firm FE, Industry FE and Year FE indicate whether the boundary, firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Columns 5 and 6 report the instrumental variables estimates for the full sample and single-plant firms, respectively. Columns 7-9 report the boundary regression estimates with alternative regional controls. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

5.2.2 Financing costs

The effects of government funding on the financing costs are reported in table 11. The FE estimates show a negative and highly significant coefficient of -0.026, which suggests a 2.6-percentage-point reduction in the average financial costs. The interaction term between the firm age and the treatment indicator is insignificant. This result implies that the financing cost effects do not significantly depend on the firm age. The LWFE model shows a weakly significant and somewhat lower estimate in absolute terms. None of the pulse variables is significant. This suggests that there are no lagged effects on the financing costs.

The IV model provides an estimate of -0.056, suggesting an even larger reduction in the financial costs. Recall that the lack of firm fixed effects calls for some caution in the interpretation because some permanent unobserved firm-specific characteristics could still affect the financing costs. The instruments build on the assumption that there is no significant regional variation in the financing costs conditional on the covariates. This would indeed be the case if the credit markets are integrated at the local level.[15] Hansen's J test does not reject the null that the overidentification restrictions are valid.

The boundary regression provides a negative and weakly significant coefficient of -0.012 for the treatment indicator, which implies a 1.2-percentage-point reduction in the financing costs. The overall findings suggest that the treatment reduced the average financing costs of the firms. However, this analysis does not directly address whether this result is related to interest rate subsidies or other explanations, such as certification. Some further analysis, however, is provided in section 5.4. While it might seem expected that interest rate subsidies would lower the interest rates of a given loan, it is worth noting several factors: First, not all loans provided by Finnvera include a direct interest rate subsidy (even if there is an indirect subsidy element). Second, the communication with Finnvera's management seems to suggest that, as a general rule, the funding provided by Finnvera is likely to be more expensive than private bank loans in the absence of a regional policy dimension. Finally, note also that the average financing costs studied here consist of financing costs of loans obtained from Finnvera and from other sources, including private banks.

The control variables show that the tangibility of assets is negatively related to interest expenses, as expected. There is somewhat mixed evidence on the effects of size on financial costs, while only the IV estimates provide support for a significant negative relationship with age. Recall that the time fixed effects absorb the market level of interest rates. Overall, the economic impact of the government funding on the financing costs appears to be sizable. The conservative fixed effects and boundary regression estimates would indicate an approximate 9-20% reduction in the average financing costs because the mean sample average financing costs are approximately 13.1% p.a. (median: 7.8%).[16]

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15 Petersen and Rajan (2002) examine evidence from U.S. small business data, noting that the importance of distance between lenders and borrowers has diminished over time because of technological innovations such as credit scoring. In contrast, Guiso et al. (2004) use Italian data to show that the local availability of capital may remain important because of the segmentation of the credit markets. In addition, Agarwal and Hauswald (2010) find evidence in U.S. data that the borrower proximity facilitates the collection of soft information and may affect the availability and cost of credit.

16 It is worth stressing that the loan interest rates calculated from the financial statement data are noisy despite the trimming. The sample averages appear relatively high, which at least partially reflects the fact that the long-term debt is used in the denominator as a proxy for interest-bearing debt given the lack of more exact measures. Using combined short- and long-term debt in the denominator results in less clear and mixed results, while that measure is problematic because of the inclusion of non-interest-bearing debt types and issues such as potential variation in the short-term debt. When the remaining outliers are removed from the original measure by trimming the financing cost distribution at the 95th percentile, the full sample re-

5.3 Discussion

The results on the real and financial effects of subsidized loans can be summarized as follows. The government funding had positive effects on the investments, sales growth, and employment of the subsidized firms, which indicates that the subsidized loans helped the firms to expand their operations. These findings are in line with the results of Criscuolo et al. (2012). Moreover, the interaction effects between the firm age and the treatment indicator suggest that the employment effects are higher for younger firms. The financial outcomes suggest two potential channels through which the financing promoted the real activity of the firms. First, the excess growth measures suggest that the government funding helped the firms to grow faster than was possible through the internal financing resources or limited access to external financing. There is also some evidence that the excess growth effects were higher for younger firms, but this result was only weakly statistically significant and sensitive to the definition of the excess growth. Second, the government funding reduced the average financing costs of the firms and likely reduced the wedge between the cost of internal and external finance. Indeed, the earlier literature suggests that a lower external finance premium could promote real activity (e.g., Rajan and Zingales 1998; Bernanke and Gertler 1995). Overall, the results suggest that the government funding potentially helped to relax two common financial obstacles, i.e., limited financing resources and costly external finance.

However, while the government funding helped the firms to grow larger, the funding did not make them more efficient, in line with Criscuolo et al. (2012). The mostly negative or insignificant productivity effects appear to be consistent with the broader country-level findings of La Porta et al. (2002), who suggest that the government involvement in the capital allocation may not necessarily improve efficiency. In fact, their analysis suggests that such an intervention could even be detrimental for the aggregate growth if the capital is allocated for inefficient projects because of political reasons rather than market failures. A potential explanation for the findings of the current paper could be that the government funding may have been used to preserve or to increase employment in lower productivity jobs. Caballero et al. (2008) provide cautionary evidence on the depressive effects of 'zombie lending' in Japan, which kept credit flowing to insolvent borrowers who crowded out healthier firms. Additionally, de Meza (2002) suggests that lending subsidies may decrease efficiency by drawing in lower-quality types. This effect is also likely to be reinforced when the entrepreneurs suffer from unrealistic optimism, which seems to be commonplace based on behavioral studies (de Meza 2002; see also de Meza and Southey 1996; Hyytinen et al. 2012). This raises concerns about the allocative

sults remain negative and significant, while the significance is lost in the boundary sample.

efficiency of government funding because the subsidized firms appear to be less productive than the nonsubsidized firms.[17]

5.4 Robustness check: real and financial effects of loan guarantees

The study has so far concentrated on Finnvera's loan financing because the regional variation in the supply of subsidized loans provides useful strategies for the identification of the policy effect. Other important financing instruments are loan guarantees, which account for approximately half of Finnvera's domestic lending volume. To check whether the above results provide a representative view of the effectiveness of the company's policy instruments, the loan guarantees are analyzed as a robustness check. This check requires some attention to the identification strategy to adjust to the somewhat different nature of guarantees. In particular, the regional aspects were not found to be as important to guarantees because there is not a pronounced 'regional bias' towards regional support areas. This finding is largely in line with the expectations because the firms located in the more densely populated areas could potentially rely more on bank financing and hence guarantees. The following analysis focuses on the fixed effects estimates because the lack of strong regional aspects limits the possible identification strategies. Overall, there are 5286 positive loan guarantee decisions in the sample.

The loan guarantee results are provided in tables 1-8 in appendix C, with only the main points of the findings discussed here. Overall, the loan guarantee estimates are similar to the loan estimates and largely confirm the earlier results; however, some differences are still observed. First, while the labor productivity effects remain negative at the beginning of the firms' life as shown by the treatment dummy, the interaction term between the firm age and the treatment dummy is positive and statistically significant. This finding suggests that the productivity effects are less negative for more mature firms and implies that some of the observed effects could be related to the stage of the firm life cycle. The difference between loan and guarantee estimates in this regard appears to be consistent with the view that the more direct involvement of banks provides more discipline in project selection. Nevertheless, the marginal effects measured up to the firm age of 20 years still show no signs of positive productivity effects.

The magnitude of investment, sales growth and employment effects appear to be somewhat more conservative, but they are nevertheless comparable

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17 One might argue that the firms could be more interested in their own survival or profits. These factors could also be interesting measures for analysis. However, the above analysis suggests that the interpretation regarding the measures such as survival could be problematic from the policy point of view. For instance, improved survival prospects of lower quality firms could be detrimental to aggregate productivity growth because the lower quality firms might crowd out higher quality firms.

to the earlier results. The employment effects in the case of guarantees show somewhat more sensitivity to the firm age because firms that are five years old have employment effects that are approximately 2.2-times as large as firms that are 20 years old. The interaction terms provide more robust evidence that the excess growth effects are diminishing for more mature firms. The measure of SG, for instance, suggests that the firms that are five years old are approximately 2.5-times as likely to show excess growth as the firms that are 20 years old. The finding that the government funding has larger excess growth effects on younger firms appears to be in line with conventional wisdom that the younger firms are more prone to suffer from financial constraints. Finally, loan guarantees do not seem to have a statistically significant effect on the financing costs of the firms. This suggests that the financial channel through which the loan guarantees operate could be related more closely to obtaining additional funds than to reducing financing costs.

6 CONCLUSIONS

While conventional wisdom suggests that credit market imperfections may constrain the growth of small businesses, there exists a limited amount of evidence on whether government funding could alleviate such constraints. This paper addressed this issue by analyzing the real and financial effects of subsidized loans granted to small businesses. The study utilized a large register-based panel of Finnish manufacturing firms and evaluated the effects of financing provided by a major state-owned specialized financing company whose objective is to cure credit market imperfections. Several methods were applied to identify the policy effects, including fixed effects models, instrumental variables models and boundary regressions. The instrumental variables models exploited the regional variation in the supply of government funding arising from the boundaries of the regional support areas. The boundary regressions analyzed firms located next to each other on the opposite sides of the regional support boundary to further control for the unobserved factors.

The findings suggest that the government funding helped firms to expand their operations because the subsidized firms were able to make more investments, grow faster and hire more employees than the nonsubsidized firms. However, the effects on labor productivity – a key measure of the effectiveness of the policy – were negative or insignificant. That is, while the government funding helped the firms to grow larger, the funding did not make them more efficient.

Regarding the financial effects, two potential channels were identified through which the government funding promoted real activity. First, the subsidized financing helped the firms to exceed the maximum growth rates that could be financed internally or with a limited access to external capital. Second, the subsidized loans helped to reduce the average financing costs of the firms. These findings suggest that the wedge between the cost of external and internal finance was diminished. There is also evidence suggesting that the employment effects and some of the excess growth effects were larger for younger firms. This result seems consistent with the prediction that such firms are more likely to face binding financial constraints than mature firms.

Overall, the results suggest that while government funding can promote the real activity of small businesses, it is important to pay special attention to the efficient allocation of subsidized financing. The previous literature suggests that a key mechanism through which banks and other financial intermediaries could promote long-term economic growth is improved productivity growth (Beck et al. 2000). That is, well-functioning financial markets improve capital allocation by increasing investments in projects with high expected returns and by decreasing funds from projects with poor prospects (Wurgler 2000). In this way, the financial markets allocate scarce resources to the most productive uses (see also Levine 2005). The disciplinary role of external finance has an important function in this process because it forces inefficient incumbents to exit the markets and allows the resources to be allocated to more efficient firms (see, e.g., Bertrand et al. 2007; Kerr and Nanda 2009).

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APPENDIX A

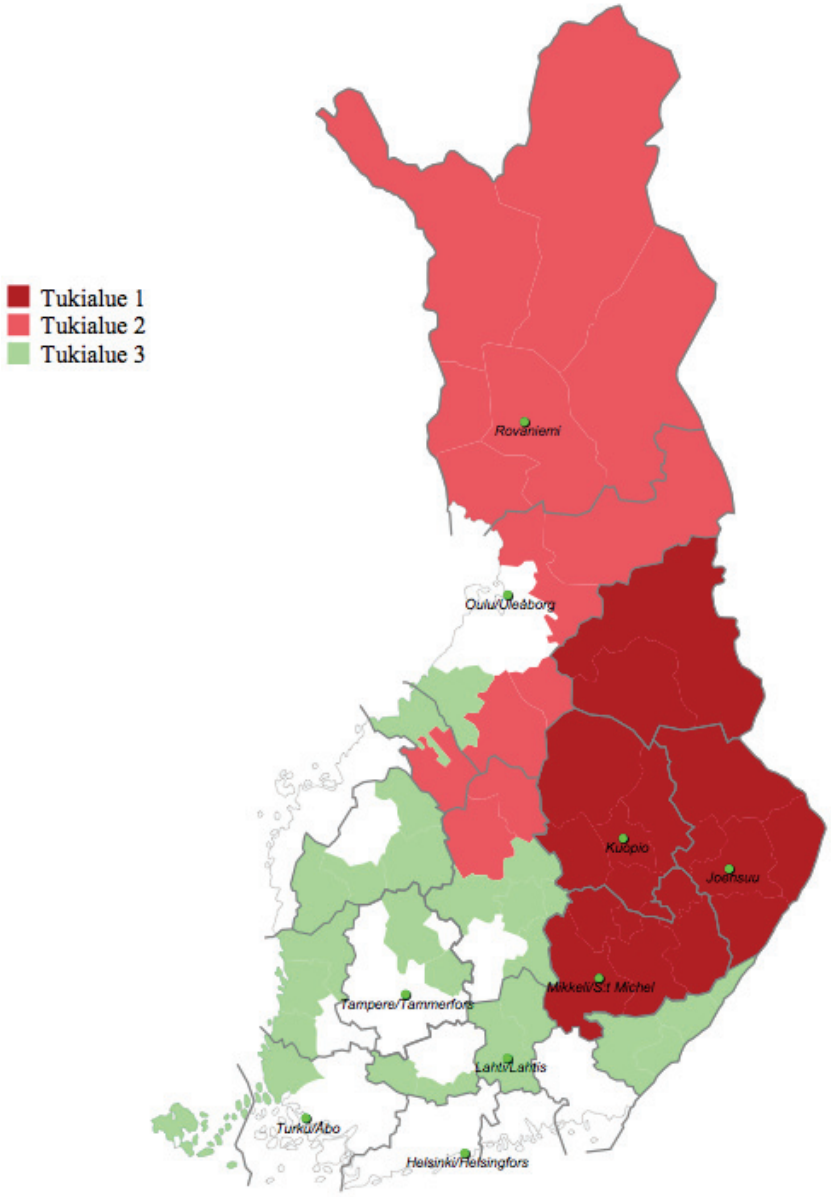

FIGURE 1 Domestic-assisted areas during the 2000-2006 period

The assisted areas are defined as follows: Tier I (dark red), Tier II (light red) and Tier III (green). Source: Ministry of the Interior.

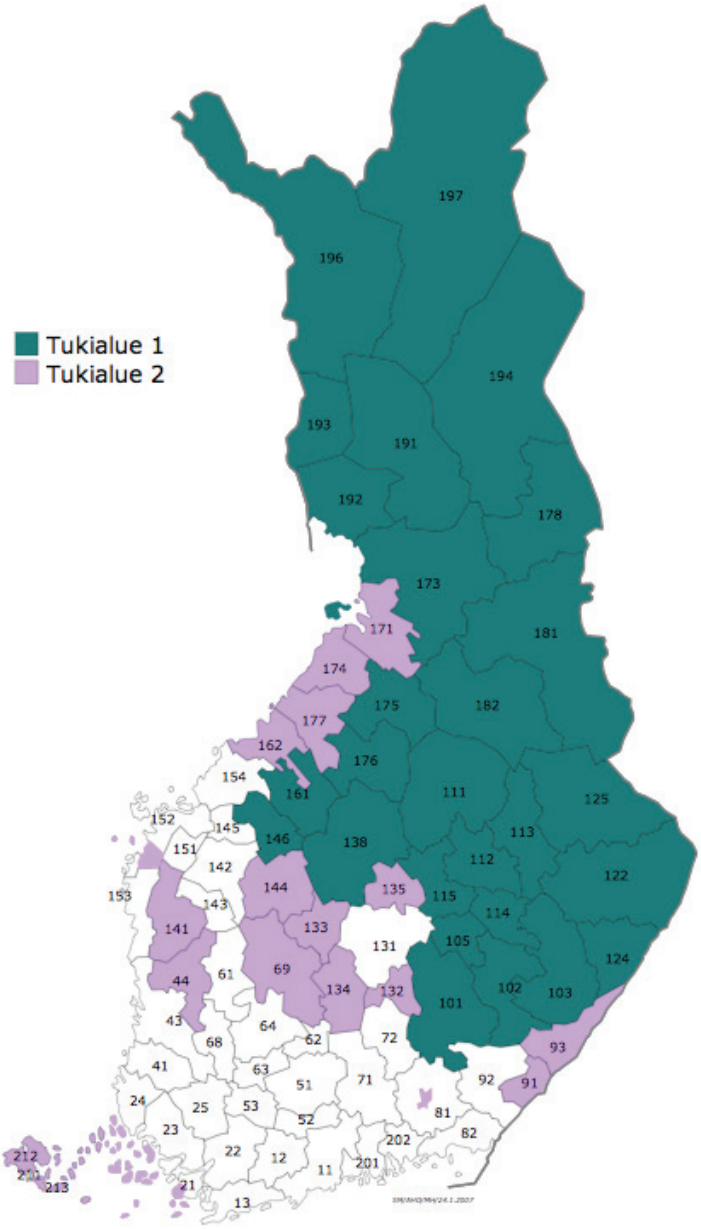

FIGURE 2 Domestic-assisted areas during the 2007-2013 period

The assisted areas are defined as follows: Tier I (green) and Tier II (purple). Source: Ministry of the Interior.

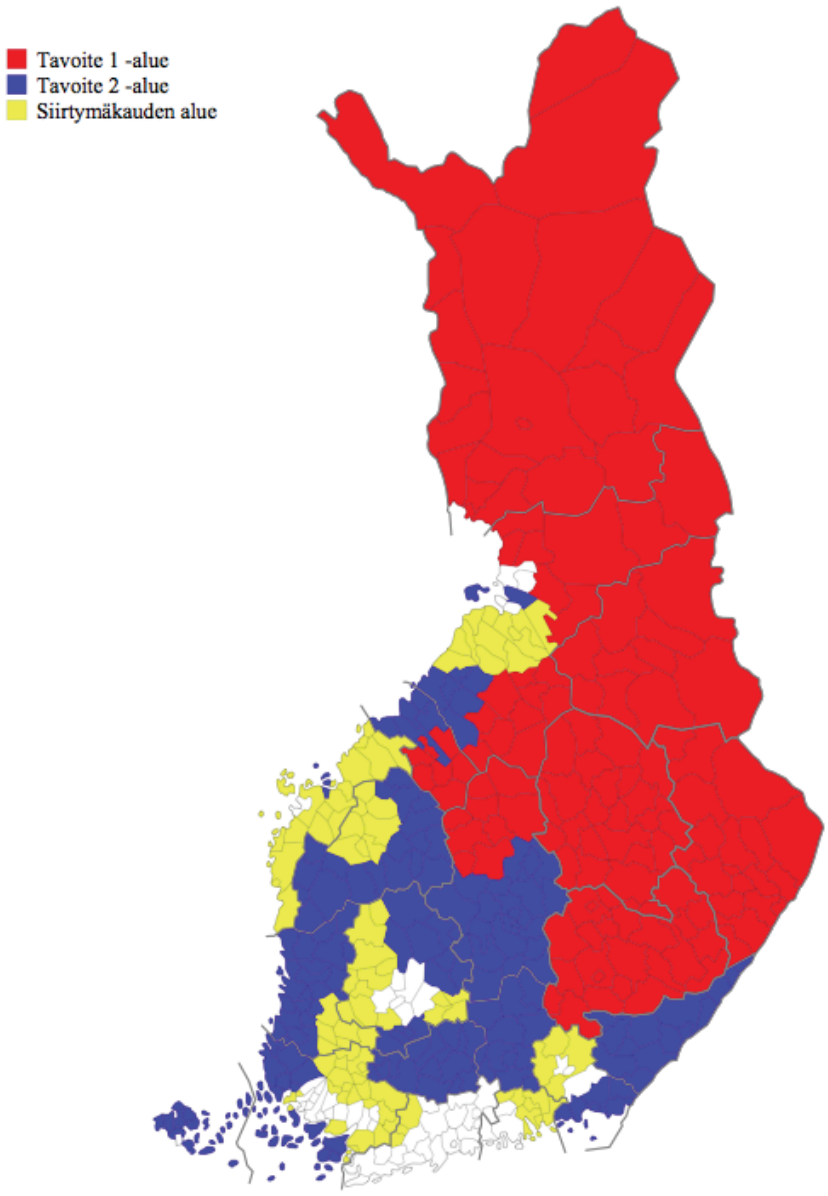

FIGURE 3 EU-assisted areas during the 2000-2006 period

The assisted areas are defined as follows: Objective I (red), Objective II (blue) and transition period areas (yellow). Source: Ministry of the Interior.

APPENDIX B

Regulation behind the instrumental variables

This chapter provides details on the regulation that forms the basis for the instrumental variables. The allocation of the state aid is directed by the EU-level regulation following Article 87.3 of the treaty. The EU Commission defined that the domestic regional assistance areas were allowed to cover at maximum 42.2% and 33% of the country during the program periods 2000-2006 and 2007-2013, respectively.[18]

The domestic areas are defined at the NUTS 4-level. The areas are classified into five categories based on the area-level economic indicators. In the program 2000-2006 period, these criteria were: 1) unemployment rate (average of 1996-1998 measured in April), 2) share of long-term and youth unemployment of the total unemployment measured in April of 1998, 3) maximum reduction of the manufacturing employment from 1985 to 1996, 4) net migration of the average population in 1995-1997, 5) composite indicator of rural problems consisting of a) average GDP per capita in 1994-1996, b) share of labor working in the agricultural and forestry occupations and c) economic dependency ratio. An area is defined as problematic if it is defined as problematic based on at least one of the indicators.

The sparsely populated areas that had fewer than 12.5 inhabitants per square kilometer were eligible for the state aid regardless of the above indicators. Outside of Eastern Finland, this concerns a large fraction of Northern Finland. Eastern Finland satisfied the requirement of the high support region, defined as GDP per capita of less than 75% of the EU average. Its GDP per capita was 74.4% of the EU average. Eastern Finland was given Tier I status in the domestic-assisted areas. Tier II and III areas were defined based on the indicators described above following the guidelines set by the EU Commission. Domestic Tier I and II areas were overlapping with the EU Objective I area. Objective I area was determined based on low population density, defined as eight inhabitants or fewer per square kilometer. Objective I area consisted of Eastern Finland and parts of Northern and Central Finland.

The maps of assistance were revised in 2007, driven by the EU regulation. In the 2007-2013 program period, the area-level economic indicators for the domestic areas were: 1) GDP per capita (average of 2001-2003), 2) unemployment indicator consisting of the unemployment rate and the share of youth and long-term unemployment in April 2005, 3) net migration of the average population in 2002-2004, 4) index of the subsistence and education structure of the population consisting of a) unemployment rate and b) share of youth and long-term unemployment of the total unemployment. Eastern Finland no longer sat-

[18] The details on the selection criteria of the support areas are based on the documents obtained from the Ministry of Employment and the Economy.

isfied the high support threshold of GDP less than the 75% of the EU average, given the inclusion of the new member states. The former Objective I region was defined as a domestic Tier I area based on the low population density of the area. Some areas were swapped between Tier I and II areas because of the special treatment of the Objective I area. Northern and Eastern Finland were given additional subsidies because of the low population density of the areas.

