Essays on Empirical Corporate Finance

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Summary

This dissertation consists of three essays on empirical corporate finance. It is submitted to the Department of Finance at the Norwegian School of Economics (NHH), in partial fulfillment of the requirements for the completion of the degree of Doctor of Philosophy.

These three essays explore the field of entrepreneurial finance. The first paper investigates an entrepreneur's personal influence on her firm. Especially, it examines how entrepreneurial attention affects firm performance. The second and third papers investigate small and medium-sized enterprises (SMEs) financing. In particular, the second paper analyzes how home equity-based borrowing alleviates financial constraints of SMEs in the seed round, while the third paper evaluates the costs and benefits of involving cornerstone investors in an IPO process. I provide a short summary of these three essays in the following.

1 Does entrepreneur divorce affect firm performance

To what degree an entrepreneur is important to the firm has been a central debate in the entrepreneur literature (e.g. Kaplan, Sensoy, and Strömberg, 2009; Becker and Hvide, 2022, etc.). This paper aims to understand this question by investigating the impact of entrepreneurial attention on firm performance.

An entrepreneur is often both a significant shareholder and the manager of a firm. She oversees various firm decisions that can be sorted into two categories, namely leader-type and manager-type decision-making tasks (Bandiera, Prat, Hansen, and Sadun, 2020). The leader-type tasks are more complicated, require a longer planning horizon and focus on growth strategies, such as, firm investments. Other assignments are considered manager-type decision-making tasks. The manager-type tasks are more straightforward, require a shorter planning horizon and focus on the execution of existing plans, such as daily operation tasks. On one hand, an entrepreneur has the skills and specific knowledge of the firm to perform these tasks. On the other hand, she also has limited capacity to work. She must decide how to divide her scarce attention across these tasks to accommodate the firm's needs (Dessein and Santos, 2021).

Because of the severe information asymmetry problem associated with small and private firms

(Berger and Udell, 1998), the matching between firm needs and entrepreneur behavior makes the empirical investigation of attention to firm performance difficult, especially on different task performance.

To overcome this challenge, I adopt two strategies. First, I follow Lu, Ray, and Teo (2016) and use divorce as an quasi-exogenous shock to an entrepreneur's attention level. Divorce is a deeply personal event that triggers economic, legal and emotional consequences. I study Norwegian firms, and it usually takes more than one year to finalize a divorce in Norway. Divorce is also quite common in developed economies nowadays. Given its disruptive and pervasive nature, divorce provides a good avenue for understanding the important role that an entrepreneur and her attention plays in firm performance.

Second, I use Norwegian administrative data to examine the impact of entrepreneurs' attention on closely held private firms during the divorce period. I define closely-held private firms as small and medium-sized enterprises (SMEs) with no more than three individual owners. The database contains rich details on entrepreneurs' demographic and socioeconomic information as well as firm accounting and corporate details. The comprehensiveness of the database allows me to conduct an in-depth analysis of firm performance changes around entrepreneurial divorce.

The research questions then become whether the entrepreneur will change her style of managing the firm during the period of divorce. If so, how will it affect the performance in leader-type and manager-type decision-making tasks?

My main result is from a cross-sectional analysis. It reveals that firm performance, in terms of asset growth, operational profitability and three-year survival rate, significantly decreases during the period of divorce. Underperformance is temporary and follows a U-shaped curve, which is likely due to a limited period of distraction. I also use a two-stage instrumental variable approach to address the potential endogeneity concern related to entrepreneurial divorce. In particular, I use neighborhood divorce rates to predict entrepreneurial divorce decisions.

Next, I verify whether limited attention prohibits the entrepreneur from pursuing a growth strategy measured by firm investment activities. My results suggest that inattentive entrepreneurs are less engaged in investment activities that generate growth and profitability, whilst still able to manage

regular business operations. In addition, I test whether this relationship is more pronounced when an entrepreneur is busier and her work requires more investment decision-makings. My results show that entrepreneurs who manage more firms, take the chair role and run larger firms are more adversely affected during the divorce event.

My paper has several contributions. First, it highlights the importance of entrepreneurs' human capital and capacity. While whether an entrepreneur is critical to the firm is still under debate (e.g. Kaplan, Sensoy, and Strömberg, 2009; Becker and Hvide, 2022), I use rich and unique population data from Norway to demonstrate that an entrepreneur's human capital is important to SME firm performance, especially in terms of firm investment policy. Second, my paper extends the limited attention theory [1] to the context of corporate performance in SMEs. I find that inattentive entrepreneurs are discouraged from performing the "leader" style tasks as the firm investment decreases during the divorce period. Nevertheless, they are still capable to performing operational duties, as daily managers. The findings of this paper shed light on the crucial role of attention in performing complicated tasks with a long-term planning horizon.

2 Home equity-based borrowing and corporate financing

The second paper revisits the topic on financial constraints faced by small and medium-sized enterprises (SMEs