The firms are eligible for regional interest rate subsidies in the assisted regions. Finnvera acts as an intermediary for the interest rate subsidies provided by the State of Finland and the European Regional Development Fund (ERDF). Notably, even large firms can obtain regional subsidies in the assisted areas if the agency considers this warranted as a way to preserve employment. The regional interest rate subsidies are loan-specific and are calculated in a similar fashion as interest rates. The eligibility for the regional subsidies is determined based on the location of the financed project.

During the 2000-2004 period, the domestic regional interest rate subsidies were 2%, 1.8% and 1% in Tier I, II and III areas, respectively (see table 1).[19] In 2005, the subsidy rates were adjusted to 1.4%, 1.1% and 0.7% in Tier I, II and III areas, respectively. In 2007, the rates for the newly revised Tier I and II areas were defined as 1.4% and 1.1%, respectively. The total interest rate subsidies are higher in the regions and for the projects that are eligible for the ERDF subsidies. In this case, the subsidies consist of a combination of State subsidies and subsidies provided by the ERDF. The subsidies in the EU projects vary between 1.7-4% in the 2001-2004 period, 1.2-2.8% in the 2004-2006 period and 1.2-2.6% since 2007, depending on the domestic support area level (see table 2).[20]

The state compensation of the credit losses of Finnvera is graduated regionally based on the assisted area level (see table 3). During the 2000-2006 period, the state compensation was graduated regionally as follows: Tier I 65%, Tier II 60%, Tier III 50% and the rest of the Finland 40%. Since 2007, the credit loss compensation was adjusted to 65%, 60% and 40% for Tier I and II areas and the rest of the Finland, respectively. In EU projects, the credit loss compensation consists of a combination of the State and ERDF compensation. Finnvera's own share of the losses is 20% and 33% in the Objective I and II programs, respectively. Since 2005, the financing of growth firms has also been covered with higher credit loss compensation. In this case, the State compensation was 80%, 75%, 65% and 55% in Tier I, II and III areas and the rest of the Finland, respectively. In 2007, the credit loss compensation for the growth firm financing was adjusted to 75%, 70% and 55% in Tier I and II areas and the rest of the Finland, respectively.

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19 The details on the subsidy rates and credit loss compensation are based on the official documents of the decisions of the Council of the State obtained from www.finlex.fi and Finnvera.

20 Since 2005, the EU Objective I areas of Northern and Eastern Finland have also been eligible for 2% guarantee commission subsidies provided as a combination of domestic and EU subsidies. In 2007, the rates were adjusted to 1.5% in Northern and Eastern Finland and 1% in Central and Southern Finland, respectively.

TABLE 1 Regional interest rate subsidies in the domestic support areas

Region	Interest rate subsidy		
	Period 2000-2004	Period 2004-2006	Since 2007
Tier I	2.0%	1.4%	1.4%
Tier II	1.8%	1.1%	1.1%
Tier III	1.0%	0.7%	No such area

Source: Decisions of the Council of the State, obtained from Finlex and Finnvera.

TABLE 2 Regional interest rate subsidies in the EU support areas

Panel A: Interest rate subsidies in the EU support areas between 2001-2004

EU support region	Domestic support region	State subsidy	ERDF subsidy	Total subsidy
Objective I	Tier I	2.0%	2.0%	4.0%
	Tier II	1.8%	1.8%	3.6%
Objective II	Tier I	2.1%	1.5%	3.6%
	Tier II	1.0%	0.7%	1.7%
	Outside support regions	1.0%	0.7%	1.7%

Panel B: Interest rate subsidies in the EU support areas between 2004-2006

EU support region	Domestic support region	State subsidy	ERDF subsidy	Total subsidy
Objective I	Tier I	1.4%	1.4%	2.8%
	Tier II	1.1%	1.1%	2.2%
Objective II	Tier I	1.3%	0.9%	2.2%
	Tier II	0.7%	0.5%	1.2%
	Outside support areas	0.7%	0.5%	1.2%

Panel C: Interest rate subsidies in the EU support areas since 2007

Region	Domestic support region	Total subsidy
Northern Finland	Tier I	2.60%
	Tier II	2.20%
Eastern Finland	Tier I	2.60%
Western Finland	Tier I	2.60%
	Tier II	2.20%
	Challenging areas outside support regions	1.20%
Southern Finland	Tier II	2.20%
	Challenging areas outside support region	1.20%

Source: Decisions of the Council of the State, obtained from Finlex and Finnvera.

TABLE 3 Credit loss compensation by region

Panel A: Domestic-assisted areas

Region	**State compensation**			
	Since 1.1.2000	*Since 1.1.2007*	*Growth firm financing since 1.1.2005*	*Growth firm financing since 1.1.2007*
Tier I	65%	65%	80%	75%
Tier II	60%	60%	75%	70%
Tier III	50%	No such area	65%	No such area
Rest of the country	40%	40%	55%	55%

Panel B: EU Objective areas

Region	**State compensation**	**ERDF compensation**	**Finnvera's share**
Objective I	40%	40%	20%
Objective II	40%	27%	33%

Source: Decisions of the Council of the State, obtained from Finlex and Finnvera.

APPENDIX C

TABLE 1 Investments: loan guarantees

	(1)	(2)	(3)	(4)
	FE	FE	FE	LWFE
Dependent variable	Investments/ capital	Investments/ capital	Investments/ capital	Investments/ capital
Treatment	0.064***	0.072***	0.066***	0.060*
	(0.020)	(0.023)	(0.025)	(0.033)
Age	-0.004***	-0.006***	-0.004**	-0.004**
	(0.001)	(0.002)	(0.001)	(0.001)
Age squared/100	0.004***	0.007***	0.004***	0.004***
	(0.001)	(0.002)	(0.001)	(0.001)
Profitability	0.186***	0.179***	0.186***	0.185***
	(0.018)	(0.019)	(0.018)	(0.018)
Group	0.007	0.012	0.008	0.010
	(0.013)	(0.016)	(0.013)	(0.013)
Foreign	0.003	0.034	0.003	0.002
	(0.025)	(0.036)	(0.025)	(0.026)
GDP	-0.840	-1.726	-0.843	-0.920
	(1.390)	(1.557)	(1.391)	(1.385)
Unemployment	-0.219	-0.009	-0.219	-0.242
	(0.293)	(0.322)	(0.293)	(0.293)
Youth unemployment	0.290**	0.299*	0.290**	0.283**
	(0.142)	(0.155)	(0.142)	(0.142)
Long-term unemployment	0.076	0.108	0.076	0.082
	(0.071)	(0.077)	(0.071)	(0.071)
Rural	-0.051	-0.032	-0.050	-0.048
	(0.053)	(0.060)	(0.053)	(0.052)
Semiurban	-0.008	-0.008	-0.008	-0.007
	(0.025)	(0.028)	(0.025)	(0.025)
Dependency ratio	0.103	0.112	0.103	0.104
	(0.067)	(0.075)	(0.067)	(0.067)
p_1				0.035
				(0.027)
p0				0.118***
				(0.031)
p1				0.004
				(0.028)
p2				-0.048*
				(0.026)
p3				-0.073***
				(0.024)
p4				-0.072***
				(0.024)
p5				-0.026
				(0.027)
Age*Treatment			-0.0001	
			(0.001)	
_cons	0.158*	0.151	0.158*	0.156
	(0.095)	(0.106)	(0.095)	(0.095)
NT	74539	65637	74539	74539
Rho	0.332	0.332	0.332	0.332
r2	0.008	0.008	0.008	0.009
Firm FE	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO
Year FE	YES	YES	YES	YES

The table reports the effects of Finnvera's loan guarantees on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the

2000-2008 period. The dependent variable is net investments at t divided by fixed assets at t-1. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted loan guarantees by Finnvera, and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *Profitability* measures EBITDA to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 - level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2, and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. Firm FE, Industry FE and Year FE indicate whether the firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

TABLE 2 Sales growth: loan guarantees

	(1) FE	(2) FE	(3) FE	(4) LWFE
Dependent variable	Sales growth	Sales growth	Sales growth	Sales growth
Treatment	0.025***	0.027***	0.022*	0.030*
	(0.009)	(0.010)	(0.012)	(0.018)
Age	-0.002***	-0.002**	-0.002***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
Age squared/100	0.002***	0.002**	0.002***	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)
ln(Total assets)	-0.097***	-0.103***	-0.097***	-0.096***
	(0.004)	(0.005)	(0.004)	(0.004)
Tangibility	0.127***	0.132***	0.127***	0.128***
	(0.011)	(0.011)	(0.011)	(0.011)
Group	0.013*	0.015*	0.013*	0.014*
	(0.007)	(0.009)	(0.007)	(0.007)
Foreign	-0.015	-0.011	-0.015	-0.015
	(0.015)	(0.022)	(0.015)	(0.015)
GDP	1.077	1.237	1.082	1.072
	(0.713)	(0.791)	(0.713)	(0.713)
Unemployment	-0.202	-0.187	-0.201	-0.206
	(0.143)	(0.155)	(0.143)	(0.142)
Youth unemployment	0.117*	0.130*	0.117*	0.117*
	(0.070)	(0.077)	(0.070)	(0.070)
Long-term unemployment	0.065*	0.066*	0.065*	0.068*
	(0.035)	(0.038)	(0.035)	(0.035)
Rural	-0.026	-0.022	-0.026	-0.025
	(0.021)	(0.023)	(0.021)	(0.021)
Semiurban	-0.004	-0.006	-0.004	-0.003
	(0.013)	(0.015)	(0.013)	(0.013)
Dependency ratio	0.120***	0.107***	0.120***	0.120***
	(0.032)	(0.035)	(0.032)	(0.032)
p_1				0.030**
				(0.012)
p0				0.028*
				(0.017)
p1				0.014
				(0.016)

p2				-0.013
				(0.017)
p3				-0.009
				(0.017)
p4				-0.016
				(0.016)
p5				-0.019
				(0.019)
Age*Treatment			0.0001	
			(0.0004)	
_cons	1.106***	1.171***	1.105***	1.094***
	(0.071)	(0.076)	(0.071)	(0.071)
NT	75536	66594	75536	75536
Rho	0.544	0.532	0.544	0.542
r2	0.028	0.029	0.028	0.028
Firm FE	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO
Year FE	YES	YES	YES	YES

The table reports the effects of Finnvera's loan guarantees on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is the log growth of net sales from t-1 to t. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted loan guarantees by Finnvera and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Total assets)* is a natural logarithm of total assets at t-1, *Tangibility* is a ratio of fixed assets to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semi-urban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2 and the pulse variables *p_1, p0, p1, p2, p3, p4,* and *p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. Firm FE, Industry FE and Year FE indicate whether the firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

TABLE 3 Employment: loan guarantees

	(1)	(2)	(3)	(4)
	FE	FE	FE	LWFE
Dependent variable	ln(Employment)	ln(Employment)	ln(Employment)	ln(Employment)
Treatment	0.053***	0.064***	0.105***	0.027
	(0.015)	(0.015)	(0.020)	(0.034)
Age	0.004*	0.004**	0.004**	0.004*
	(0.002)	(0.002)	(0.002)	(0.002)
Age squared/100	-0.005***	-0.007***	-0.006***	-0.005***
	(0.002)	(0.002)	(0.002)	(0.002)
ln(Total assets)	0.285***	0.261***	0.285***	0.286***
	(0.007)	(0.007)	(0.007)	(0.007)
Group	0.017	0.029**	0.019	0.019
	(0.013)	(0.013)	(0.013)	(0.013)
Foreign	0.038	0.062	0.038	0.038
	(0.027)	(0.039)	(0.027)	(0.027)

GDP	-2.389**	-1.890	-2.501**	-2.416**
	(1.194)	(1.162)	(1.194)	(1.194)
Unemployment	-0.397*	-0.422**	-0.403*	-0.401*
	(0.214)	(0.215)	(0.214)	(0.214)
Youth unemployment	-0.038	0.032	-0.040	-0.039
	(0.096)	(0.098)	(0.096)	(0.096)
Long-term unemployment	0.037	0.028	0.036	0.040
	(0.047)	(0.047)	(0.047)	(0.047)
Rural	-0.023	-0.001	-0.022	-0.022
	(0.037)	(0.035)	(0.037)	(0.037)
Semiurban	0.025	0.029	0.026	0.026
	(0.023)	(0.022)	(0.023)	(0.023)
Dependency ratio	0.002	-0.026	-0.001	0.001
	(0.054)	(0.054)	(0.053)	(0.054)
p_1				0.044***
				(0.016)
p0				0.071**
				(0.029)
p1				0.051*
				(0.028)
p2				0.017
				(0.028)
p3				0.014
				(0.027)
p4				0.017
				(0.026)
p5				0.015
				(0.022)
Age*Treatment			-0.003***	
			(0.001)	
_cons	-1.556***	-1.408***	-1.552***	-1.570***
	(0.124)	(0.120)	(0.124)	(0.124)
NT	77903	68806	77903	77903
rho	0.932	0.922	0.932	0.932
r2	0.126	0.118	0.126	0.126
Firm FE	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO
Year FE	YES	YES	YES	YES

The table reports the effects of Finnvera's loan guarantees on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is a natural logarithm of employment. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted loan guarantees by Finnvera and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Total assets)* is a natural logarithm of total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 - level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2 and the pulse variables *p_1, p0, p1, p2, p3, p4*, and *p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. Firm FE, Industry FE and Year FE indicate whether the firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

TABLE 4 Labor productivity: loan guarantees

	(1)	(2)	(3)	(4)
	FE	FE	FE	LWFE
Dependent variable	ln(Labor productivity)	ln(Labor productivity)	ln(Labor productivity)	ln(Labor productivity)
Treatment	-0.015	-0.015	-0.040**	0.006
	(0.012)	(0.013)	(0.016)	(0.026)
Age	0.001	0.002	0.001	0.001
	(0.001)	(0.002)	(0.001)	(0.001)
Age squared/100	-0.002*	-0.003*	-0.002*	-0.002*
	(0.001)	(0.001)	(0.001)	(0.001)
ln(Capital intensity)	0.015***	0.015***	0.015***	0.014***
	(0.003)	(0.003)	(0.003)	(0.003)
Group	0.006	0.001	0.005	0.005
	(0.011)	(0.012)	(0.011)	(0.011)
Foreign	-0.004	-0.002	-0.003	-0.003
	(0.024)	(0.032)	(0.024)	(0.024)
GDP	0.211	-0.201	0.259	0.234
	(0.872)	(0.934)	(0.871)	(0.871)
Unemployment	-0.382**	-0.309	-0.380**	-0.379**
	(0.186)	(0.199)	(0.186)	(0.185)
Youth unemployment	-0.009	-0.034	-0.008	-0.009
	(0.080)	(0.084)	(0.080)	(0.080)
Long-term unemployment	-0.036	-0.012	-0.036	-0.039
	(0.043)	(0.046)	(0.043)	(0.043)
Rural	-0.003	-0.028	-0.003	-0.004
	(0.027)	(0.028)	(0.027)	(0.027)
Semiurban	-0.013	-0.026	-0.013	-0.013
	(0.017)	(0.018)	(0.017)	(0.017)
Dependency ratio	0.007	-0.026	0.008	0.008
	(0.042)	(0.045)	(0.042)	(0.042)
p_1				-0.010
				(0.015)
p0				-0.035
				(0.024)
p1				-0.037
				(0.024)
p2				-0.024
				(0.024)
p3				0.005
				(0.023)
p4				0.007
				(0.022)
p5				0.00004
				(0.020)
Age*Treatment			0.002**	
			(0.001)	
_cons	10.50***	10.53***	10.50***	10.50***
	(0.065)	(0.070)	(0.065)	(0.065)
N	73146	64539	73146	73146
rho	0.715	0.711	0.715	0.715
r2	0.011	0.011	0.011	0.011
Firm FE	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO
Year FE	YES	YES	YES	YES

The table reports the effects of Finnvera's loan guarantees on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is a natural logarithm of value added divided by employment. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted loan guarantees by Finnvera, and zero otherwise. The control

variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Capital intensity)* is a natural logarithm of fixed assets divided by employment at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2 and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. Firm FE, Industry FE and Year FE indicate whether the firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

TABLE 5 Excess growth #1 (IG): loan guarantees

	(1) FE	(2) FE	(3) FE	(4) LWFE
Dependent variable	Excess growth (IG)	Excess growth (IG)	Excess growth (IG)	Excess growth (IG)
Treatment	0.090***	0.101***	0.110***	0.046
	(0.016)	(0.017)	(0.022)	(0.031)
Age	-0.004**	-0.003*	-0.004**	-0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
Age squared/100	0.005***	0.005**	0.005***	0.005***
	(0.002)	(0.002)	(0.002)	(0.002)
ln(Total assets)	-0.071***	-0.076***	-0.071***	-0.070***
	(0.006)	(0.006)	(0.006)	(0.006)
Tangibility	0.125***	0.109***	0.124***	0.126***
	(0.016)	(0.017)	(0.016)	(0.016)
Group	0.012	0.012	0.012	0.013
	(0.013)	(0.015)	(0.013)	(0.013)
Foreign	-0.007	0.027	-0.007	-0.007
	(0.027)	(0.038)	(0.027)	(0.027)
GDP	1.157	1.613	1.115	1.104
	(1.073)	(1.178)	(1.072)	(1.074)
Unemployment	0.299	0.135	0.297	0.293
	(0.234)	(0.251)	(0.234)	(0.234)
Youth unemployment	0.347***	0.299**	0.346***	0.344***
	(0.115)	(0.123)	(0.115)	(0.115)
Long-term unemployment	0.144**	0.125**	0.144**	0.148***
	(0.057)	(0.061)	(0.057)	(0.057)
Rural	0.002	0.009	0.002	0.003
	(0.032)	(0.034)	(0.032)	(0.032)
Semiurban	-0.017	-0.024	-0.017	-0.017
	(0.020)	(0.022)	(0.020)	(0.020)
Dependency ratio	0.059	0.083	0.058	0.059
	(0.051)	(0.055)	(0.051)	(0.051)
p_1				0.021
				(0.021)
p0				0.084***
				(0.029)
p1				0.066**
				(0.029)

p2				0.020
				(0.029)
p3				0.015
				(0.030)
p4				-0.002
				(0.029)
p5				0.046
				(0.029)
Age*Treatment			-0.001	
			(0.001)	
_cons	0.980***	1.000***	0.982***	0.964***
	(0.104)	(0.110)	(0.104)	(0.104)
N	77040	67998	77040	77040
Rho	0.395	0.396	0.395	0.395
r2	0.011	0.011	0.011	0.012
Firm FE	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO
Year FE	YES	YES	YES	YES

The table reports the effects of Finnvera's loan guarantees on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is an indicator for whether the firm's realized sales growth exceeded the maximum internally financed growth rate at t. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted loan guarantees by Finnvera and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Assets)* is a natural logarithm of total assets at t-1, *Tangibility* is a ratio of fixed assets to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, GDP is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2 and the pulse variables p_1, p0, p1, p2, p3, p4, and p5 are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. Firm FE, Industry FE and Year FE indicate whether the firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

TABLE 6 Excess growth #2 (SFG): loan guarantees

	(1) FE	(2) FE	(3) FE	(4) LWFE
Dependent variable	Excess growth (SFG)	Excess growth (SFG)	Excess growth (SFG)	Excess growth (SFG)
Treatment	0.094***	0.097***	0.132***	0.035
	(0.015)	(0.016)	(0.021)	(0.031)
Age	-0.004**	-0.003*	-0.003**	-0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
Age squared/100	0.005***	0.004**	0.004***	0.004***
	(0.001)	(0.002)	(0.001)	(0.001)
ln(Total assets)	-0.047***	-0.049***	-0.047***	-0.046***
	(0.006)	(0.006)	(0.006)	(0.006)
Tangibility	0.077***	0.055***	0.077***	0.078***
	(0.016)	(0.017)	(0.016)	(0.016)

Group	0.026**	0.022	0.027**	0.027**
	(0.013)	(0.014)	(0.013)	(0.013)
Foreign	0.017	0.035	0.017	0.016
	(0.026)	(0.035)	(0.026)	(0.026)
GDP	1.953*	2.193*	1.873*	1.897*
	(1.039)	(1.135)	(1.038)	(1.040)
Unemployment	0.256	0.178	0.251	0.251
	(0.228)	(0.245)	(0.228)	(0.228)
Youth unemployment	0.228**	0.185	0.227**	0.228**
	(0.108)	(0.117)	(0.108)	(0.108)
Long-term unemployment	0.098*	0.083	0.098*	0.103*
	(0.054)	(0.057)	(0.054)	(0.054)
Rural	0.015	0.025	0.015	0.016
	(0.031)	(0.035)	(0.031)	(0.031)
Semiurban	-0.021	-0.025	-0.021	-0.021
	(0.020)	(0.021)	(0.020)	(0.020)
Dependency ratio	0.007	0.023	0.005	0.005
	(0.050)	(0.055)	(0.050)	(0.050)
p_1				0.017
				(0.020)
p0				0.081***
				(0.027)
p1				0.090***
				(0.028)
p2				0.057**
				(0.028)
p3				0.014
				(0.030)
p4				0.022
				(0.028)
p5				0.032
				(0.028)
Age*Treatment			-0.002**	
			(0.001)	
_cons	0.698***	0.708***	0.701***	0.692***
	(0.101)	(0.107)	(0.101)	(0.101)
N	76992	67951	76992	76992
rho	0.416	0.419	0.416	0.417
r2	0.007	0.007	0.007	0.008
Firm FE	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO
Year FE	YES	YES	YES	YES

The table reports the effects of Finnvera's loan guarantees on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is an indicator for whether the firm's realized sales growth exceeded the maximum short-term financed growth rate at t. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted loan guarantees by Finnvera, and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Total assets)* is a natural logarithm of total assets at t-1, *Tangibility* is a ratio of fixed assets to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2, and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. Firm FE, Industry FE and Year FE indicate whether the firm, industry and year fixed effects are included in the mod-

el, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

TABLE 7 Excess growth #3 (SG): loan guarantees

	(1)	(2)	(3)	(4)
	FE	FE	FE	LWFE
Dependent variable	Excess growth (SG)	Excess growth (SG)	Excess growth (SG)	Excess growth (SG)
Treatment	0.053***	0.053***	0.114***	-0.023
	(0.016)	(0.017)	(0.022)	(0.033)
Age	-0.003	-0.002	-0.002	-0.003
	(0.002)	(0.002)	(0.002)	(0.002)
Age squared/100	0.004**	0.003	0.004**	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
ln(Total assets)	-0.029***	-0.032***	-0.030***	-0.028***
	(0.006)	(0.006)	(0.006)	(0.006)
Tangibility	0.144***	0.125***	0.144***	0.146***
	(0.017)	(0.018)	(0.017)	(0.017)
Group	0.019	0.015	0.021	0.022
	(0.013)	(0.015)	(0.013)	(0.014)
Foreign	-0.028	-0.022	-0.029	-0.029
	(0.030)	(0.039)	(0.030)	(0.030)
GDP	0.624	0.747	0.492	0.540
	(1.140)	(1.257)	(1.140)	(1.139)
Unemployment	0.212	0.192	0.204	0.200
	(0.249)	(0.268)	(0.249)	(0.249)
Youth unemployment	0.272**	0.240*	0.270**	0.270**
	(0.120)	(0.128)	(0.120)	(0.120)
Long-term unemployment	0.038	0.039	0.037	0.045
	(0.061)	(0.064)	(0.061)	(0.061)
Rural	0.007	0.032	0.007	0.009
	(0.035)	(0.038)	(0.035)	(0.035)
Semiurban	-0.033	-0.032	-0.033	-0.033
	(0.022)	(0.024)	(0.022)	(0.022)
Dependency ratio	0.028	0.033	0.025	0.026
	(0.056)	(0.062)	(0.056)	(0.056)
p_1				0.018
				(0.022)
p0				0.117***
				(0.029)
p1				0.104***
				(0.029)
p2				0.054*
				(0.029)
p3				0.033
				(0.030)
p4				0.014
				(0.029)
p5				0.012
				(0.030)
Age*Treatment			-0.004***	
			(0.001)	
_cons	0.579***	0.596***	0.584***	0.563***
	(0.109)	(0.117)	(0.109)	(0.109)
N	76981	67940	76981	76981
Rho	0.391	0.393	0.391	0.392

r2	0.004	0.003	0.004	0.005
Firm FE	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO
Year FE	YES	YES	YES	YES

The table reports the effects of Finnvera's loan guarantees on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is an indicator for whether the firm's realized sales growth exceeded the maximum sustainable growth rate at t. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted loan guarantees by Finnvera, and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Total assets)* is a natural logarithm of total assets at t-1, *Tangibility* is a ratio of fixed assets to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2, and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. Firm FE, Industry FE and Year FE indicate whether the firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Standard errors are reported in parentheses: * $p <$ 0.10, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

TABLE 8 Financing costs: loan guarantees

	(1) FE	(2) FE	(3) FE	(4) LWFE
Dependent variable	Financing costs	Financing costs	Financing costs	Financing costs
Treatment	-0.004	-0.002	0.001	-0.018
	(0.006)	(0.007)	(0.008)	(0.013)
Age	0.0002	-0.001	0.0003	0.0002
	(0.001)	(0.001)	(0.001)	(0.001)
Age squared/100	0.0003	0.001	0.0003	0.0002
	(0.001)	(0.001)	(0.001)	(0.001)
ln(Total assets)	-0.010***	-0.010***	-0.010***	-0.010***
	(0.003)	(0.003)	(0.003)	(0.003)
Profitability	0.012*	0.013*	0.012*	0.012*
	(0.007)	(0.008)	(0.007)	(0.007)
Tangibility	-0.080***	-0.076***	-0.080***	-0.080***
	(0.009)	(0.010)	(0.009)	(0.009)
Group	0.017**	0.026***	0.017**	0.017**
	(0.008)	(0.008)	(0.008)	(0.008)
Foreign	-0.018	-0.035	-0.018	-0.019
	(0.022)	(0.029)	(0.022)	(0.022)
GDP	-0.431	-0.684	-0.444	-0.443
	(0.672)	(0.737)	(0.672)	(0.672)
Unemployment	0.075	-0.006	0.075	0.074
	(0.128)	(0.139)	(0.128)	(0.128)
Youth unemployment	-0.112**	-0.127**	-0.112**	-0.112**
	(0.053)	(0.057)	(0.053)	(0.053)
Long-term unemployment	-0.002	-0.010	-0.002	-0.002
	(0.031)	(0.033)	(0.031)	(0.031)
Rural	0.010	0.004	0.010	0.010
	(0.019)	(0.021)	(0.019)	(0.019)

Semiurban	-0.012	-0.027*	-0.012	-0.012
	(0.014)	(0.016)	(0.014)	(0.014)
Dependency ratio	-0.061**	-0.041	-0.061**	-0.061**
	(0.030)	(0.030)	(0.030)	(0.030)
p_1				-0.009
				(0.008)
p0				0.010
				(0.010)
p1				0.010
				(0.010)
p2				0.010
				(0.011)
p3				0.006
				(0.009)
p4				0.012
				(0.011)
p5				-0.002
				(0.008)
Age*Treatment			-0.0003	
			(0.0003)	
_cons	0.403***	0.397***	0.404***	0.405***
	(0.066)	(0.067)	(0.066)	(0.066)
NT	54695	47694	54695	54695
rho	0.568	0.575	0.568	0.569
r2	0.007	0.008	0.007	0.007
Firm FE	YES	YES	YES	YES
Industry FE	NO	NO	NO	NO
Year FE	YES	YES	YES	YES

The table reports the effects of Finnvera's loan guarantees on the firm performance. The sample consists of an unbalanced panel of Finnish manufacturing corporations over the 2000-2008 period. The dependent variable is financial expenses at t divided by the average long-term debt measured between t-1 and t. *Treatment* is an indicator that takes a value equal to one in all the periods in and after the firm is granted loan guarantees by Finnvera, and zero otherwise. The control variables are defined as follows: *Age* is the age of the firm since incorporation measured at t, *ln(Total assets)* is a natural logarithm of total assets at t-1, *Profitability* is EBITDA divided by total assets at t-1, *Tangibility* is a ratio of fixed assets to total assets at t-1, *Group* is an indicator for firms that belong to a business group at t-1, *Foreign* is an indicator for foreign ownership at t-1, *GDP* is a NUTS 4 -level regional GDP per capita measured in million euros at t-1, *Unemployment* is the municipality-level unemployment rate measured at t-1, *Youth unemployment* is the share of youth unemployment of the total unemployment in the municipality measured at t-1, *Long-term unemployment* is the share of long-term unemployment of the total unemployment in the municipality at t-1, *Rural* and *Semiurban* are indicators for rural and semiurban municipalities, respectively, measured at the beginning of the period t, *Dependency ratio* is the economic dependency ratio in the municipality at t-2, and the pulse variables *p_1, p0, p1, p2, p3, p4, and p5* are indicators for t periods before and after the beginning of the treatment. NT is the number of observations in the sample. Rho measures intraclass error correlation. R2 stands for R-squared. Firm FE, Industry FE and Year FE indicate whether the firm, industry and year fixed effects are included in the model, respectively. Columns 1-4 report the fixed effects estimates for the full sample, single-plant firms, the full sample with interaction effects and the time-varying treatment effects model for the full sample, respectively. Standard errors are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. The standard errors have been clustered at the firm level. Source of data: Statistics Finland.

III

LIFE-CYCLE EFFECTS IN SMALL BUSINESS FINANCE

LIFE-CYCLE EFFECTS IN SMALL BUSINESS FINANCE

Ilkka Ylhäinen[1]

Abstract

This paper studies the life-cycle profiles of small firms' cost and use of credit using a large panel of Finnish firms from the period 1999-2010. The findings suggest that the choice of method matters for the conclusions drawn about the relationship between firm age and financing costs. The cross-sectional age profiles of financing costs are hump-shaped and consistent with hold-up theories. In contrast, methods that control for cohort or firm fixed effects demonstrate that the financing costs decrease monotonically as the firms mature, in line with the prediction of Diamond (1989). The findings suggest that these differences in the life-cycle profiles relate to cohort effects. The life-cycle profiles of the use of credit also indicate that firms are more dependent on financial intermediaries in the early periods of their lives. Several findings are made about the cohort effects. The younger cohorts face lower financing costs than the older cohorts. The younger cohorts also rely less on new bank loans than the older cohorts, whereas the amount of bank financing used suggests a more complex relationship. Finally, the cohorts born during recessions, particularly the Finnish Great Depression and the banking crisis of the 1990s, pay higher financing costs and use smaller amounts of bank loans in a persistent fashion, even after their creditworthiness is controlled for. This finding suggests that recessions and periods of financial instability could have a lasting impact on the perceived riskiness of the firms and their use of external finance in the future.

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1 INTRODUCTION

How do the cost of credit and the use of bank finance evolve over the life cycle in small business finance? The theories of financial intermediation, including that of Diamond (1989), predict that informational asymmetries are most severe in the early periods of firms' lives and that such problems diminish over time as the firms mature (see also Boot and Thakor 1994). Diamond (1991) also predicts that firms are more dependent on the monitoring provided by banks early in their lives and switch to other sources of finance when their reputation improves (see also Berger and Udell 1998). These theoretical frameworks suggest that the cost of credit would decrease and the availability of finance would improve as the firm gets older and does not default. Hold-up theories proposed by Sharpe (1990), Rajan (1992), von Thadden (2004) and Kim et al. (2012) imply an alternative life-cycle profile for financing costs: In a two-period framework, the competition between banks prompts them to offer low borrowing rates to new firms in the first period. The firms become locked in after obtaining the loan, however, as the bank gains an information monopoly over them. The bank then extracts rents from the firms in the form of higher borrowing rates, which implies rising financing costs in the next period. The full life-cycle profile is predicted by Kim et al. (2012). In their model, there are rising interest rate mark-ups in the early periods of firms' lives and decreasing mark-ups for older firms whose quality has been revealed.

Previous empirical studies that have analyzed the effects of firm age on the availability and cost of credit have largely used cross-sectional datasets or short panels:[2] For instance, the well-known studies of Petersen and Rajan (1994, 1995) utilize cross-sectional data and find a negative correlation between firm age and the cost and use of credit. In more recent literature, Hyytinen and Pajarinen (2007) study a panel of Finnish firms over the period 1999-2002 and find

[2] Degryse et al. (2009) summarize findings from the closely related literature on relationship banking. Their summary suggests that a large fraction of studies that evaluate the effects of lending relationships on the cost or availability of credit are cross-sectional. Firm age is a typical control variable in these studies, but there is also another problem in these studies: it is difficult to distinguish bank relationship length effects from age effects (see, e.g., Petersen and Rajan 1994).

that the cost of credit is higher for younger firms even after controlling for the observed and unobserved creditworthiness of the firms.[3] In their panel of Japanese firms from the period 1997-2002, Sakai et al. (2010) suggest that the cost of credit is lower for older firms. Kim et al. (2012) study Norwegian small business data from 2000-2001, analyzing the life-cycle patterns of interest rate mark-ups. They find evidence in favor of lock-in theories. Their empirical results suggest that young firms face a low mark-up, whereas there is a rising mark-up for middle-aged firms and a falling mark-up for older firms.

The identification of the life-cycle profiles is difficult, however. This difficulty makes the question of the evolution of firms' financing costs and use of bank financing challenging to evaluate in a reliable fashion. To begin with, age effects cannot be distinguished from unobserved firm-specific heterogeneity, including firm quality, in cross-sectional data. Importantly, if there are cohort-specific differences in the firms' cost and use of credit, it is not possible to distinguish them from the age effects in the cross-section. Additionally, in the presence of time- and cohort-specific effects, an identification problem arises in the repeated cross-sections or panel data. Because there is a linear relationship between age, period, and cohort effects (i.e., age=period-cohort), it is not possible to identify all these effects in the same model without some restrictions (see, e.g., Hall et al. 2005). The existence of unobserved firm-specific heterogeneity results in another problem; firm fixed effects remove the cohort effects but do not eliminate the problem of identifying the age and time effects simultaneously (Hall et al. 2005). All these issues would have to be tackled to identify the life-cycle profiles of the cost and use of credit. The current study takes several steps in this direction and supplements the scarce corporate finance literature on this largely unexplored issue.

Whether there are significant time and cohort effects in the cost and use of small business loans is a policy-relevant issue that would benefit from further empirical research. Time effects could arise from fluctuations in the macroeconomic and financial environment, while there also remains a question about whether such effects would affect each age group equally. Holmström and Tirole (1997) predict that poorly capitalized firms, such as start-ups, are most hurt by credit tightening. The empirical evidence indeed suggests that bank-dependent firms are most affected by the tightening of monetary policy and by negative shocks faced by the banking sector (e.g., Gertler and Gilchrist 1994; Kroszner et al. 2007; Dell'Ariccia et al. 2008; Khwaja and Mian 2008; Chava and Purnanandam 2011). The literature on the micro foundations of credit cycles also suggests that financial market imperfections could have significant real effects; that is, shocks to collateral values and their interaction with credit limits could affect borrower net worth and result in large and persistent fluctuations

[3] They utilize data similar to this study, although there are important differences in the current study, including a different measure of financing costs, a longer time horizon, a different sample composition and a wider range of empirical methods. For other studies related to financing costs and banking relationships in the context of Finnish markets, see, e.g., Niskanen and Niskanen (2010) and Peltoniemi (2004).

in the output and asset prices (Kiyotaki and Moore 1997; Bernanke and Gertler 1989).

Where could potential cohort-specific effects arise in small business finance? Building on the analogue from the labor economics literature, firms that were established during weak economic times could face a stigma of being perceived as a different quality than otherwise identical firms born during stronger times.[4] The earlier corporate finance literature also highlights the potential adverse effects suffered by bank-dependent borrowers who lose their banking relationships or become otherwise credit-constrained during recessions and financial crises (e.g., Kashyap et al. 1994; Kroszner et al. 2007; Slovin et al. 1993). Corporate managers who started their businesses during a recession may also have less faith in financial markets. Graham and Narasimham (2004) find that publicly listed U.S. firms that experienced the U.S. Great Depression use less leverage in the 1940s than other firms. Malmendier et al. (2011) suggest that the CEOs of publicly listed U.S. firms who grew up during the Great Depression lean excessively towards internal finance. Schoar and Zuo (2011) observe more broadly in their sample of publicly listed U.S. firms that CEOs who started their careers during recessions use more conservative management approaches, including the lower use of leverage. Malmendier and Nagel (2010) provide complementary evidence suggesting that macroeconomic shocks faced earlier in life could affect the financial risk taking of individuals.

The development of the financial markets and improvements in the informational environment could also be potential sources of cohort effects in small business finance. For instance, the younger cohorts may benefit from improved bank screening technologies, such as credit scoring and the better availability of high-quality credit information. Petersen and Rajan (2002), for instance, suggest that the technological change in the banking sector has improved the availability of finance for more distant borrowers in the U.S. The improved availability of borrower-specific information from credit bureaus and credit rating agencies could reduce adverse selection, lower the informational rents banks can extract from borrowers, and improve borrower discipline (Jappelli and Pagano 1993, 2000; Padilla and Pagano 1997, 2000). The development of financial markets would generally predict the availability of lower cost external finance for firms (Rajan and Zingales 1998).

This study analyzes the life-cycle profiles of financing costs and the use of credit using a large register-based panel of Finnish firms. This new dataset covers the period 1999-2010 and provides a longer and more recent study period than used in the previous studies. The firms in the sample are on average very small – most of them are micro firms – and thus provide an effective testing ground for the theories of asymmetric information. In addition, the Finnish financial system is bank-based, an institutional setup that provides a good com-

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[4] Studies in labor economics and related literature suggest that the initial periods of career have long-lasting consequences for the rest of the career (e.g., Kahn 2010; Oyer 2006, 2008). Cohorts that graduate during weak economic times face lasting adverse consequences in comparison to cohorts graduating during stronger economic times.

parison point to the studies on more market-orientated financial systems, including the U.S system. The study also differentiates itself from the previous literature by paying careful attention to disentangling age, period, and cohort effects. This identification problem has been largely ignored in the previous corporate finance studies, which have relied on cross-sectional data and, in some instances, short panels. The current study utilizes a number of alternative methods to overcome the identification problem. In particular, the life-cycle profiles estimated from the cross-sectional data and models are compared to more appropriate methods that control for cohort or firm fixed effects. An important feature of the current dataset is that it also includes the widely used commercial credit scores of the firms in the dataset. Thus, the observed creditworthiness of the firms can be controlled in the analysis among other key control variables.

The findings of the paper suggest that the choice of the method affects the conclusions drawn about the relationship between the firm age and the financing costs. The cross-sectional age profiles of financing costs are hump-shaped and consistent with hold-up theories. In contrast, the regressions that control for the cohort or firm fixed effects suggest that the financing costs decrease monotonically as the firms mature, in line with the prediction of Diamond (1989). The findings also suggest that these differences in the age profiles relate to cohort effects. Moreover, the age profiles of the use of credit indicate that firms are more dependent on financial intermediaries in the early periods of their lives.

Several main findings are made about the cohort effects. First, the younger cohorts face lower costs of credit than the older cohorts. While the source of this cohort effect was not formally tested, the longer-term trend of decreasing cohort-specific financing costs would generally appear to be consistent with the hypothesis about the improvements in the financial system and the information environment. The findings also suggest that the younger cohorts are less likely to rely on new bank loans, whereas the measure of the amount of bank financing used suggests a more complex relationship.

Second, the findings suggest that cohorts born in recessions, particularly the Finnish Great Depression and the banking crisis of the 1990s, face higher financing costs and use a smaller amount of bank loans in a persistent fashion. This effect is robust to controlling for the observed creditworthiness of the firms with commercial credit scores. These findings suggest that recessions and the accompanying periods of financial instability could have a lasting impact or stigma on the perceived riskiness of the firms. The findings also suggest that weak economic times could have a lasting impact on firms' use of bank loans. This result could be related to the stigmatizing effects of being born during weak economic times or to the recession-born entrepreneurs' more conservative attitude towards bank financing. Such persistent effects are intriguing and might call for more research to further understand their causes. These findings could also prove useful in the designing of policies to avoid lasting adverse effects from recessions and periods of financial instability.

The remainder of the paper is organized as follows: Section 2 presents the dataset. Section 3 provides an overview of the empirical methods. Sections 4-6 present the empirical results, and Section 7 concludes.

2 DATA

2.1 Data sources

The dataset used in this study consists of a register-based panel of Finnish firms from the period 1999-2010. The panel design is unbalanced and therefore allows firms to enter into and exit from the sample (e.g., because of bankruptcy) during the study horizon. The dataset consists of financial statements and related data compiled from official sources by Asiakastieto ltd, a major information provider of firm and credit data in Finland. The financial statement data originate from the Finnish Trade Register, an official register of Finnish firms. The dataset also contains the commercial credit scores and associated credit ratings of the firms computed by Asiakastieto. Several macroeconomic variables were matched to the dataset, including the aggregate country-level unemployment rates, GDP growth, house prices, and consumer prices, which were obtained from the databases of Statistics Finland. The Finnish government bond yields were obtained from the database of the Bank of Finland.

The estimation sample is restricted to non-farm and non-financial corporations. This restriction helps avoid issues such as differences in the accounting practices from affecting the results.[5] The estimation sample concentrates on the cohorts born between the periods 1970-2009. Because the informational asymmetries are likely to be the most relevant for relatively young firms, the cohorts born before 1970 are dropped from the sample. This helps to control for the additional noise caused by the very few firm observations among the older firms

[5] Corporations are the dominant business form in the dataset, covering 97.58% of the observations in the original dataset over the period 1999-2010. The following industries were not considered relevant for the current study and were dropped from the sample based on the Standard Industry Classification (SIC) 2008, and if not available, SIC 2002: Agriculture, forestry and fishing; Financial and insurance activities; Activities of membership organizations; Public administration and defense; compulsory social security; Activities of extraterritorial organizations and bodies; Industry unknown.

in the age distribution.[6] Firm observations with negative total assets are dropped from the sample.

2.2 Variable definitions

The study analyzes the life-cycle profiles of small firms' cost of credit and use of bank financing. These measures are computed from the financial statement data. *Financing costs* are measured as financial expenses at period t divided by the average outstanding interest-bearing debt between periods t-1 and t.[7] Two alternative measures of the use of external debt financing are utilized as follows. *Obtained loans* is an indicator that takes a value of one if the firms has obtained a positive amount of new loans from financial institutions during the period, and zero otherwise. In the context of this definition, new loans are measured as a difference in the amount of outstanding loans from financial institutions in the balance sheet at the end of periods t and t-1.[8] *Bank debt* is a ratio of outstanding debt from financial institutions scaled by total assets at period t.[9]

The previous empirical banking literature suggests that age, size, and type of business are three key determinants of firms that rely on banking relationships: In particular, younger, smaller, and less transparent firms that have more intangible assets are more difficult to screen successfully (see, e.g., Freixas and Rochet 2008, 105). These findings motivate the selection of the independent variables used in this study. *Firm age* is a key variable of interest in this study. It is also a measure that has been considered as a good proxy for informational asymmetries in the previous corporate finance literature (e.g., Beck et al. 2006; Hyytinen and Pajarinen 2008; Hyytinen and Väänänen 2006). The firm age is calculated by subtracting the year of birth from the current year. The year of birth is defined as the year the firm was registered in the Finnish Trade Register.

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6 In the robustness tests, start-up firms born potentially because of mergers or spinoffs were removed from the sample based on a mechanical rule of dropping firms with net sales larger than or equal to the 99th percentile of the start-up firm distribution, which includes the firms of age one year or less. This did not materially change the estimated life-cycle profiles.

7 The financing cost measure is computed only for the observations in which the financial expenses are positive and non-zero. It would be conceptually problematic to evaluate the effects of firm age on the financing costs if the firms have no financial expenses (see, e.g., Hyytinen and Pajarinen 2007).

8 Note that the analysis aims to be neutral regarding whether the obtaining of bank loans relates to the supply or demand side decisions. It is good to take into account that this indicator does not necessarily measure the supply side constraints of bank loans, simply because some firms may have no demand for bank loans. Note also that since the above indicator is based on the outstanding loans in the balance sheet, it might provide a somewhat crude proxy for the use of new loans.

9 For convenience, these measures are referred to as bank financing in the text. This seems a reasonable shortcut definition because bank loans represent a major fraction of the financing obtained from financial institutions in Finland (see, e.g., Business Financing Survey 2009). It is still worth keeping in mind that loans from financial institutions can generally also cover financing from other financial institutions, including special financing institutions.

The current year refers to the year of the financial statement.[10] Several firm-level control variables are included in the models to control for the observed firm characteristics. Firm size is proxied with *ln(Size)*, which is a natural logarithm of total assets at t-1. *Tangibility* is a proxy for collateralizable assets and defined as a ratio of fixed to total assets at t-1. *Profitability* is measured as earnings before interest, taxes, depreciation, and amortization divided by total assets at t-1. *Credit score* measures the observed creditworthiness of the firms (i.e., the probability of default) at t-1 computed by Asiakastieto.[11] This commercial credit score is defined at the interval 3-99, where low values indicate high creditworthiness and high values indicate low creditworthiness.[12] New firms and firms with no available financial statements have also been rated using a similar methodology. The credit scores for 2006 are not available in the data because of changes in the dataset; therefore, values from the previous period are used in that particular year.[13] *Recession-born* is a dummy that takes a value equal to one if the firm is born during a period of negative real GDP growth (years 1991, 1992, 1993, and 2009) and zero otherwise. An alternative definition of the variable used in the further analysis focuses on the Finnish Great Depression years 1991-1993 alone and removes the year 2009 from that definition.

The industry-specific characteristics are controlled using two-digit–level industry dummies. There was a change in the industry classifications in 2008 that affects the classifications used in the data. Specifically, firms that existed in the earlier periods but did not exist anymore in 2008 were classified using the previous standard industrial classification (SIC) version. In the following analysis, industries are classified using SIC 2008 when available and using SIC 2002 in the other instances. A dummy for the firms classified using SIC 2002 is included in the regressions to take into account the scale differences in the different versions of the classifications. Regional dummies measured at the two-digit zip-code level based on the firms' addresses are also included in the regressions. This controls for the possibility that local credit market characteristics would be reflected in the firms' financing costs. Petersen and Rajan (1995), for instance, argue that the life-cycle profiles of financing costs could differ between competitive and non-competitive markets because monopolistic banks may be able to subsidize younger firms. It is also worth taking into account that firms in certain areas of the country are eligible for more government subsidies than others, which could be reflected in the financing costs. The regional fixed effects provide a way to control for the fixed regional characteristics, including these local credit market characteristics.

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10 In some instances, the method of calculating the firm age resulted in negative ages, in which case, the observation was dropped.

11 It is worth noting that since the credit score provides an overall measure of creditworthiness, it should as such capture the effect of other partial measures of creditworthiness, including leverage.

12 There were also some observations with value 100 in the sample.

13 The transition matrices of the credit ratings and the serial correlations of the credit scores indicate that there is considerable persistence in the creditworthiness of the firms. This suggests that the use of credit score from the previous period provides a reasonable solution for the missing data issue.

The macroeconomic control variables used in some of the specifications are defined as follows: *Unemployment* measures the country-level unemployment rates at period t. *Term spread* measures the difference in the yields of the Finnish government bonds of the maturity of ten and five years at period t, respectively. *House prices growth* measures the growth of the house prices index defined in natural logarithms between periods t-1 and t. *CPI growth* measures the growth of consumer prices defined in natural logarithms between periods t-1 and t. *GDP growth* measures the growth of gross domestic product defined in natural logarithms between periods t-1 and t. The time fixed effects used in other panel specifications provide an alternative way to control for the business cycle fluctuations. It is worth keeping in mind that the time fixed effects absorb the market level of interest rates in the analysis of the cost of credit.

To avoid issues related to large outliers, some of the key variables are trimmed or winsorized as follows: *Financing costs* are trimmed at the 5th and 95th percentile of the distribution to ensure that some observed large outliers are not driving the findings.[14] In this type of measure, outliers could arise, e.g., because of large changes in the amount of outstanding debt near the end of the period that are not reflected in the financial expenses accrued over the year (see, e.g., Bernhardsen and Larsen 2003; Kim et al. 2012). *Bank debt* is trimmed at the values below zero and above one. *Profitability* and *Tangibility* are winsorized at the 1st and 99th percentiles to ensure that outliers in the control variables are not confounding the results. These control variables are winsorized rather than trimmed to avoid any unnecessary loss of observations.

2.3 Descriptive statistics

The panel statistics are provided in table 1. This table reports the number of firms in the panel for each year that the data cover. These numbers indicate that the coverage of the dataset has improved in the recent years.

The descriptive statistics for the key variables used in the estimations are provided in table 2. The average financing costs are 5.5% p.a. (median: 4.6%). Figure 1 indicates that the financing cost distribution shows relatively few extreme observations after the trimming described in the previous section. The dummy for obtaining bank loans indicates that in 16.2% of the firm-year observations, the firms obtained new loans during the period. The mean percentage of bank debt is 13.7% based on the definition of a ratio of bank loans to total assets.

The firms in the sample are on average 11.5 years old. The firm size distribution is highly skewed; the average size of the balance sheet is approximately 2.6 million euros, whereas the median is only approximately 135 000 euros.

[14] This drops out (erroneous) negative values, some unrealistically small (but positive) values and very large values. Note that this trimming does not remove any zero values, which are already removed in the process of forming the variable.

Therefore, a natural logarithm of total assets is used in the estimation as a proxy for firm size. The number of employees, which is not reported in the table, confirms that the firms are mostly very small; the average number of workers is 11.9 persons, while the median is only 2.1 persons. The average ratio of fixed assets to total assets in the balance sheet is 0.272. The profitability measure indicates that the average return on assets before interest, taxes, depreciation and amortization is 14.2%. The average credit score suggests that the firms are on average rated as A+ (i.e., "Satisfactory+") on the seven-step rating scale AAA, AA+, AA, A+, A, B, C. The indicator for recession-born cohorts indicates that 14.9% of the firm-year observations belong to firms born during the periods of negative real GDP growth. The statistics for the macro controls used in some of the models are also provided in the table; the mean unemployment rate during the study period is 8.3%, the average spread between the ten- and five-year government bonds is 0.7 percentage point, the mean house prices growth is 4.8%, the mean CPI growth is 1.4%, and the mean GDP growth is 2.7%.

The correlation matrices for the control variables are provided in table 3. The table indicates that the problem of multicollinearity should not be a significant concern among the firm-specific control variables shown in panel A. The correlations are somewhat higher among the macro controls shown in panel B.

TABLE 1 Panel statistics

Year	Freq.	Percent	Cum.
1999	47 670	5.08	5.08
2000	57 808	6.16	11.24
2001	61 522	6.56	17.80
2002	66 763	7.11	24.91
2003	73 888	7.87	32.78
2004	73 218	7.80	40.59
2005	63 683	6.79	47.37
2006	66 933	7.13	54.50
2007	71 108	7.58	62.08
2008	115 663	12.33	74.41
2009	118 086	12.58	86.99
2010	122 088	13.01	100.00
Total	938 430	100	

The table reports the amount of firm observations in the panel for each year.

TABLE 2 Descriptive statistics

variable	mean	sd	Min	p25	p50	p75	max	NT
Firm characteristics								
Financing costs	0.055	0.038	0.005	0.030	0.046	0.067	0.235	400851
Obtained loans	0.162	0.369	0.000	0.000	0.000	0.000	1.000	701178
Bank debt	0.137	0.227	0.000	0.000	0.000	0.211	1.000	922295
Age	11.531	8.084	0.000	5.000	11.000	17.000	40.000	938430
ln(Size)	11.891	1.887	0.000	10.662	11.820	13.001	23.656	935576
Tangibility	0.272	0.288	0.000	0.032	0.157	0.452	0.992	935576
Profitability	0.142	0.328	-1.500	0.022	0.146	0.299	0.952	935576
Credit score	29.708	20.012	3.000	15.000	26.000	38.000	100.000	797335
Recession-born	0.149	0.356	0.000	0.000	0.000	0.000	1.000	938430
Macro controls								
Unemployment	0.083	0.010	0.064	0.077	0.084	0.090	0.102	938430
Term spread	0.007	0.004	0.001	0.004	0.006	0.010	0.012	938430
House prices growth	0.048	0.034	-0.005	0.006	0.062	0.072	0.084	701594
CPI growth	0.014	0.012	0.000	0.009	0.012	0.025	0.040	659301
GDP growth	0.027	0.045	-0.073	0.031	0.041	0.052	0.081	701594

The table reports the descriptive statistics for the unbalanced panel of Finnish corporations from the period 1999-2010. The statistics include mean, standard deviation, minimum, 25th percentile, 50th percentile, 75th percentile and the maximum of the variables, respectively. The variables are defined as follows: *Financing costs* are financial expenses divided by the average interest bearing debt between t-1 and t. *Obtained loans* is a dummy, which takes a value equal to one if the amount of outstanding debt from financial institutions in the firms' balance sheet is larger in period t than in t-1, and zero otherwise. *Bank debt* is a ratio of loans from financial institutions to total assets. *Age* is the years since the initial incorporation at t. *Ln(Size)* is a natural logarithm of total assets at t-1. *Tangibility* is a ratio of fixed to total assets at t-1. *Profitability* is EBITDA (earnings before interest, taxes, depreciation and amortization) divided by total assets at t-1. *Credit score* measures the observed creditworthiness of the firms (i.e., the probability of default) at the scale 3-99, where higher values mean lower creditworthiness. *Recession-born* is an indicator equal to one if the firm was born during a period of negative real GDP growth (years 1991, 1992, 1993, and 2009), and zero otherwise. *Unemployment* measures the country-level unemployment at t. *Term spread* is a difference in the yields of ten- and five-year Finnish government bonds at t. *House prices growth* measures the country-level growth of house prices measured in natural logarithms between t-1 and t. *CPI growth* measures the growth of consumer prices index measured in natural logarithms between t and t-1. *GDP growth* measures the growth of gross domestic product measured in natural logarithms between t-1 and t. *NT* is the number of firm-year observations.

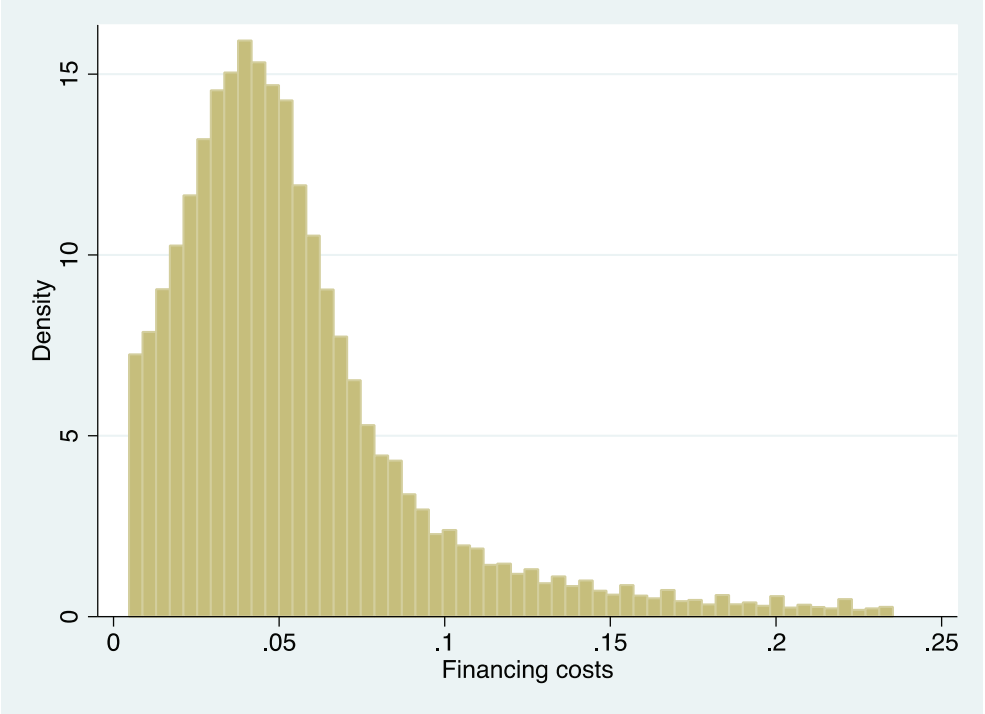

FIGURE 1 Financing cost distribution

The figure shows the distribution of financing costs for the unbalanced panel of Finnish corporations from the period 1999-2010. The financing costs are defined as the financial expenses divided by the average interest bearing debt between periods t-1 and t. The distribution is trimmed at the 5th and 95th percentile to control for outliers.

TABLE 3 Correlation matrices: independent variables

Panel A: Firm-specific controls

	Age	ln(Size)	Tangibil-ity	Profitabil-ity	Credit score	Reces-sion-born
Age	1.000					
ln(Size)	0.166	1.000				
Tangibility	0.002	0.054	1.000			
Profitability	-0.035	0.078	0.042	1.000		
Credit score	-0.244	-0.283	0.109	-0.147	1.000	
Recession-born	0.005	0.004	-0.020	0.000	-0.025	1.000

Panel B: Macro controls

	Unemployment	Term spread	House prices growth	CPI growth	GDP growth
Unemployment	1.000				
Term spread	0.465	1.000			
House prices growth	0.267	0.096	1.000		
CPI growth	-0.629	-0.623	-0.198	1.000	
GDP growth	-0.132	-0.517	0.559	0.549	1.000

The table reports the correlation matrices for the firm and macro controls used in the estimations.

3 EMPIRICAL APPROACH

3.1 Identification of age, period, and cohort effects

The fundamental problem of identifying age, period, and cohort effects is well known in the economics literature, but the issue has been left almost unaddressed in the corporate finance literature.[15] The identification problem is stated as follows: because there is a linear relationship between the age, period, and cohort effects (based on the identity: $Age = Period - Cohort$), it is not possible to identify all of them in the same model without some restrictions (see, e.g., Hall et al. 2005). This makes it difficult to evaluate the life-cycle profiles of small firms' cost and use of credit. Indeed, the modeling and identification of such relationships is complicated for an obvious reason: it is impossible to observe two firms (or entrepreneurs) at the same point in time that have the same age but who are born at different periods (cf. Hall et al. 2005). This is problematic from the point of view of empirical research because the otherwise identical firms that belong to different cohorts could face very different economic environments. This problem could be acute, for instance, if the stage of the business cycle during which the firm is born has persistent effects on the firm for the rest of the periods. The identification problem is equally complicated if the younger cohorts face fundamentally different financial environments than the older cohorts. Such cohort-specific differences could arise because of certain factors, including differences in the availability of credit information, developments in bank screening methods and general developments in the financial system.

The previous economic literature suggests several solutions to the identification problem in various other contexts. Deaton and Paxson (1992) and Attanasio (1998) identify the life-cycle effects as follows: they use a polynomial of

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15 Sakai et al. (2010) provide a short discussion about the issue. Otherwise, the identification problem has been largely ignored in the empirical corporate finance research. Notably, Petersen and Rajan (1995, 419) claim that they can identify the age effects in cross-sectional data under certain assumptions, namely the stationarity of the survival process of firms.

age or age dummies, together with cohort effects, and normalize the time dummies to sum to zero and to be orthogonal to a linear time trend (see also Deaton 1997). Hall et al. (2005) analyze the identification problem related to the life-cycle effects in another context and discuss various approaches for addressing the issue, such as testing which effects are present and constraining some of the cohort, time or age dummies to have equal effects in the same dimension. They also highlight the problems that arise in the presence of unobserved firm-specific heterogeneity; for example, including firm fixed effects removes the cohort effects and renders some of the cohort-based approaches unavailable. However, the firm fixed effects do not eliminate the problem of identifying the age and period effects simultaneously (cf. Hall et al. 2005).

In the context of corporate finance, Sakai et al. (2010) argue that the empirical approach suggested by Deaton and Paxton (1992), Attanasio (1998) and Deaton (1997) could result in the unstable age profiles of financing costs in short panels. They, in turn, focus on analyzing the slope of the age profile of financing costs and control the year effects using a prime lending rate. However, their study does not analyze other aspects of life-cycle effects in small business finance, such as the use of credit, nor does it provide measurements of the magnitude of the age or cohort effects. The current study aims to overcome these shortages by building on the alternative methods suggested in the earlier cohort literature.

3.2 Estimation of life-cycle profiles

The empirical analysis of the study proceeds as follows: First, the age profiles of the cost and use of credit are estimated from yearly cross-sections. This method has been a common practice in the previous corporate finance studies that have often used cross-sectional data because of the limitations of the survey datasets (see, for instance, Petersen and Rajan 1994, 1995). This study investigates whether the cross-sectional age profiles are stable over time and whether there are significant biases in the cross-sectional estimates in comparison to the estimates obtained from other methods. This analysis should help to consider the relevance of cross-sectional age profiles in comparison to the profiles obtained from more appropriate cohort methods.

Second, several alternative identification assumptions are considered in the analysis of the life-cycle profiles, building on the earlier suggested cohort methods and full panel dataset. Consider a general age, period, and cohort effects model (adopted from Hall et al. 2005) to be defined as follows:

$$y_{it} = \underbrace{\mu}_{constant} + \underbrace{\alpha_c}_{\substack{cohort \\ dummies}} + \underbrace{\beta_t}_{\substack{time \\ dummies}} + \underbrace{\gamma_a}_{\substack{age \\ dummies}} + \underbrace{X_{it}'\delta}_{controls} + \underbrace{\varepsilon_{it}}_{\substack{error \\ term}} \quad (1)$$

where y_{it} measures the cost or use of credit, μ is a constant, α_c is the cohort effect, β_t is the period effect, γ_a is the age effect, X_{it} is a vector of control variables, ε_{it} is an error term and $i = 1, \ldots, N$; $c = 1, \ldots, C$; t= $1, \ldots, T$ and $a = 1, \ldots, A$ index firms, cohorts, time periods, and ages, respectively. The estimation of the above model requires that the indicator variables are estimated relative to their reference values. This is implemented by imposing nullity on the coefficients α_1, β_1, and γ_1 that measure the first cohort, period, and age, respectively. This, however, does not remove the collinearity between the age, period, and cohort effects because the variables in the equation are not linearly independent (Hall et al. 2005, 7). Consider the following modifications on equation (1) that allow the identification of the model based on the several alternative identification assumptions:

In the baseline case, the models that contain age dummies (and controls) together with *either* time or cohort dummies are compared to each other (cf. Heathcote et al. 2005). This comparison provides a useful starting point for the analysis and evaluates the relevance of the time versus cohort effects in the cost and use of credit. These first two models are defined in more detail as follows:

The first model includes time dummies but leaves out all the cohort dummies (i.e., α_c is dropped from equation (1)). That is, this model assumes that there are no cohort effects and treats the dataset as a pooled cross-section. The time dummies included in the regressions control for the period-specific effects that might arise, e.g., because of macroeconomic or financial factors such as the market level of interest rates or changes in the supply of credit.

The second model includes cohort dummies but no time dummies (i.e., β_t is dropped from equation (1)). This model accounts for the possibility of the existence of cohort effects in the cost and use of credit but assumes away any time effects, in contrast to the earlier model.

The comparison between these first two models provides an informal evaluation about whether the time or cohort dimension is a more important factor influencing the age profiles of the cost and use of credit. However, these baseline models could as such provide an unsatisfactory solution to the identification problem of the age, period, and cohort effects; that is, failure to control one of these distinct dimensions (period or cohort) could result in spurious findings (Mason et al. 1973). Because of this, the baseline models are compared to other models that aim to identify age, period, and cohort effects in several alternative ways.

In the third model, the identification is achieved by aggregating the cohorts into groups by grouping the cohorts at the four-year level. The grouping of single-year cohorts in this way overcomes the fundamental identification problem (see, e.g., Hall et al. 2005; Levin and Stephan 1991). Hall et al. (2005) note that the grouping of cohorts equates to obtaining the identification of the age effect by comparing closely adjacent ages to each other and assuming that they come from the same cohort. The researchers note, however, that the grouping of cohorts at multi-year intervals may be a less satisfactory solution than utilizing *a priori* information about the cohorts or time periods in the identifica-

tion of the models, as suggested by Rodgers (1982). In the current study, special attention is paid to make sure that the cohort groups are natural and match some key macroeconomic and financial regimes observed, for instance, during the Finnish Great Depression and the banking crisis of the 1990s.

In the fourth model, the time effects are controlled by replacing the time dummies β_t with macroeconomic control variables following the suggestion of Rodgers (1982) (see also Hall et al. 2005; Gourinchas and Parker 2002). Specifically, Rodgers (1982) advocates the inclusion of such measures correlated with the time effects instead of time dummies to circumvent the identification problem. The macroeconomic controls used here include the aggregate country-level unemployment rates, the house prices growth, the spread in the yields of the ten- and five-year Finnish government bonds, the consumer prices index growth and the GDP growth. These variables should capture some key measures of the macroeconomic conditions that are relevant from the point of view of the financial conditions of the firms.

In the fifth model, the identification is obtained by constraining two time dummy coefficients equal to each other. This approach builds on the suggestion of Mason et al. (1973), who note that it is possible to identify the three sets of dummy variables for age, period, and cohort by setting two coefficients equal to each other in the same dimension (see also Hall et al. 2005). In the current study, this approach is implemented by dropping both the first and last time dummies from the model (i.e., setting both β_1 and β_T to zero in equation (1)). This allows for the inclusion of the single-year cohort dummies into the model. Recall that the first cohort dummy is dropped from the model to avoid the dummy variable trap because of the constant term.

In the sixth model, the cohort effects α_c are replaced with firm fixed effects μ_i in equation (1). Additionally, in this case, the identification is obtained by setting two time dummies equal to each other. As was done earlier, the first and last time dummies are dropped from the model, which allows the identification of the model.[16]

The standard errors of the panel data models are adjusted for the firm-level clustering. The cross-sectional regressions based on yearly cross-sections use heteroskedasticity robust standard errors.

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16 The consideration of alternative restrictions on the cohort or time dummies suggests that the results remain somewhat sensitive to the choice of the identification assumption. However, some potential alternatives, such as dropping two subsequent time or cohort dummies, in some instances resulted in negative predicted financing costs for the older firms or unrealistically large financing costs for the younger firms or deviated otherwise from other estimates to such a degree that the credibility of the restrictions were easy to question.

4 LIFE-CYCLE PROFILES OF FINANCING COSTS

4.1 Cross-sectional analysis

The regression results for the life-cycle profiles of financing costs estimated from yearly cross-sections are provided in table 4. The firm age is modeled using a third-order polynomial. The coefficient of age is positive and significant in each yearly cross-section. The coefficients of age squared and age cubed are negative and positive, respectively, and highly significant in almost all cases. These results indicate a non-linear relationship between the firm age and the financing costs. The fitted age profiles based on these models are shown in figure 2. The findings suggest that the life-cycle profiles obtained from the cross-sectional data are hump-shaped. That is, the financing costs of young and old firms are on average lower than those of intermediate age (approximately 10 years). The profiles are relatively similar in different years, although casual examination would suggest that the profiles are somewhat flatter in the years when the monetary policy rates are higher.

TABLE 4 Cross-sectional life-cycle profiles of financing costs

Panel A: Years 2000-2005

	(1)	(2)	(3)	(4)	(5)	(6)
Year	2000	2001	2002	2003	2004	2005
Dependent variable	Financing costs	Financing costs	Financing costs	Financing costs	Financing costs	Financing costs
Age	0.0009***	0.0007***	0.0010***	0.0011***	0.0016***	0.0015***
	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0002)	(0.0002)
Age^2[a]	-0.0072***	-0.0054***	-0.0072***	-0.0081***	-0.0110***	-0.0097***
	(0.0026)	(0.0021)	(0.0018)	(0.0016)	(0.0017)	(0.0017)
Age^3[b]	0.0016***	0.0010**	0.0013***	0.0015***	0.0020***	0.0017***
	(0.0006)	(0.0005)	(0.0004)	(0.0003)	(0.0003)	(0.0003)
ln(Size)	-0.0005***	-0.00004	0.0002	-0.0004***	-0.0027***	-0.0026***
	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Tangibility	0.0030***	0.0058***	0.0049***	0.0009	-0.0071***	-0.0065***
	(0.0009)	(0.0008)	(0.0008)	(0.0007)	(0.0008)	(0.0009)
Profitability	-0.0041***	-0.0055***	-0.0032***	-0.0032***	-0.0006	-0.0004
	(0.0011)	(0.0010)	(0.0009)	(0.0009)	(0.0010)	(0.0011)
Credit score[c]	0.025***	0.025***	0.027***	0.028***	0.025***	0.024***
	(0.0015)	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0013)
Industry FE	YES	YES	YES	YES	YES	YES
Region FE	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES
N	27020	33944	37069	37875	32293	25956
r2	0.036	0.035	0.034	0.040	0.061	0.061

Panel B: Years 2006-2010

	(7)	(8)	(9)	(10)	(11)
Year	2006	2007	2008	2009	2010
Dependent variable	Financing costs	Financing costs	Financing costs	Financing costs	Financing costs
Age	0.0014***	0.0016***	0.0007***	0.0010***	0.0009***
	(0.0002)	(0.0003)	(0.0003)	(0.0002)	(0.0002)
Age^2[a]	-0.0091***	-0.0099***	-0.0036**	-0.0062***	-0.0050***
	(0.0016)	(0.0019)	(0.0017)	(0.0014)	(0.0011)
Age^3[b]	0.0016***	0.0016***	0.0005*	0.0010***	0.0008***
	(0.0003)	(0.0004)	(0.0003)	(0.0003)	(0.0002)
ln(Size)	-0.0021***	-0.0014***	-0.0006***	-0.0022***	-0.0030***
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0001)
Tangibility	-0.0061***	-0.0029***	-0.0018**	-0.0070***	-0.0075***
	(0.0009)	(0.0010)	(0.0009)	(0.0008)	(0.0006)
Profitability	-0.0023**	-0.0035***	-0.0006	0.0006	0.0027***
	(0.0011)	(0.0013)	(0.0012)	(0.0010)	(0.0008)
Credit score[c]	0.022***	0.023***	0.027***	0.023***	0.019***
	(0.0013)	(0.0015)	(0.0015)	(0.0014)	(0.0010)
Industry FE	YES	YES	YES	YES	YES
Region FE	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES
N	27728	23480	27709	32508	44955
r2	0.046	0.038	0.036	0.056	0.071

The table shows the estimates for the financing costs obtained from the separate yearly cross-sections of the years 2000-2010. The dependent variable *Financing costs* is financial expenses divided by the average interest-bearing debt between t-1 and t. The independent variables are defined as follows: *Age*, modeled as a third-order polynomial, is the age of the firm defined as the years since the initial incorporation at t. *Ln(Size)* is a natural logarithm of total assets at t-1. *Tangibility* is a ratio of fixed to total assets at t-1. *Profitability* is EBITDA (earnings before interest, taxes, depreciation and amortization) divided by total assets at t-1. *Credit score* measures the observed creditworthiness of the firms (i.e., the probability of default) at the scale 3-99, where higher values mean lower creditworthiness. The models also include industry dummies measured at the two-digit level, regional dummies measured at the two-digit zip-code level and a constant, which are not reported. *N* is the number of observations. *R2* stands for R-squared. Heteroskedasticity robust standard errors are in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. [a,b,c] The coefficients and standard errors of *age^2*, *age^3, and credit score* have been multiplied by 100, 1000, and 100, respectively.

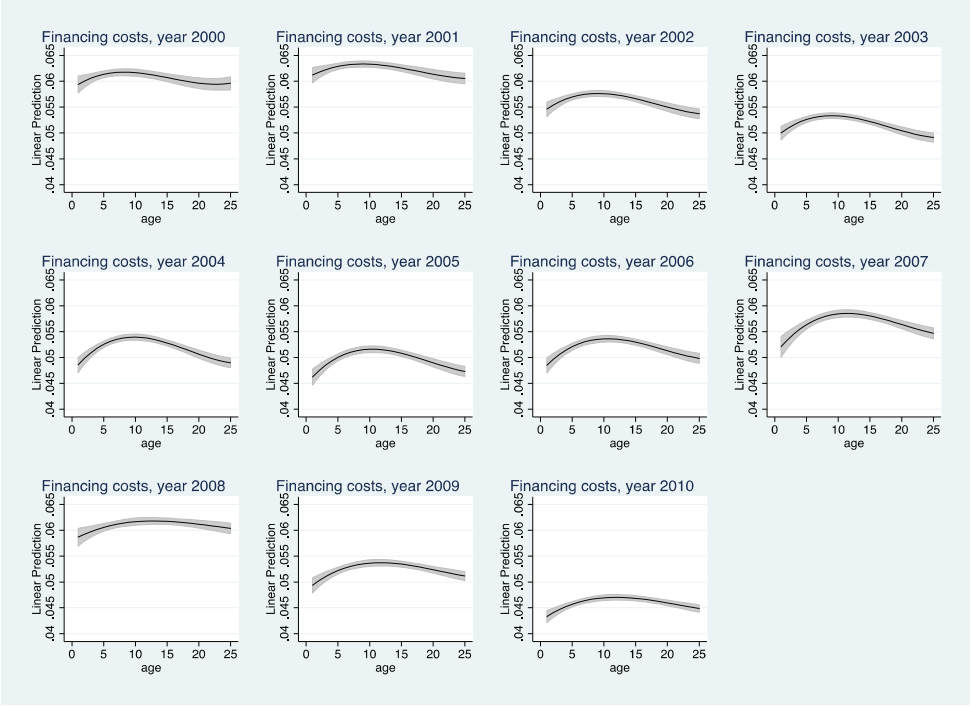

FIGURE 2 Cross-sectional life-cycle profiles of financing costs

The figures show the fitted life-cycle profiles of financing costs and associated 95% confidence intervals estimated from the yearly cross-sections for the years 2000-2010. The models include a third-order polynomial of firm age and the following controls: ln(size), tangibility, profitability, credit score, two-digit industry dummies and two-digit zip-code–level regional dummies.

4.2. Cohort analyses

The summary of the models that analyze the life-cycle profiles of financing costs using the full dataset and alternative identification assumptions is provided in table 5. Firm age is modeled using dummies for each age in each specification. Note that the time fixed effects and macro controls absorb the overall level of market interest rates. The fitted age profiles obtained from the models are presented in figure 3. The pooled panel model (model 1) that controls the time fixed effects provides a hump-shaped age profile, which is very similar to the ones observed in the cross-sectional data. Model 2 replaces the time fixed effects with cohort fixed effects, which results in a downward-sloping age profile. That is, the inclusion of the cohort effects results in substantial changes in the age profiles. Both models 1 and 2 overcome the fundamental identification problem by assuming away one of the dimensions, i.e., time or cohort effects. However, this assumption could result in biased findings if the ignored distinct dimension remains important for the age profiles.

The next models address the identification problem in the following alternative ways: Model 3 includes time dummies together with aggregated cohort dummies, where the birth years are grouped at the four-year level. This model provides somewhat imprecise results in comparison to other cohort models; the findings based on the grouped cohorts suggest a more hump-shaped age profile than with the single-year cohort dummies. Hence, the aggregation of the cohort groups does not seem to provide a particularly accurate way to control for the cohort effects. Model 4 includes single-year cohort dummies and replaces the time dummies with macroeconomic controls, which results in a downward-sloping age profile of financing costs. This relationship is somewhat more pronounced than in model 2, which lacked the period-specific controls. Model 5 includes both time and cohort dummies and obtains the identification by dropping both the first and last of the time dummies. This results in a downward-sloping age profile of financing costs that is also somewhat steeper than in the previous model. Finally, model 6 replaces the cohort fixed effects with firm fixed effects. The identification is obtained by dropping both the first and last time dummies. This model provides a somewhat steeper but otherwise similar age profile as the previous model with cohort dummies.[17]

The control variable estimates seem sensible and provide statistically highly significant findings in most cases. Larger and more profitable firms pay lower financing costs. Firms with more tangible assets in their balance sheet face lower financing costs. In this latter case, the only exception relates to the model with firm fixed effects, in which case the coefficient of tangibility is positive albeit insignificant. Firms with lower credit quality, as indicated by their credit scores, pay more for their credit.

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17 Note that the industry and region dummies are dropped from the fixed effects model given the limited time variation of these variables.

TABLE 5 Life-cycle profiles of financing costs: model summary

	(1)	(2)	(3)	(4)	(5)	(6)
Model	Age, period	Age, cohort	Age, period, avg.cohort	Age, cohort, macro	Age, period, cohort	Age, period, firm
Dependent variable	Financing costs	Financing Costs	Financing costs	Financing costs	Financing costs	Financing costs
ln(Size)	-0.0013***	-0.0012***	-0.0013***	-0.0013***	-0.0013***	-0.0022***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Tangibility	-0.0023***	-0.0027***	-0.0023***	-0.0027***	-0.0023***	0.0004
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0006)
Profitability	-0.0018***	-0.0012***	-0.0018***	-0.0016***	-0.0018***	-0.0022***
	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0003)	(0.0004)
Credit score[a]	0.025***	0.024***	0.025***	0.024***	0.024***	0.0054***
	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Age dummies	YES	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	NO	YES
Cohort FE	NO	YES	YES	YES	YES	NO
Industry FE	YES	YES	YES	YES	YES	NO
Region FE	YES	YES	YES	YES	YES	NO
Time FE	YES	NO	YES	NO	YES	YES
Macro controls	NO	NO	NO	YES	NO	NO
Constant	YES	YES	YES	YES	YES	YES
NT	350537	350537	350537	323517	350537	350558
rho						0.62
r2	0.055	0.042	0.055	0.054	0.055	0.044

The table shows the estimates for the financing costs obtained from the panel regressions over the 2000-2010 period. The dependent variable *Financing costs* is financial expenses divided by the average interest-bearing debt between t and t-1. The independent variables are defined as follows: *Age*, modeled using dummies for each age, is the age of the firm defined as the years since the initial incorporation at t. *Ln(Size)* is a natural logarithm of total assets at t-1. *Tangibility* is a ratio of fixed to total assets at t-1. *Profitability* is EBITDA (earnings before interest, taxes, depreciation and amortization) divided by total assets at t-1. *Credit score* measures the observed creditworthiness of the firms (i.e., the probability of default) at the scale 3-99, where higher values mean lower creditworthiness. The table also reports whether the firm, cohort, industry, region, and time fixed effects, as well as macro controls and a constant, are included in the models. *NT* is the number of firm-year observations. *Rho* measures the intra-class error correlation. *R2* stands for R-squared. Standard errors clustered at the firm level are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
[a] The coefficients and standard errors of *credit score* have been multiplied by 100.

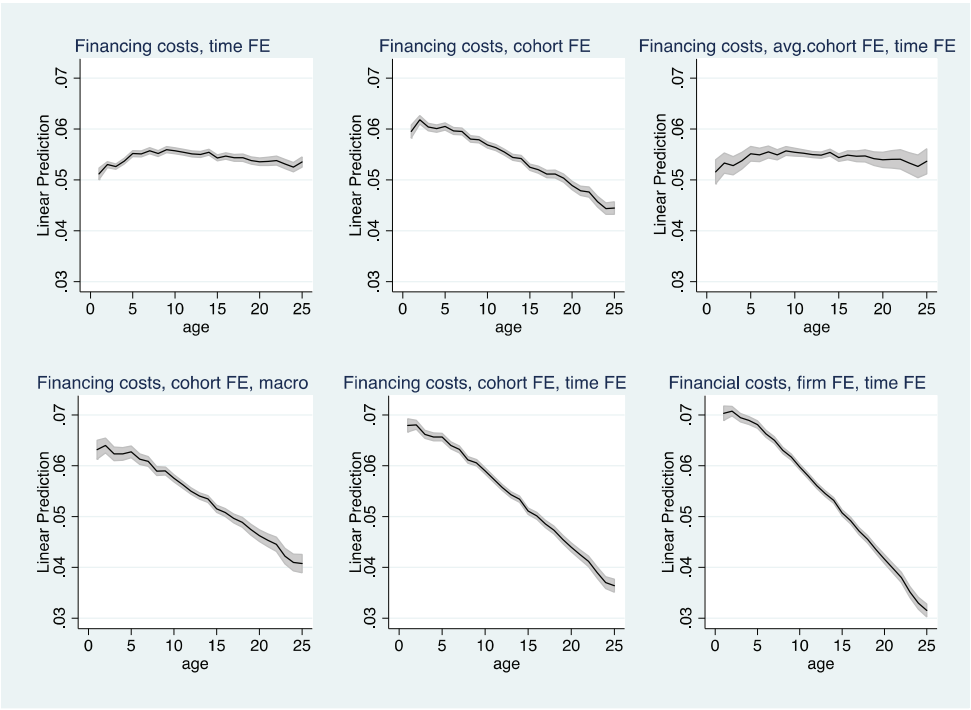

FIGURE 3 Life-cycle profiles of financing costs

The figures show the fitted life-cycle profiles of financing costs and associated 95% confidence intervals from the panel regressions over the period 1999-2010. The models include firm age dummies and the following controls: ln(size), tangibility, profitability and credit score. In addition, two-digit–level industry dummies and two-digit zip-code–level regional dummies are included in specifications 1-5. The models with the following additional controls are estimated: 1) time fixed effects 2) cohort fixed effects 3) cohort fixed effects (birth years grouped at the four-year level) and time fixed effects 4) cohort fixed effects and macro controls 5) cohort and time fixed effects 6) firm and time fixed effects.

The financing cost estimates suggest several key implications: First, the life-cycle profiles of financing costs obtained from the cross-sectional models are in line with the predictions of hold-up theories (e.g., Sharpe 1990, Rajan 1992, von Thadden 2004, and Kim et al. 2012).[18] That is, new firms face lower financing

[18] It is worth noting that the classic two-period hold-up models of Sharpe (1990), Rajan (1992) and von Thadden (2004) focus on banks' private information and do not concentrate explicitly on firm age. Ioannidou and Ongena (2010) also suggest that the hold-up problem could arise each time after the firms switch banks. However, concentration on the firm age rather than other proxies of banks' private information (for example, relationship length) should make little difference in the current context. First, firm age is a well-reasoned proxy for asymmetric information (see, e.g., Hyytinen and Pajarinen 2008). Second, even an assumption that the firms would on average borrow only from one bank does not seem unreasonable. Niskanen and Niskanen (2000) utilize cross-sectional Finnish survey data and provide evidence that the average number of firms' banking relationships (including non-borrowers) is 0.85. The recent survey results support the view that the majority of the firms have few, and in many cases one, bank relationships. Almost 80% of the micro firms and about

costs, which then rise in the following periods until the firm age of these firms reaches approximately ten years. After that, the financing costs begin to decrease. These findings would be consistent with the situation in which banks compete for new customers, who then become locked in after accepting the loan contract. Over time, the informational asymmetry would start to diminish once the firms reach the intermediate age and would become more transparent. Second, the models that control for cohort or firm fixed effects suggest, in contrast, that the financing costs decrease approximately monotonically when the firms mature. This downward-sloping age profile of financing costs is in line with the prediction of Diamond (1989). Taken together, the findings suggest that the alternative methods in disentangling age, period, and cohort effects provide conflicting implications about the relationship between firm age and financing costs.

The comparison between the age profiles obtained from the cross-sectional models and the models that control for cohort or firm fixed effects suggests that the differences between the profiles are related to cohort effects. The following analysis examines the cohort effects in more detail. The fitted cohort-specific financing costs evaluated at the cohort years between 1970 and 2008 are shown in figure 4.[19] This figure shows the mean predicted financing costs for a four-year-old firm born during the period 1970-2008 and based on the 2009 economic environment as captured by time dummies. The findings suggest that the financing costs have a rather smooth downward-sloping profile in terms of cohort year. That is, holding other things constant, the younger cohorts face lower financing costs than the older cohorts. For instance, the predictions suggest that two identical four-year-old firms born in 1975 and 2005 would face financing costs of approximately 9.5% p.a. and 5.2% p.a., respectively, in this economic environment. This is a sizable difference in the cost of credit between the different cohort groups. The alternative cohort profile averaged over all firm ages and time periods is shown in the appendix (figure 1). This alternative cohort profile is very similar to the profile shown here.

50% of the small firms that responded to the survey have only one main lending bank (Business Financing Survey 2012).

19 The predictions evaluated in the youngest cohort group, observed only for one period and during financial crisis, are, not surprisingly, imprecise and not included in the plots. However, this cohort of 2009 is studied in more detail in section 6 among the cohorts born during the Finnish Great Depression and banking crisis of the 1990s.

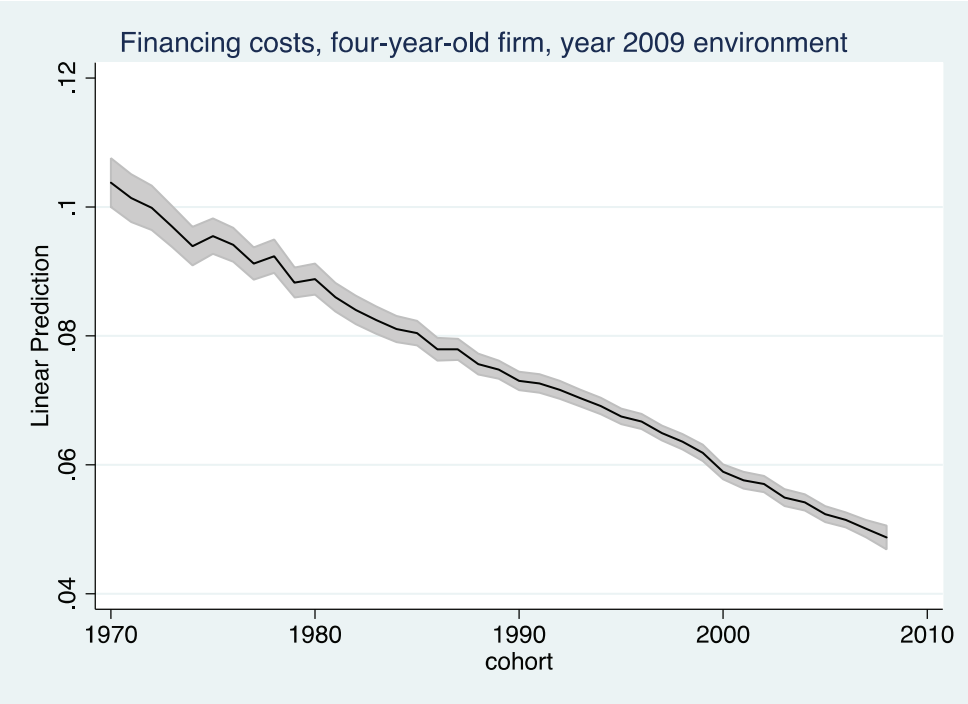

FIGURE 4 Cohort profile of financing costs

The figure shows the predicted financing costs and associated 95% confidence intervals for a four-year-old firm evaluated at the cohort years from 1970 to 2008 and year 2009 economic environment. The estimates are based on the panel regressions over the period 1999-2010. The model includes firm age dummies, single-year cohort dummies and the following controls: ln(size), tangibility, profitability, credit score, two-digit–level industry dummies, two-digit zip-code–level regional dummies and time dummies.

While this analysis does not formally analyze the source of these cohort effects, the previous literature suggests some potential explanations for the findings. The earlier international literature, including a study by Jappelli and Pagano (2000), suggests that the availability of borrower-specific credit information has improved over time because of the birth of credit bureaus and credit rating agencies. Such an improved information environment could generally reduce the adverse selection, lower the informational rents banks can extract from borrowers, and improve borrower discipline (Jappelli and Pagano 1993, 2000; Padilla and Pagano 1997, 2000). Moreover, in the U.S. context, Petersen and Rajan (2002) suggest that in the banking sector, technological innovations, such as credit scoring, have improved the availability of credit for more distant firms. In general, the financial development would reduce the cost of the external finance available to firms (Rajan and Zingales 1998). These predictions from the previous literature appear to be consistent with the observed trend of decreasing cohort-specific financing costs. Section 6 provides a more formal cohort analysis that evaluates whether the cohorts born during recessions and accompanied financial crises show differences in their costs and use of credit.

5 LIFE-CYCLE PROFILES OF BANK FINANCING

5.1 Cross-sectional analysis

The cross-sectional estimates for obtaining bank loans are provided in table 6. The findings suggest that the cross-sectional estimates for this proxy of using bank financing are rather noisy; in most cases, the coefficient of age is negative, but it is statistically significant only in four cases. The fitted life-cycle profiles for the cross-sectional estimates are plotted in figure 5. The findings suggest that the age profiles of obtaining bank loans are gradually downward sloping. However, the estimates based on this measure are rather imprecise in the cross-sectional data.

TABLE 6 Cross-sectional life-cycle profiles of obtaining bank loans

Panel A: Years 2000-2005

	(1)	(2)	(3)	(4)	(5)	(6)
Year	2000	2001	2002	2003	2004	2005
Dependent variable	Obtained loans	Obtained loans	Obtained loans	Obtained loans	Obtained loans	Obtained loans
Age	-0.0020	0.0010	-0.0015	-0.0022	-0.0002	-0.0039*
	(0.0026)	(0.0022)	(0.0020)	(0.0020)	(0.0019)	(0.0020)
Age^2[a]	0.0196	-0.0114	0.0048	0.0117	0.0008	0.0249*
	(0.0213)	(0.0175)	(0.0155)	(0.0146)	(0.0140)	(0.0144)
Age^3[b]	-0.0066	0.0025	-0.0009	-0.0024	-0.0003	-0.0053*
	(0.0050)	(0.0040)	(0.0034)	(0.0031)	(0.0029)	(0.0029)
ln(Size)	0.0203***	0.0218***	0.0195***	0.0194***	0.0239***	0.0246***
	(0.0011)	(0.0010)	(0.0009)	(0.0009)	(0.0009)	(0.0010)
Tangibility	0.129***	0.0973***	0.0816***	0.0816***	0.123***	0.143***
	(0.0082)	(0.0069)	(0.0065)	(0.0063)	(0.0069)	(0.0079)
Profitability	-0.0110*	-0.0043	-0.0040	-0.0070	-0.0090*	-0.0175***
	(0.0063)	(0.0058)	(0.0054)	(0.0052)	(0.0050)	(0.0056)
Credit score[c]	0.112***	0.133***	0.152***	0.148***	0.155***	0.130***
	(0.0116)	(0.0098)	(0.0096)	(0.0094)	(0.0093)	(0.0102)
Industry FE	YES	YES	YES	YES	YES	YES
Region FE	YES	YES	YES	YES	YES	YES

Constant	YES	YES	YES	YES	YES	YES
N	39098	49188	53174	56737	57437	46552
r2	0.040	0.039	0.037	0.039	0.044	0.049

Panel B: Years 2006-2010

	(7)	(8)	(9)	(10)	(11)
Year	2006	2007	2008	2009	2010
Dependent variable	Obtained loans	Obtained loans	Obtained loans	Obtained loans	Obtained loans
Age	-0.0006	0.0003	-0.0036*	-0.0029*	-0.0031***
	(0.0019)	(0.0023)	(0.0020)	(0.0016)	(0.0012)
Age^2[a]	-0.0048	-0.0035	0.0133	0.0132	0.0114
	(0.0132)	(0.0149)	(0.0126)	(0.0099)	(0.0074)
Age^3[b]	0.0012	0.0003	-0.0017	-0.0022	-0.0016
	(0.0026)	(0.0028)	(0.0023)	(0.0018)	(0.0013)
ln(Size)	0.0285***	0.0289***	0.0291***	0.0225***	0.0235***
	(0.0010)	(0.0011)	(0.0010)	(0.0008)	(0.0006)
Tangibility	0.123***	0.148***	0.142***	0.0948***	0.0770***
	(0.0076)	(0.0084)	(0.0076)	(0.0058)	(0.0043)
Profitability	-0.0107*	-0.0230***	-0.0037	-0.0148***	-0.0041
	(0.0056)	(0.0065)	(0.0056)	(0.0045)	(0.0032)
Credit score[c]	0.179***	0.210***	0.174***	0.151***	0.0901***
	(0.0103)	(0.0114)	(0.0109)	(0.0091)	(0.0064)
Industry FE	YES	YES	YES	YES	YES
Region FE	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES
N	50088	41572	49525	61656	93782
r2	0.051	0.056	0.050	0.037	0.038

The table shows the estimates of obtaining bank loans from the separate yearly cross-sections of the years 2000-2010. The dependent variable *Obtained loans* is an indicator equal to one if the amount of outstanding bank loans in the balance sheet is larger in period t than in period t-1, and zero otherwise. The independent variables are defined as follows: *Age*, modeled as a third-order polynomial, is the age of the firm defined as the years since the initial incorporation at t. *Ln(Size)* is a natural logarithm of total assets at t-1. *Tangibility* is a ratio of fixed to total assets at t-1. *Profitability* is EBITDA (earnings before interest, taxes, depreciation and amortization) divided by total assets at t-1. *Credit score* measures the observed creditworthiness of the firms (i.e., the probability of default) at the scale 3-99, where higher values mean lower creditworthiness. The models also include industry dummies measured at the two-digit level, regional dummies measured at the two-digit zip-code level and a constant, which are not reported. *N* is the number of observations. *R2* stands for R-squared. Heteroskedasticity robust standard errors are in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. [a,b,c] The coefficients and standard errors of *age^2, age^3, and credit score* have been multiplied by 100, 1000, and 100, respectively.

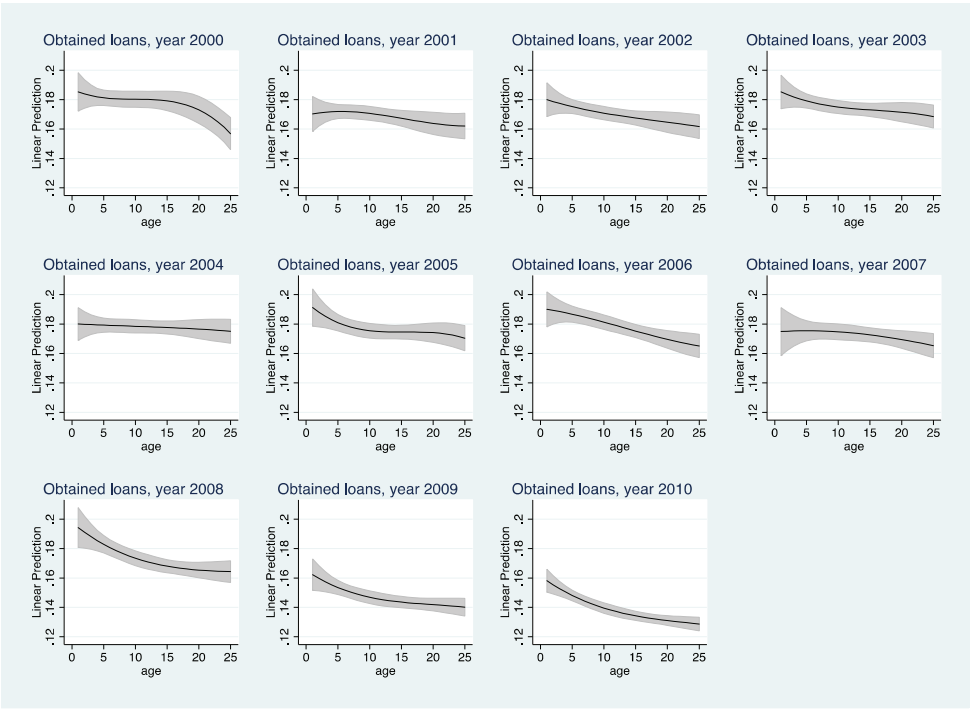

FIGURE 5 Cross-sectional life-cycle profiles of obtaining bank loans

The figures show the fitted life-cycle profiles of obtaining bank loans and associated 95% confidence intervals estimated from the yearly cross-sections between the years 2000-2010. The models include a third-order polynomial of firm age and the following controls: ln(size), tangibility, profitability, credit score, two-digit industry dummies and two-digit zip-code–level regional dummies.

The amount of bank debt used provides an alternative measure to analyze the firms' use of external finance. The cross-sectional estimates of the life-cycle profiles of bank debt, scaled by total assets, are provided in table 7. The coefficient of age is negative and statistically highly significant. The coefficients of age squared and age cubed are positive and negative, respectively. The nonlinear terms are also highly significant, with the exception of 2007. The fitted life-cycle profiles obtained from the cross-sectional models are shown in figure 6. The findings indicate that the age profiles of bank debt are s-shaped in the earlier periods, and the downward-sloping relationship is more pronounced in the later years.

TABLE 7 Cross-sectional life-cycle profiles of bank debt

Panel A: Years 2000-2005

	(1)	(2)	(3)	(4)	(5)	(6)
Year	2000	2001	2002	2003	2004	2005
Dependent variable	Bank debt	Bank debt	Bank debt	Bank debt	Bank debt	Bank debt
Age	-0.0057***	-0.0038***	-0.0051***	-0.0062***	-0.0055***	-0.0052***
	(0.0014)	(0.0012)	(0.0011)	(0.0011)	(0.0010)	(0.0011)
Age^2[a]	0.0462***	0.0300***	0.0336***	0.0368***	0.0321***	0.0297***
	(0.0107)	(0.0092)	(0.0083)	(0.0076)	(0.0072)	(0.0074)
Age^3[b]	-0.0110***	-0.0068***	-0.0068***	-0.0070***	-0.0062***	-0.0057***
	(0.0025)	(0.0021)	(0.0018)	(0.0016)	(0.0015)	(0.0015)
ln(Size)	0.0128***	0.0144***	0.0146***	0.0158***	0.0177***	0.0167***
	(0.0006)	(0.0005)	(0.0005)	(0.0005)	(0.0005)	(0.0005)
Tangibility	0.213***	0.189***	0.186***	0.186***	0.212***	0.231***
	(0.0051)	(0.0044)	(0.0041)	(0.0040)	(0.0042)	(0.0047)
Profitability	-0.0663***	-0.0537***	-0.0410***	-0.0446***	-0.0514***	-0.0577***
	(0.0037)	(0.0034)	(0.0030)	(0.0030)	(0.0031)	(0.0034)
Credit score[c]	0.180***	0.224***	0.239***	0.237***	0.222***	0.221***
	(0.0063)	(0.0056)	(0.0054)	(0.0054)	(0.0051)	(0.0057)
Industry FE	YES	YES	YES	YES	YES	YES
Region FE	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES
N	38772	48817	52770	56294	56932	46175
r2	0.175	0.184	0.185	0.185	0.192	0.203

Panel B: Years 2006-2010

	(7)	(8)	(9)	(10)	(11)
Year	2006	2007	2008	2009	2010
Dependent variable	Bank debt	Bank debt	Bank debt	Bank debt	Bank debt
Age	-0.0040***	-0.0024**	-0.0069***	-0.0088***	-0.0085***
	(0.0010)	(0.0012)	(0.0011)	(0.0010)	(0.0007)
Age^2[a]	0.0204***	0.0105	0.0317***	0.0382***	0.0341***
	(0.0067)	(0.0075)	(0.0067)	(0.0059)	(0.0045)
Age^3[b]	-0.0038***	-0.0020	-0.0050***	-0.0055***	-0.0048***
	(0.0013)	(0.0014)	(0.0012)	(0.0011)	(0.0008)
ln(Size)	0.0192***	0.0186***	0.0227***	0.0254***	0.0274***
	(0.0005)	(0.0006)	(0.0006)	(0.0005)	(0.0004)
Tangibility	0.222***	0.242***	0.241***	0.228***	0.193***
	(0.0046)	(0.0051)	(0.0047)	(0.0041)	(0.0032)
Profitability	-0.0498***	-0.0609***	-0.0537***	-0.0545***	-0.0341***
	(0.0034)	(0.0039)	(0.0035)	(0.0031)	(0.0022)
Credit score[c]	0.260***	0.247***	0.252***	0.267***	0.248***
	(0.0057)	(0.0062)	(0.0065)	(0.0061)	(0.0045)
Industry FE	YES	YES	YES	YES	YES
Region FE	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES
N	49656	41260	48930	60646	91695
r2	0.208	0.211	0.201	0.209	0.200

The table shows the estimates of the amount of bank debt used, obtained from the separate yearly cross-sections of the years 2000-2010. The dependent variable *Bank debt* is a ratio of outstanding loans from financial institutions divided by total assets at t. The independent variables are defined as follows: *Age*, modeled as a third-order polynomial, is the age of the firm defined as the years since the initial incorporation at t. *Ln(Size)* is a natural logarithm of total assets at t-1. *Tangibility* is a ratio of fixed to total assets at t-1. *Profitability* is EBITDA (earnings before interest, taxes, depreciation and amortization) divided by total assets at t-1. *Credit score* measures the observed creditworthiness of the firms (i.e., the probability of default) at the scale 3-99, where higher values mean lower creditworthiness. The models also include industry dummies measured at the two-digit level, regional dummies measured at the two-digit zip-code level and a constant, which are not reported. *N* is the number of observations. *R2* stands for R-squared. Heteroskedasticity robust standard errors are in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. ^{a,b} The coefficients and standard errors of *age^2*, *age^3, and credit score* have been multiplied by 100, 1000, and 100, respectively.

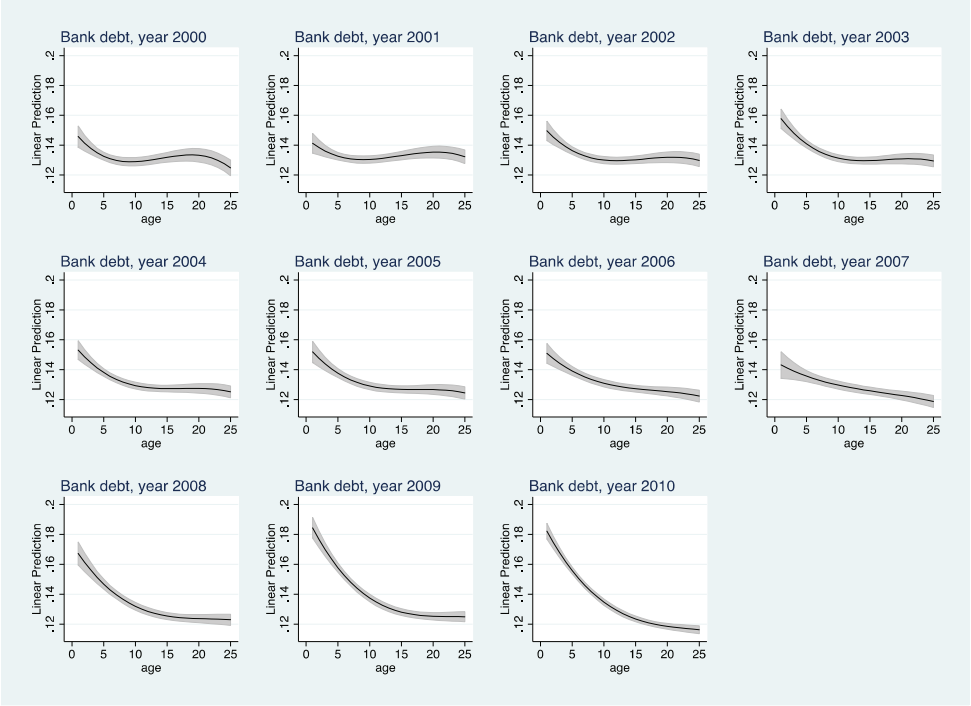

FIGURE 6 Cross-sectional life-cycle profiles of bank debt

The figures show the fitted life-cycle profiles of the amount of bank debt used and associated 95% confidence intervals estimated from the yearly cross-sections for the years 2000-2010. The models include a third-order polynomial of firm age and the following controls: ln(size), tangibility, profitability, credit score, two-digit industry dummies and two-digit zip-code–level regional dummies.

5.2 Cohort analyses

The summary of the models for obtaining bank loans based on the full dataset and alternative identification assumptions is provided in table 8. The fitted life-cycle profiles based on these estimates are provided in figure 7. The findings indicate that the shape of the age profile is relatively flat or only gradually downward sloping in the pooled panel model (model 1), which includes the time fixed effects but no controls for the cohort effects. The inclusion of the single-year cohort or firm fixed effects makes the downward-sloping relationship more pronounced (models 2, 4, 5, and 6). This relationship is particularly pronounced in model 4, which replaces the time dummies with macro controls. Model 3, which is based on the aggregated cohort effects, results in somewhat imprecise profiles and suggests that the grouped cohorts may provide a rather crude proxy of the cohort effects. The findings from the cohort and firm fixed effects models seem generally consistent with the hypothesis that firms are more dependent on the financial intermediaries in the early periods of their lives, as suggested by Diamond (1991).

The control variable estimates of models 1-5 indicate that larger firms and firms with more tangible assets are more likely to resort to obtaining new bank loans. This suggests that such firms could demand more external finance and be more likely to obtain financing given their lower informational opaqueness and higher amount of collateralizable assets. These models also suggest that less-profitable firms and firms of lower credit quality are more likely to rely on bank loans. The only exception to these findings relates to model 6, which includes firm fixed effects. In this model, the control variables reverse their signs. The alternative measure of bank loans studied next also provides a robustness check for these findings.

TABLE 8 Life-cycle profiles of obtaining bank loans: model summary

	(1)	(2)	(3)	(4)	(5)	(6)
Model	Age, period	Age, cohort	Age, period, avg.cohort	Age, cohort, macro	Age, period, cohort	Age, period, firm
Dependent variable	Obtained loans	Obtained loans	Obtained loans	Obtained loans	Obtained loans	Obtained loans
ln(Size)	0.0234***	0.0235***	0.0234***	0.0236***	0.0234***	-0.0297***
	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0004)	(0.0011)
Tangibility	0.103***	0.103***	0.103***	0.102***	0.103***	-0.0646***
	(0.0025)	(0.0025)	(0.0025)	(0.0025)	(0.0025)	(0.0049)
Profitability	-0.0079***	-0.0068***	-0.0081***	-0.0077***	-0.0080***	0.0375***
	(0.0017)	(0.0017)	(0.0017)	(0.0017)	(0.0017)	(0.0021)
Credit score[a]	0.142***	0.141***	0.142***	0.144***	0.142***	-0.104***
	(0.0033)	(0.0033)	(0.0033)	(0.0033)	(0.0033)	(0.0045)
Age dummies	YES	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	NO	YES
Cohort FE	NO	YES	YES	YES	YES	NO
Industry FE	YES	YES	YES	YES	YES	NO
Region FE	YES	YES	YES	YES	YES	NO
Time FE	YES	NO	YES	NO	YES	YES
Macro controls	NO	NO	NO	YES	NO	NO
Constant	YES	YES	YES	YES	YES	YES
NT	598809	598809	598809	559711	598809	598862
rho						0.393
r2	0.040	0.040	0.040	0.041	0.040	0.006

The table shows the estimates of obtaining bank loans using the panel regressions over the period 1999-2010. The dependent variable *Obtained loans* is an indicator equal to one if the amount of outstanding bank loans in the balance sheet is larger in period t than in period t-1, and zero otherwise The independent variables are defined as follows: *Age*, modeled using dummies for each age, is the age of the firm defined as the years since the initial incorporation at t. *Ln(Size)* is a natural logarithm of total assets at t-1. *Tangibility* is a ratio of fixed to total assets at t-1. *Profitability* is EBITDA (earnings before interest, taxes, depreciation and amortization) divided by total assets at t-1. *Credit score* measures the observed creditworthiness of the firms (i.e., the probability of default) at the scale 3-99, where higher values mean lower creditworthiness. The table also reports whether the firm, cohort, industry, region and time fixed effects, as well as macro controls and a constant, are included in the models. *NT* is the number of firm-year observations. *Rho* measures the intra-class error correlation. *R2* stands for R-squared. Standard errors clustered at the firm level are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. [a] The coefficients and standard errors of *credit score* have been multiplied by 100.

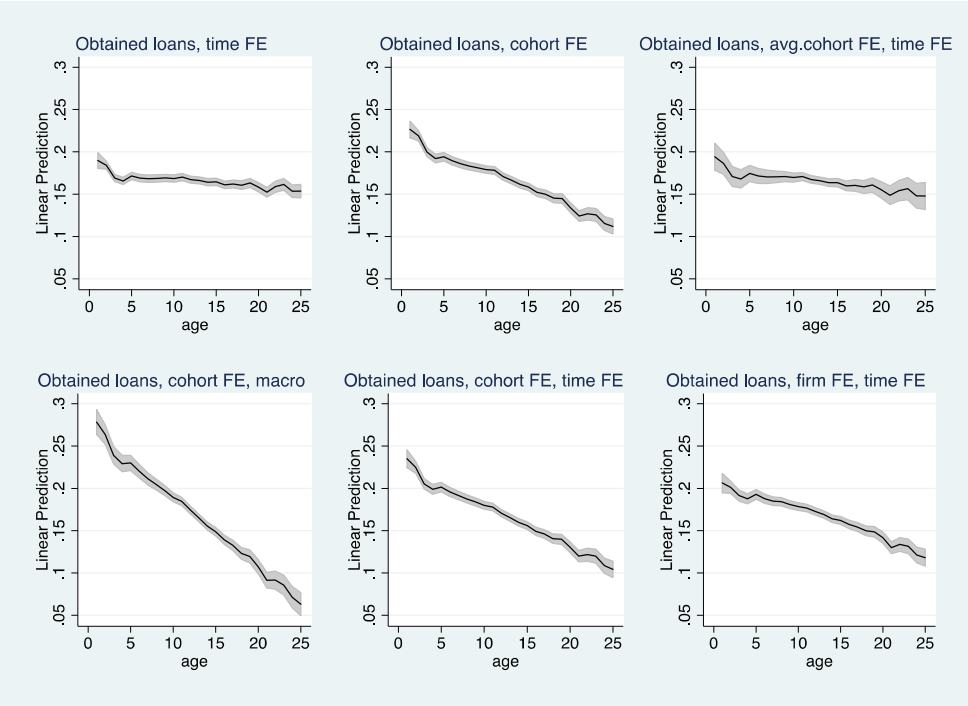

FIGURE 7 Life-cycle profiles of obtaining bank loans

The figures show the fitted life-cycle profiles of obtaining new bank loans and associated 95% confidence intervals for the panel regressions over the period 1999-2010. The models include firm age dummies and the following controls: ln(size), tangibility, profitability and credit score. In addition, two-digit–level industry dummies and two-digit zip-code–level regional dummies are included in specifications 1-5. The models with the following additional controls are estimated: 1) time fixed effects 2) cohort fixed effects 3) cohort fixed effects (birth years grouped at the four-year level) and time fixed effects 4) cohort fixed effects and macro controls 5) cohort and time fixed effects 6) firm and time fixed effects.

The summary of the models for the amount of bank debt used based on the full dataset and alternative identification assumptions is provided in table 9. The fitted life-cycle profiles obtained from these models are shown in figure 8. The findings suggest that the age profiles of bank debt are generally downward sloping. The pooled panel model (model 1) and the models with the single-year cohort fixed effects (models 2, 4, 5) provide rather similar profiles. Model 3, which uses the cohort fixed effects based on the grouped cohorts, provides somewhat imprecise results. The downward-sloping age profile becomes steeper when the firm fixed effects are controlled for (model 6). The findings confirm the results observed in the case of the previous bank loan measure, demonstrating that firms are more dependent on bank financing in the earlier periods of their lives.

The control variable estimates are in line with the expectations and provide further support for the findings observed earlier; that is, larger firms and firms with more tangible assets use more bank debt. More-profitable firms and

firms of higher observed creditworthiness use less bank debt. The findings seem consistent with the hypothesis that borrowers with lower credit ratings are more dependent on the monitoring provided by banks, as predicted by Diamond (1991). The signs of the control variables do not appear to be sensitive to the inclusion of firm fixed effects in this case (see model 6).

TABLE 9 Life-cycle profiles of bank debt: model summary

	(1)	(2)	(3)	(4)	(5)	(6)
Model	Age, period	Age, cohort	Age, period, avg.cohort	Age, cohort, macro	Age, period, cohort	Age, period, firm
Dependent variable	Bank debt	Bank debt	Bank debt	Bank debt	Bank debt	Bank debt
ln(Size)	0.0195***	0.0194***	0.0194***	0.0198***	0.0194***	0.0383***
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0007)
Tangibility	0.209***	0.209***	0.209***	0.208***	0.209***	0.110***
	(0.0023)	(0.0023)	(0.0024)	(0.0024)	(0.0023)	(0.0029)
Profitability	-0.0473***	-0.0469***	-0.0474***	-0.0462***	-0.0474***	-0.0501***
	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0011)
Credit score[a]	0.235***	0.234***	0.235***	0.239***	0.235***	0.0597***
	(0.0026)	(0.0026)	(0.0026)	(0.0027)	(0.0026)	(0.0022)
Age dummies	YES	YES	YES	YES	YES	YES
Firm FE	NO	NO	NO	NO	NO	YES
Cohort FE	NO	YES	YES	YES	YES	NO
Industry FE	YES	YES	YES	YES	YES	NO
Region FE	YES	YES	YES	YES	YES	NO
Time FE	YES	NO	YES	NO	YES	YES
Macro controls	NO	NO	NO	YES	NO	NO
Constant	YES	YES	YES	YES	YES	YES
NT	591947	591947	591947	553175	591947	591999
rho						0.737
r2	0.191	0.192	0.192	0.193	0.192	0.043

The table shows the estimates for the amount of bank debt used, obtained from the panel regressions over the period 1999-2010. The dependent variable *Bank debt* is a ratio of outstanding loans from financial institutions divided by total assets at t. The independent variables are defined as follows: *Age*, modeled using dummies for each age, is the age of the firm defined as the years since the initial incorporation at t. *Ln(Size)* is a natural logarithm of total assets at t-1. *Tangibility* is a ratio of fixed to total assets at t-1. *Profitability* is EBITDA (earnings before interest, taxes, depreciation and amortization) divided by total assets at t-1. *Credit score* measures the observed creditworthiness of the firms (i.e., the probability of default) at the scale 3-99, where higher values mean lower creditworthiness. The table also reports whether the firm, cohort, industry, region and time fixed effects, as well as macro controls and a constant, are included in the models. *NT* is the number of firm-year observations. *Rho* measures the intra-class error correlation. *R2* stands for R-squared. Standard errors clustered at the firm level are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
[a] The coefficients and standard errors of *credit score* have been multiplied by 100.

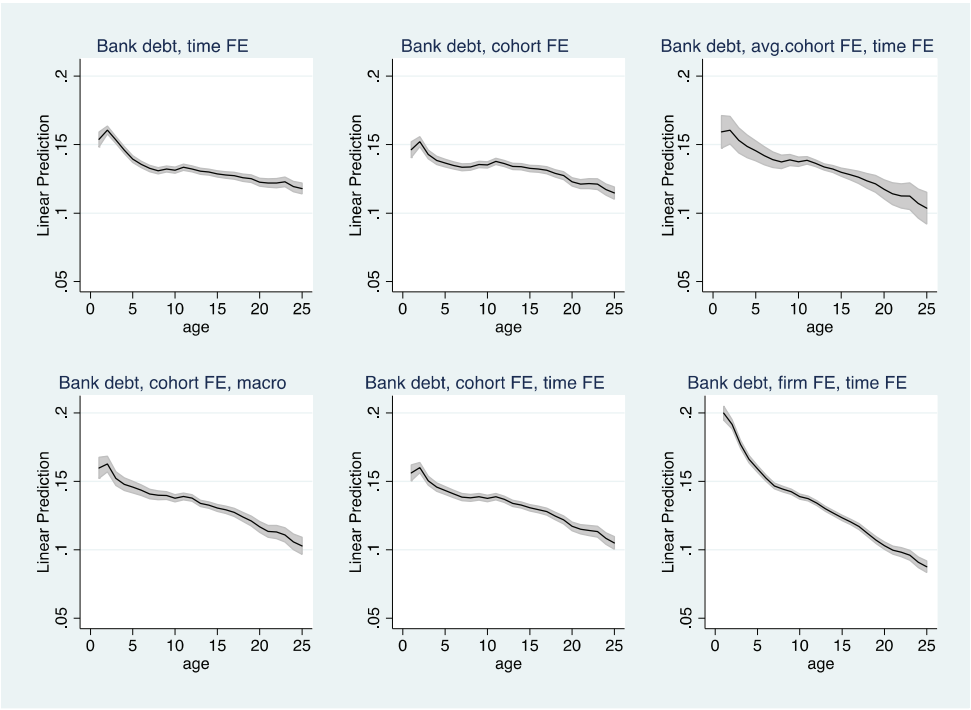

FIGURE 8 Life-cycle profiles of bank debt

The figures show the fitted life-cycle profiles of the amount of bank debt used and associated 95% confidence intervals for the panel regressions over the period 1999-2010. The models include firm age dummies and the following controls: ln(size), tangibility, profitability and credit score. In addition, two-digit-level industry dummies and two-digit zip-code–level regional dummies are included in specifications 1-5. The models with the following additional controls are estimated: 1) time fixed effects 2) cohort fixed effects 3) cohort fixed effects (birth years grouped at the four-year level) and time fixed effects 4) cohort fixed effects and macro controls 5) cohort and time fixed effects 6) firm and time fixed effects.

The fitted cohort profile for the measure of obtaining bank loans is provided in figure 9. The figure shows the predicted cohort profile for a four-year-old firm born between the periods 1970-2008 and in the year 2009 economic environment. The alternative cohort profile averaged over all firm ages and time periods is shown in the appendix (figure 2). The findings indicate that the profile for the indicator of obtaining bank loans is rather smoothly downward sloping in terms of cohort year. That is, the older cohorts are more likely to resort to new bank loans than the younger cohorts. The predicted values for obtaining new bank loans for two identical four-year-old firms born in 1975 and 2005 are approximately 0.262 and 0.151, respectively, in the year 2009 economic environment. The data suggest that the firm from the cohort of 1975 is approximately 11 percentage points (i.e., 74%) more likely to resort to new bank loans than the identical firm from the cohort of 2005. This flow measure of the use of bank loans suggests that there are significant differences between the older and the younger cohorts in their use of bank loans.

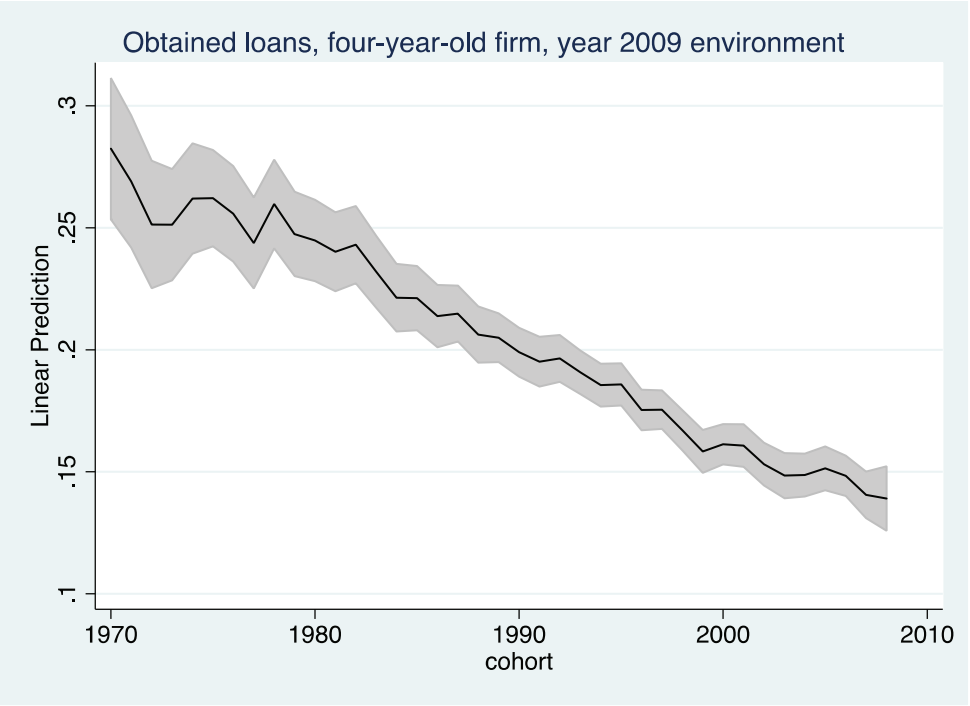

FIGURE 9 Cohort profile of obtaining bank loans

The figure shows the predictions of obtaining bank loans and associated 95% confidence intervals for a four-year-old firm evaluated at the cohort years from 1970 to 2008 and year 2009 economic environment. The estimates are based on the panel regressions over the period 1999-2010. The model includes firm age dummies, single-year cohort dummies and the following controls: ln(size), tangibility, profitability, credit score, two-digit–level industry dummies, two-digit zip-code–level regional dummies and time dummies.

Figure 10 shows the predicted cohort profile of the amount of bank debt used for a four-year-old firm born between the periods 1970-2008, and based on the economic environment of year 2009. The alternative cohort profile averaged over all firm ages and time periods is shown in the appendix (figure 3). The findings on this measure suggest that the cohorts born in the 1970s use more bank debt than the cohorts born in the 1980s and in the 1990s. The predicted values are lowest among the cohorts born in the 1990s, which is also the period of the Finnish Great Depression and banking crisis. The figure also indicates that the use of bank debt increases among the cohorts born in the early or mid-2000s and then decreases sharply among the cohorts born closer to the end of the decade. The predicted values of bank debt for two identical four-year-old firms born in 1975 and 2005 are 0.172 and 0.156, respectively, in the year 2009 economic environment. In comparison, an identical four-year-old firm from the intermediate cohort of 1995 has a predicted value of 0.145 in this environment, which is a lower estimate than obtained for the other two cohorts. In summary, the amount of bank debt used suggests a more complex relationship for the cohort effects than the indicator for obtaining new bank loans. The following sec-

tion complements the analysis by focusing in more detail on the cohorts born during recessions and financial crises.

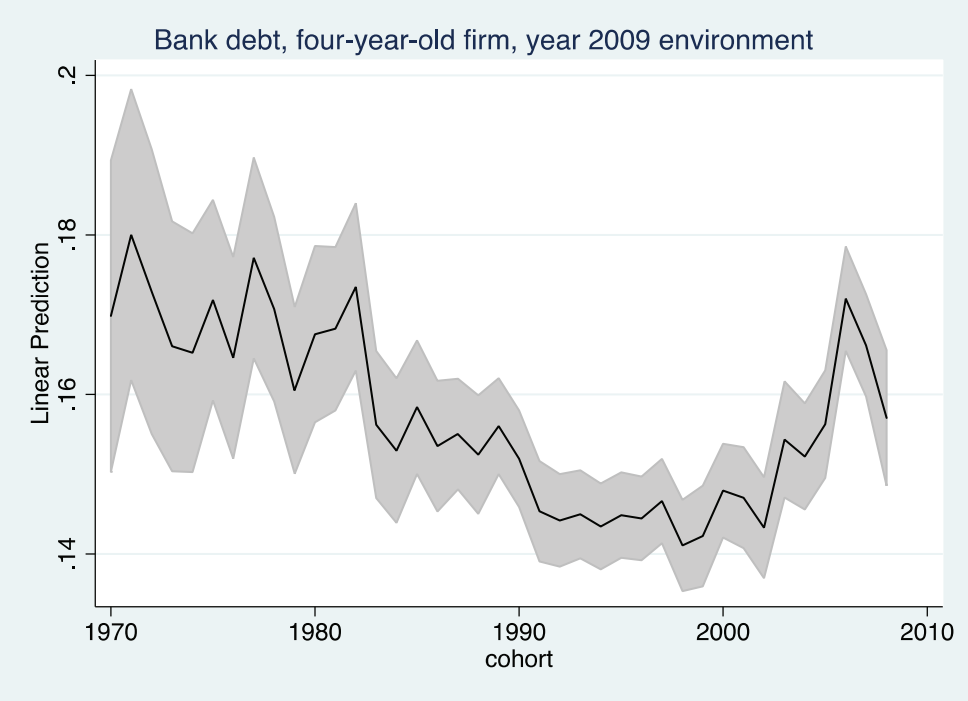

FIGURE 10 Cohort profile of bank debt

The figure shows the predicted amount of bank debt used and associated 95% confidence intervals for a four-year-old firm evaluated at the cohort years from 1970 to 2008 and year 2009 economic environment. The estimates are based on the panel regressions over the period 1999-2010. The model includes firm age dummies, single-year cohort dummies and the following controls: ln(size), tangibility, profitability, credit score, two-digit–level industry dummies, two-digit zip-code–level regional dummies and time dummies.

6 RECESSION COHORTS

This section provides a further evaluation of the sources of the cohort effects. The following analysis studies whether the cohorts born during severe recessions show persistent differences in their costs and use of credit. The main focus of the analysis is on the recession-born dummy, which takes a value equal to one if the firm was born during recession, and zero otherwise. Recessions are defined in this context as a year of negative real GDP growth. Based on this definition, the years 1991, 1992, 1993, and 2009 are defined as recession years. The real GDP contracted during these years by 6%, 3.5%, 0.8% and 8.4%, respectively, according to data from Statistics Finland. These economic contractions reflect two major financial crises that are described in more detail below.

Finland suffered a great depression and banking crisis in the 1990s after the collapse of the Soviet Union – its trade partner – and the boom and bust followed by the liberalization of the Finnish financial markets.[20] The resulting economic contraction in Finland during the period 1991-1993 turned out to be the deepest contraction experienced by an industrialized country since the 1930s (see, e.g., Gorodnichenko et al. 2012). Honkapohja and Koskela (1999) document that trade with the Soviet Union collapsed almost overnight by 70% in 1991. Their analysis suggests that financial factors were a key propagation mechanism for the crisis. After the revaluation of the currency in 1989, Finland had to defend its currency peg from speculative attacks, which kept real interest rates high and short-term rates volatile. The household and firm sectors had become highly indebted because of rapid lending growth in the boom period. Moreover, a large fraction of the corporate borrowing was in foreign currency terms. The hard currency policy was eventually abandoned, which resulted in the depreciation of the Finnish markka in 1991 and 1992 after the forced devaluation and floatation of the currency, respectively. The asset price collapse and the corporate bankruptcies resulted in a banking crisis. Real house prices had

[20] See, e.g., Gorodnichenko et al. (2012) and Honkapohja and Koskela (1999) for analyses about the Finnish great depression. See, e.g., Honkapohja (2009) and Vihriälä (1996, 1997) for descriptions about the Finnish banking crisis and the financial environment of that period.

risen rapidly in the boom period, only to collapse from the top observed at the end of 1980s to approximately half of their previous value after the financial crisis that accompanied the depression (see, e.g., Honkapohja 2009).

The Finnish banking sector came close to collapse during the worst years of the depression in 1991-1993, requiring a massive government intervention and restructuring with capital injections and guarantees. The situation stabilized somewhat in 1993, although the banks continued to post losses in 1994 and 1995 despite the improvements in the overall economic situation. The final cost of the banking sector interventions amounted to approximately ten percent of the Finnish annual GDP. Nearly 90 percent of the total bank support commitments went to the savings bank group, in particular their central institution Skopbank, and STS bank, which together accounted for approximately 60 percent of the banking sector losses within the period of 1991-1995. (Vihriälä 1997, 37-40.) More recently, the international financial crisis that followed the collapse of the U.S. investment bank Lehman Brothers caused a large contraction in the Finnish GDP in 2009. The side effects of the crisis were also reflected in the Finnish credit markets, with surveys reporting that approximately 40 percent of micro firms and more than one-fourth of other firms reported financing difficulties – a sharp increase from the previous years (Business Financing Survey 2009). Taken together, these two significant economic contractions and the accompanying financial crises provide an effective testing ground for analyzing the effects of negative shocks faced by the real economy and the banking sector on the firms established during that period.

Because the recession-born dummy is time-invariant, the firm fixed effects must be dropped in the following models. However, the cohort fixed effects based on the aggregated cohorts, in which the single-year cohorts are grouped at the four-year level, are included in the models as defined in the following specifications. This grouping follows the same approach as used in the earlier analysis. In the current analysis, such grouping is implemented to diminish the multicollinearity between the cohort and recession-born dummies.[21] The inclusion of the aggregated cohort dummies is advantageous because they can be used to control for other cohort-specific trends in the cost and use of credit.[22] Hence, in these cohort models, the recession effects are identified from within the cohort group variation between the firms born in the recession and non-recession years.[23] The baseline models without such cohort controls are also

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21 The correlation remains high (that is, close but below 0.80) between the recession-born dummy and the cohort group 1990-1993 containing the firms born during the worst depression years of the 1990s. However, the grouping of cohorts at this interval results in natural and balanced cohort groups, which still avoid the perfect multicollinearity while retaining more accuracy than more coarse groupings, such as the decade fixed effects used by Schoar and Zuo (2011).

22 As a reminder, the age profiles based on the grouped cohorts are less precise than the ones based on the individual birth-year dummies as observed in the earlier analysis. Indeed, a further aggregation of the cohort groups makes the recession effect estimates less precise, which can result in a loss of statistical significance, even though the sign of the effect remains the same.

23 In the case of the Finnish Great Depression of the 1990s, for instance, the identification comes from the differences between the cohort born in 1990, a year of modest,

provided as a comparison point. Recall that industry, region and time fixed effects are included in each model in addition to the firm characteristics, such as their observed creditworthiness.

TABLE 10 Cost and use of credit: cohorts born during recessions

	(1)	(2)	(3)	(4)	(5)	(6)
Model	Age, period	Age, period, avg.cohort	Age, period	Age, period, avg.cohort	Age, period	Age, period, avg.cohort
Dependent variable	Financing costs	Financing costs	Obtained loans	Obtained loans	Bank debt	Bank debt
ln(Size)	-0.0013***	-0.0013***	0.0234***	0.0234***	0.0195***	0.0194***
	(0.0001)	(0.0001)	(0.0004)	(0.0004)	(0.0003)	(0.0003)
Tangibility	-0.0023***	-0.0023***	0.103***	0.103***	0.209***	0.209***
	(0.0004)	(0.0004)	(0.0025)	(0.0025)	(0.0024)	(0.0024)
Profitability	-0.0018***	-0.0018***	-0.0079***	-0.0080***	-0.0473***	-0.0474***
	(0.0003)	(0.0003)	(0.0017)	(0.0017)	(0.0012)	(0.0012)
Credit score[a]	0.025***	0.025***	0.142***	0.142***	0.235***	0.235***
	(0.0005)	(0.0005)	(0.0033)	(0.0033)	(0.0026)	(0.0026)
Recession-born	0.0005	0.0015**	0.0014	0.0027	-0.0043***	-0.0085***
	(0.0003)	(0.0006)	(0.0020)	(0.0036)	(0.0015)	(0.0029)
Age dummies	YES	YES	YES	YES	YES	YES
Cohort FE	NO	YES	NO	YES	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES
Region FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES
NT	350537	350537	598809	598809	591947	591947
r2	0.055	0.055	0.040	0.040	0.191	0.192

The table shows the estimates for the financing costs and the use of bank financing obtained from the panel regressions over the period 1999-2010. The dependent variables are defined as follows: *Financing costs* is financial expenses divided by the average interest-bearing debt between t and t-1. *Obtained loans* is an indicator equal to one if the amount of outstanding bank loans in the balance sheet is larger in period t than in period t-1, and zero otherwise. *Bank debt* is a ratio of outstanding bank loans divided by total assets at t. The independent variables are defined as follows: *Age*, modeled using dummies for each age, is the age of the firm defined as the years since the initial incorporation at t. *Ln(Size)* is a natural logarithm of total assets at t-1. *Tangibility* is a ratio of fixed to total assets at t-1. *Profitability* is EBITDA (earnings before interest, taxes, depreciation and amortization) divided by total assets at t-1. *Credit score* measures the observed creditworthiness of the firms (i.e., the probability of default) at the scale 3-99, where higher values mean lower creditworthiness. *Recession-born* is an indicator equal to one, if the firm was born during the period of negative real GDP growth (years 1991, 1992, 1993, and 2009), and zero otherwise. The table also reports whether the cohort dummies, where the birth year is grouped at the four-year level, are included in the models. All the models include industry, region and time dummies, and a constant, which are not reported. *NT* is the number of firm-year observations. *R2* stands for R-squared. Standard errors clustered at the firm level are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. [a] The coefficients and standard errors of *credit score* have been multiplied by 100.

close-to-zero growth, and the cohorts of 1991-1993, born after the sudden collapse of the Soviet Union and in the middle of the banking crisis. Indeed, comparisons of these particular years are common (cf. Gorodnichenko et al. 2012).

The results are shown in table 10. In the case of financing costs, the estimate of the recession-born dummy is positive but insignificant in the baseline model, which includes time dummies but no cohort dummies. This model, however, may fail to capture other cohort-specific trends in the financing costs as implied in the previous analysis. When the cohort effects are controlled using the aggregated cohort dummies, the recession-born dummy is positive and statistically highly significant. This estimate suggests that the cohorts born during recessions and financial crises pay approximately 15 basis points more for their credit, when the observed creditworthiness of the firms is held constant. Regarding the use of external finance, the findings suggest that the probability of obtaining new bank loans does not differ significantly between the recession and the non-recession cohorts. However, when the use of bank loans is measured as the amount of bank debt used scaled by total assets, the recession-born dummy is negative and highly statistically significant. That is, the recession-born cohorts use lower amounts of bank loans than the non-recession cohorts.

TABLE 11 Cost and use of credit: Finnish Great Depression cohorts

	(1)	(2)	(5)	(6)	(3)	(4)
Model	Age, period	Age, period, avg.cohort	Age, period	Age, period, avg.cohort	Age, period	Age, period, avg.cohort
Dependent variable	Financing costs	Financing costs	Obtained loans	Obtained loans	Bank debt	Bank debt
ln(Size)	-0.0013***	-0.0013***	0.0234***	0.0234***	0.0195***	0.0194***
	(0.0001)	(0.0001)	(0.0004)	(0.0004)	(0.0003)	(0.0003)
Tangibility	-0.0023***	-0.0023***	0.103***	0.103***	0.209***	0.209***
	(0.0004)	(0.0004)	(0.0025)	(0.0025)	(0.0024)	(0.0024)
Profitability	-0.0018***	-0.0018***	-0.0079***	-0.0080***	-0.0473***	-0.0474***
	(0.0003)	(0.0003)	(0.0017)	(0.0017)	(0.0012)	(0.0012)
Credit score[a]	0.025***	0.025***	0.142***	0.142***	0.235***	0.235***
	(0.0005)	(0.0005)	(0.0033)	(0.0033)	(0.0026)	(0.0026)
Recession-born	0.0005	0.0015**	0.0014	0.0027	-0.0043***	-0.0085***
	(0.0003)	(0.0006)	(0.0020)	(0.0036)	(0.0015)	(0.0029)
Age dummies	YES	YES	YES	YES	YES	YES
Cohort FE	NO	YES	NO	YES	NO	YES
Industry FE	YES	YES	YES	YES	YES	YES
Region FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES
NT	350537	350537	598809	598809	591947	591947
r2	0.055	0.055	0.040	0.040	0.191	0.192

The table shows the estimates for the financing costs and use of bank financing obtained from the panel regressions over the period 1999-2010. The dependent variables are defined as follows: *Financing costs* is financial expenses divided by the average interest-bearing debt between t and t-1. *Obtained loans* is an indicator equal to one if the amount of outstanding bank loans in the balance sheet is larger in period t than in period t-1, and zero otherwise. *Bank debt* is a ratio of outstanding bank loans divided by total assets at t. The independent variables are defined as follows: *Age*, modeled using dummies for each age, is the age of the firm defined as the years since the initial incorporation at t. *Ln(Size)* is a natural logarithm of total assets at t-1. *Tangibility* is a ratio of fixed to total assets at t-1. *Profitability* is EBITDA (earnings before interest, taxes, depreciation and amortization) divided by total assets at t-1. *Credit score* measures the observed creditworthiness of the firms (i.e., the probability of default) at the scale 3-99, in which higher values mean lower creditworthiness.

Recession-born is an indicator equal to one if the firm was born during the worst periods of the Finnish Great Depression (years 1991-1993), and zero otherwise. The table also reports whether the cohort dummies, where the birth year is grouped at the four-year level, are included in the models. All the models include industry, region and time dummies, and a constant, which are not reported. *NT* is the number of firm-year observations. *R2* stands for R-squared. Standard errors clustered at the firm level are reported in parentheses: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. [a] The coefficients and standard errors of *credit score* have been multiplied by 100.

Table 11 reproduces the results with an alternative definition of the recession-born indicator, which now focuses solely on the cohorts born during the worst years of the Finnish Great Depression and the accompanying banking crisis of the 1990s. These cohorts should provide useful information for drawing inference about the long-term effects of severe economic depressions and banking crises. This newly defined recession-born indicator takes a value equal to one if the firm is born during the crisis years 1991, 1992 or 1993, and zero otherwise. Hence, in practice, this specification checks whether the exclusion of the youngest financial crisis cohort of 2009 from the indicator affects the estimates. This should provide a useful robustness test because the estimates of such young cohorts observed only for a short period of time and during the financial market turbulence might be less accurate in comparison to their older counterparts.[24] Importantly, the concentration on the older cohorts born in the 1990s should provide further insights on whether the recession effects have a lasting rather than transitory impact on the firms.

The results that focus on the depression cohorts of the 1990s remain identical to the previous estimates. The recession-born effect in the financing costs of these cohorts is the same 15 basis points as in the case of the more broadly defined recession cohort. The estimates for the amount of bank debt used are also the same as earlier. These findings suggest that the depression cohorts of the 1990s are a key group behind the persistent differences between the recession and the non-recession cohorts observed previously in the analysis. The magnitude of the recession-born effect on the financing costs (15 basis points) roughly matches the magnitude of a five-point change in the credit score from the lower bound of the credit rating class AA+ (credit score: 20) to the lower bound of the credit rating class AA (credit score: 25). This credit rating change would increase the predicted financing costs approximately 12 basis points (i.e., from 5.19% p.a. to 5.31% p.a). The persistent recession-born effect of a similar magnitude is intriguing because the observed creditworthiness of the firms is controlled for in the regressions. The recession-born effect on the amount of bank debt used also appears to be significant in economic terms. Because the mean value of bank debt is 0.137, the recession-born estimate of approximately -0.009 suggests that the recession cohorts use an amount of bank debt that is more

[24] The mean value of this newly defined recession-born indicator is 0.137, which is somewhat lower than the value of 0.149 of the original indicator. The correlation coefficient between the recession-born indicator and the cohort group dummy containing cohorts 1990-1993 rises from the previous less than 0.80 to 0.84, which might as such call for some caution, while the estimates seem to provide no obvious reasons for concern.

than six percent lower than the non-recession cohorts. The observation of such a lasting impact suggests persistent differences either in the firms' perceived riskiness or in the entrepreneurs' attitudes towards bank finance. This result suggests that severe recessions and periods of financial instability could have scarring effects.

Summarizing the evidence, the stigma of being born during weak economic times remains a potential explanation for the higher cost of credit of the recession cohorts. The lower use of bank financing among these cohorts could potentially be interpreted in two ways because the data do not allow distinguishing between the supply- and demand-side effects.[25] First, the stigmatizing effects might explain why the recession cohorts use lower amounts of bank debt. Indeed, the cohorts born during the Finnish Great Depression in the middle of the banking crisis of the 1990s could have lost their access to intermediated credit. The previous literature indicates that the lost access to financial intermediates and the termination of lending relationships because of the banking crises could be damaging to the firms (e.g., Bernanke 1983; Slovin et al. 1993; Peek and Rosengren 2000; Kroszner et al 2007; Khwaja and Mian 2008). The firms could also have faced poor product market demand and suffered financially because of steep economic contraction. The potential disruptions in lending relationships and other financial problems could explain why the firms might be perceived as of lower quality from the lenders' point of view than otherwise identical firms born during stronger economic times.[26] Second, the earlier literature suggests that corporate managers who started out during recessions could have less faith in financial markets and could utilize external finance more conservatively (cf. Graham and Narasimhan 2004; Malmendier and Nagel 2010; Malmendier et al. 2011; Schoar and Zuo 2011). Malmendier et al. (2011) suggest that recession cohorts, having witnessed a major financial crisis, may be debt averse and lean excessively towards internal finance. Schoar and Zuo (2011) also suggest that recession-born managers make more conservative capital structure choices, including lower use of leverage. As noted above, the differences in the attitude towards bank finance could explain why the recession cohorts use bank loans in smaller amounts than other cohorts.

The previous studies that analyze the cohort-specific effects of the U.S. depression have focused on publicly listed firms. The current study differentiates itself from that literature by suggesting that similar persistent effects are observed among privately held small businesses in a different institutional en-

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25 In fact, the problem of distinguishing between loan supply and loan demand shocks during banking crises remains a common and challenging issue in the empirical banking literature (see, e.g., Peek and Rosengren 2000).

26 Alternatively, one could also make an argument that these firms at least survived the depression, unlike other potentially lower quality firms. This potential selection effect is worth entertaining in the interpretation. Still, it seems plausible that the adverse conditions that the firms have faced in the past could negatively affect their track record in comparison to otherwise identical firms with an unblemished history. The previous literature suggests that certification provided by banks is particularly important for firms that do not have access to public debt markets (see, e.g., Diamond 1991; Slovin et al. 1993). This seems to suggest that any problems in the lending relationships could have potentially far-reaching implications for the firms.

vironment in Finland. It is also worth noting that the Finnish financial markets are bank-based and that small businesses account for a major portion of the corporate sector, as indicated also in the current dataset. Based on these observations, the Finnish Great Depression and banking crisis of the 1990s provides a particularly unique comparison point for the findings of the previous literature. The current study also provides new evidence about the scarring effects of severe economic recessions and associated periods of financial instability by focusing on both the financing costs and the bank loans. The study also paid special attention to control for the differences in the observed and permanent unobserved creditworthiness of the recession and non-recession cohorts.

7 CONCLUSIONS

This paper studied the life-cycle profiles of small firms' financing costs and the use of bank financing. The study used an extensive panel of Finnish firms from the period 1999-2010 and paid attention to disentangling age, period, and cohort effects in the empirical models. This identification problem has been largely ignored in the earlier corporate finance literature. The findings of the current study suggest that the choice of method affects the conclusions drawn about the relationship between financing costs and firm age. The cross-sectional age profiles of financing costs are hump-shaped and consistent with the hold-up theories. In contrast, the methods that control for cohort or firm fixed effects suggest that the financing costs decrease monotonically as the firms mature, in line with the prediction of Diamond (1989). The findings also suggest that these differences in the life-cycle profiles relate to cohort effects. Moreover, the age profiles of the use of credit indicate that firms are more dependent on financial intermediaries in the early periods of their lives.

Several cohort effects are identified. First, the younger cohorts face lower costs of credit than the older cohorts. While the source of this cohort effect was not formally tested, the longer-term trend of decreasing cohort-specific financing costs would generally appear to be consistent with the hypothesis regarding improvements in the financial system and information environment. The findings also suggest that the younger cohorts are less likely to rely on new bank loans, whereas the measure of the amount of bank financing used suggests a more complex relationship.

Second, the findings suggest that the cohorts born in recessions, particularly the Finnish Great Depression and accompanying banking crisis of the 1990s, face higher financing costs and use lower amounts of bank loans in a persistent fashion. This effect is robust to controlling for the creditworthiness of the firms with commercial credit scores. These findings suggest that recessions and accompanying periods of financial instability could have a lasting impact or stigma on the perceived riskiness of the firms. The weak economic times could have a lasting impact on the firms' use of external finance because the recession-born cohorts use a lower amount of bank loans for the rest of the periods.

This observation could be related to the stigmatizing effects of being born during weak economic times or to the recession-born entrepreneurs' more conservative attitude towards bank finance. Such persistent effects, observed even many years after the depression and banking crisis of the 1990s, are intriguing and might call for additional research to further understand their causes. These findings could also prove useful in the designing of policies to avoid lasting adverse effects from recessions and periods of financial instability. While the financial development and the observed decrease in the cost of credit have diminished the case for government intervention, the findings also imply that the periods of financial instability might call for some policy measures targeted to bank-dependent small businesses, and to young firms in particular.

Taken together, the findings of the paper suggest that the choice of method in disentangling age, period, and cohort effects matters for the conclusions drawn about the life-cycle effects in small business finance. One key implication from the analysis is that the life-cycle profiles estimated from cross-sectional datasets, whose use has been a common practice in the previous corporate finance literature, should be interpreted with caution. Moreover, the existence of cohort effects in the cost and use of credit observed in this study also suggests that the identification problem should not be overlooked either in the repeated cross-section or in the panel datasets. The future literature could further study the scope of the cohort effects in various institutional environments.

APPENDIX

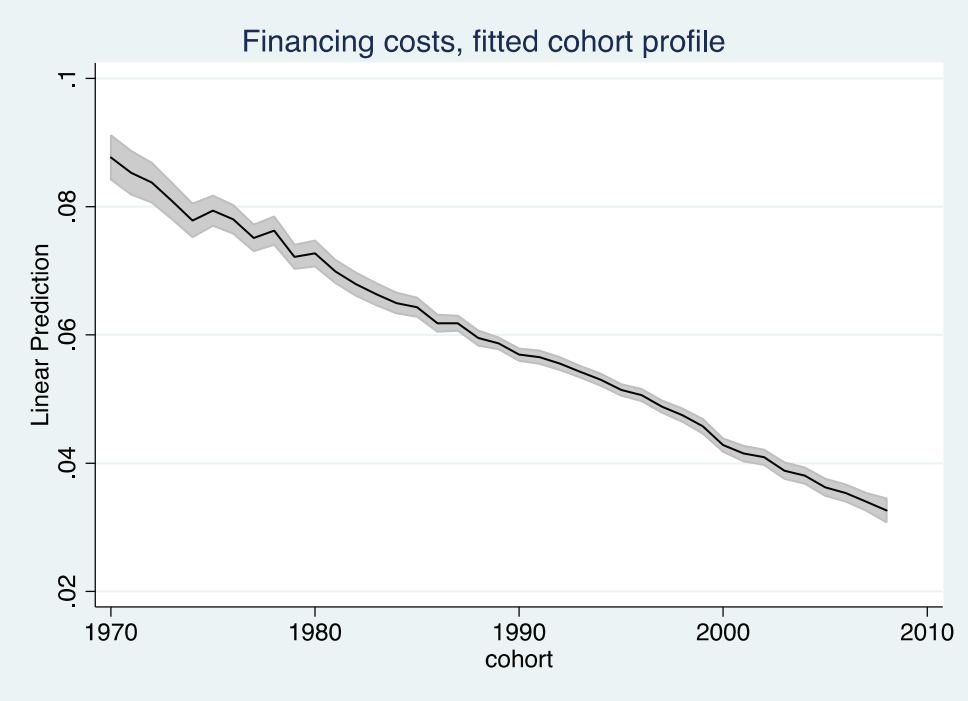

FIGURE 1 Cohort profile of financing costs

The figure shows the predicted mean financing costs and associated 95% confidence intervals evaluated at the cohort years from 1970 to 2008. The estimates are based on the panel regressions over the period 1999-2010. The model includes firm age dummies, single-year cohort dummies and the following controls: ln(size), tangibility, profitability, credit score, two-digit–level industry dummies, two-digit zip-code–level regional dummies and time dummies.

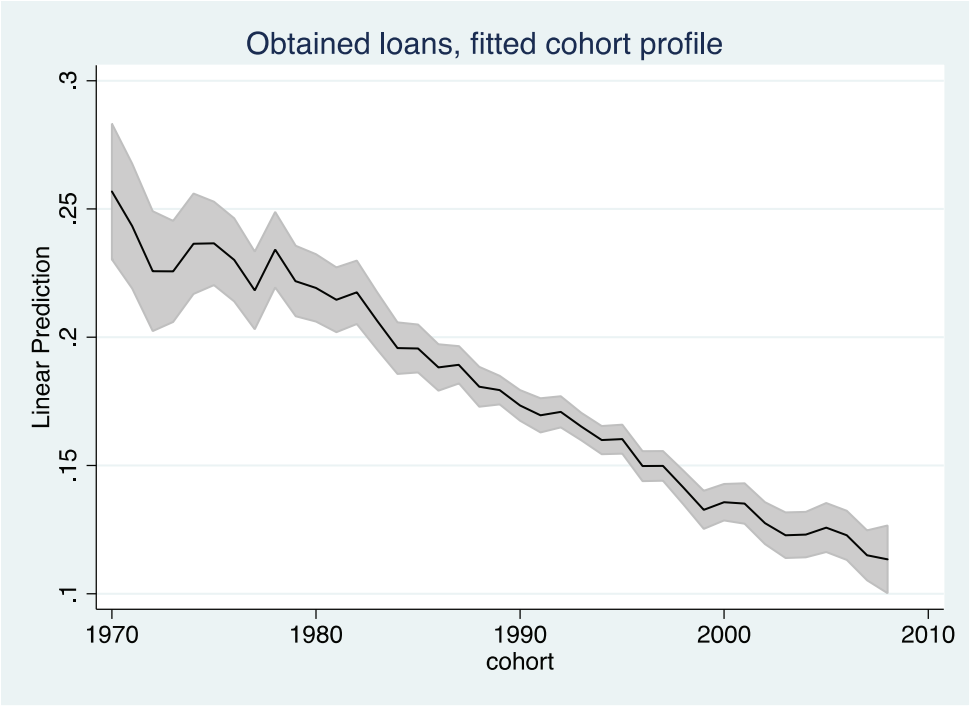

FIGURE 2 Cohort profile of obtaining bank loans

The figure shows the predicted mean value of obtaining bank loans and associated 95% confidence intervals evaluated at the cohort years from 1970 to 2008. The estimates are based on the panel regressions over the period 1999-2010. The model includes firm age dummies, single-year cohort dummies and the following controls: ln(size), tangibility, profitability, credit score, two-digit –level industry dummies, two-digit zip-code–level regional dummies and time dummies.

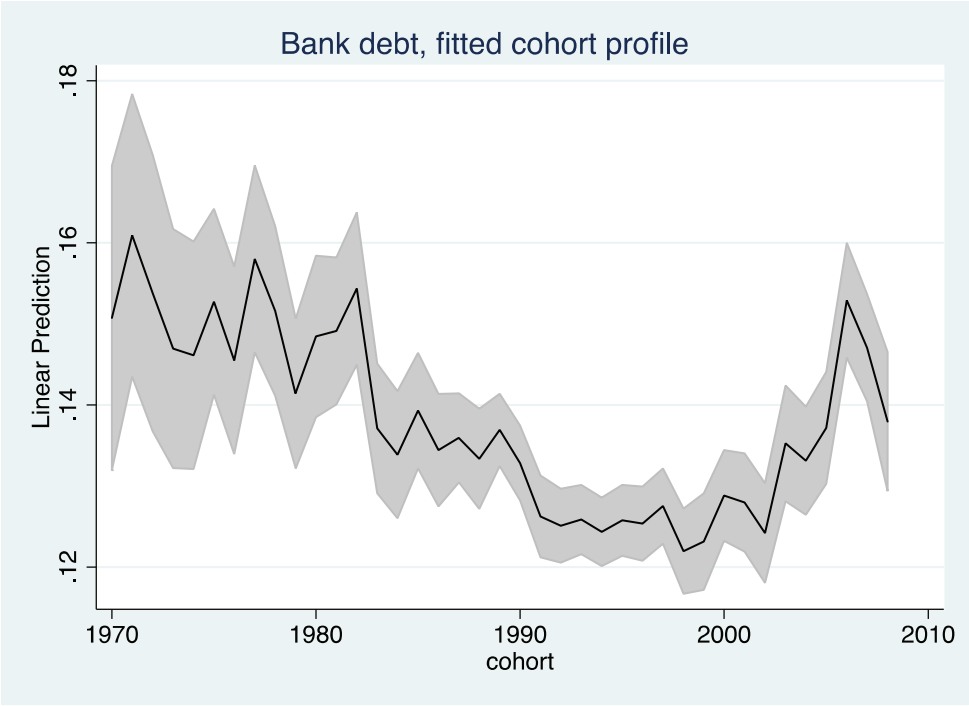

Figure 3 Cohort profile of bank debt

The figure shows the predicted mean amount of bank debt used and associated 95% confidence intervals evaluated at the cohort years from 1970 to 2008. The estimates are based on the panel regressions over the period 1999-2010. The model includes firm age dummies, single-year cohort dummies and the following controls: ln(size), tangibility, profitability, credit score, two-digit–level industry dummies, two-digit zip-code–level regional dummies and time dummies.

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YHTEENVETO (SUMMARY)

Esseitä pk-yritysten rahoituksesta

Väitöskirja koostuu kolmesta empiirisestä esseestä, joissa tarkastellaan pk-yritysten rahoitukseen liittyviä kysymyksiä ja julkisen yritysrahoituksen roolia luottomarkkinoiden epätäydellisyyksien korjaamisessa.

Ensimmäisessä esseessä analysoidaan julkisen yritysrahoituksen dynamiikkaa. Tarkastelussa keskitytään valtion erityisrahoitusyhtiö Finnveran myöntämään rahoitukseen. Kyseisen julkisen rahoittajan keskeisenä toiminta-periaatteena on markkinapuutteiden korjaaminen yritysluottomarkkinoilla. Tutkimusaineisto koostuu 7999 teollisuusalan osakeyhtiötä kattavasta tasapainoisesta paneelista aikaväliltä 2000-2008 ja se pohjautuu Tilastokeskuksen rekisteriaineistoihin. Tutkimuksen havaintojen perusteella julkista yritysrahoitusta käyttävien yritysten joukossa on ns. kanta-asiakkaita, jotka käyttävät tuettua julkista rahoitusta toistuvasti useana peräkkäisenä vuotena. Ekonometrisessa analyysissa tarkastellaan dynaamisten diskreetin valinnan paneelimallien avulla, johtuuko toistuva julkisen yritysrahoituksen käyttö ns. todellisesta tilariippuvuudesta vai havaitsemattomasta yrityskohtaisesta heterogeenisuudesta, kuten ajassa muuttumattomista riskiominaisuuksista. Tuloksien mukaan julkisessa yritysrahoituksessa on positiivista tilariippuvuutta, vaikka merkittävä osa rahoituksen toistuvasta käytöstä voidaankin selittää havaitsemattomalla yrityskohtaisella heterogeenisuudella. Toisin sanoen, aiemmin tuettua rahoitusta saaneet yrityksen saavat sitä jatkossakin suuremmalla todennäköisyydellä.

Toisessa esseessä tarkastellaan valtion erityisrahoitusyhtiö Finnveran myöntämän rahoituksen vaikuttavuutta keskittyen erityisesti lainarahoitukseen. Tutkimusaineisto koostuu noin 15 000 teollisuusalan osakeyhtiötä käsittävästä paneelista aikaväliltä 2000-2008 ja se on muodostettu Tilastokeskuksen rekisteriaineistoista. Tutkimusmenetelminä käytetään useita vaihtoehtoisia mikroekonometrisia arviointimenetelmiä, joihin lukeutuvat kiinteiden vaikutusten mallit, instrumenttimuuttujamenetelmä – joka hyödyntää julkisen rahoituksen alueellisessa tarjonnassa esiintyvää variaatioita – ja menetelmä, jossa verrattaan aluepoliittisen tukialuerajan vastakkaisilla puolilla sijaitsevia vierekkäisiä yrityksiä keskenään. Tutkimustulosten mukaan julkinen yritysrahoitus on auttanut yrityksiä laajentamaan toimintaansa lisäämällä yritysten investointeja, työntekijöiden määrää ja liikevaihdon kasvua. Toisaalta vaikutukset työn tuottavuuteen osoittautuivat negatiivisiksi tai tilastollisesti ei-merkitseviksi, mikä osaltaan kyseenalaistaa kyseisen politiikkatoimenpiteen mahdollisuuksia tukea pitkän aikavälin kasvua. Tutkimuksessa tarkasteltiin myös mahdollisia kanavia, joiden kautta julkinen rahoitus on mahdollisesti vaikuttanut yritysten toimintaan. Havaintojen mukaan julkinen rahoitus on auttanut yrityksiä kasvamaan nopeammin kuin olisi ollut mahdollista turvautumalla pelkästään sisäiseen tai rajallisesti saatavilla olevaan ulkoiseen rahoitukseen. Tuettu lainarahoitus näyttäisi myös laskeneen yritysten keskimääräisiä rahoituskustannuksia. Lisäksi havaittiin, että osa rahoituksen kasvu- ja työllisyysvaikutuksista ilmeni koros-

tuneemmin nuoremmilla yrityksillä. Tuloksien perusteella julkinen yritysrahoitus voi edesauttaa pk-yrityksiä laajentamaan toimintaansa, mutta samalla julkisen rahoituksen tehokkaaseen kohdentumiseen tulisi kiinnittää erityistä huomiota.

Kolmannessa esseessä tarkastellaan yritysten rahoituskustannusten ja pankkirahoituksen käytön kehitystä yli yritysten elinkaaren. Tutkimusaineistona käytetään Asiakastiedon kattavaa tilinpäätösaineistosta koostuvaa paneelia, joka kattaa aikavälin 1999-2010. Tutkimustulosten mukaan poikkileikkausaineistoista estimoidut rahoituskustannusten ikäprofiilit ovat yhdenmukaisia pankkirahoituksen hold-up –teorioiden kanssa, toisin sanoen nuorimpien ja vanhimpien yritysten rahoituskustannukset ovat matalampia kuin keski-ikäisten yritysten. Sen sijaan vaihtoehtoiset mallit, jotka huomioivat kohortti- ja yrityskohtaiset tekijät, indikoivat, että rahoituskustannukset laskevat monotonisesti yritysten vanhetessa. Tulokset viittaavat siihen, että nämä eri menetelmien tuottamat ikäprofiilien erot selittyvät kohorttikohtaisilla tekijöillä. Lisäksi pankkirahoituksen ikäprofiileja koskevat tulokset tukevat näkemystä, että yritykset ovat riippuvaisempia ulkoista rahoitusta välittävistä tahoista elinkaarensa alkuvaiheessa. Tutkimuksessa löydettiin myös useita kohorttivaikutuksia koskevia tuloksia: Ensinnäkin nuorempien yrityskohorttien kohtaamat rahoituskustannukset ovat alhaisempia kuin vanhempien kohorttien. Nuoremmat kohortit turvautuvat myös pienemmällä todennäköisyydellä uusiin pankkilainoihin kuin vanhemmat kohortit, joskin pankkirahoituksen määrällä mitattuna havainnot osoittautuvat monimutkaisemmaksi. Kokonaisuudessaan kohorttikohtaiset havainnot näyttäisivät rahoitusmarkkinoiden ja pk-yritysten informaatioympäristön kehitystä koskevien hypoteesien mukaisilta. Lisäksi havaittiin, että voimakkaan taantuman, ja eritoten 90-luvun alun laman ja pankkikriisin aikana syntyneet yrityskohortit maksavat korkeampia rahoituskustannuksia ja käyttävät pankkirahoitusta vähäisemmässä määrin kuin muut kohortit senkin jälkeen, kun yritysten luottokelpoisuus on kontrolloitu. Tuloksien perusteella voimakkaat taantumat ja rahoitusmarkkinoiden epävakaat ajanjaksot voivat vaikuttaa pysyvällä tavalla yritysten koettuun riskisyyteen ja pankkirahoituksen käyttöön.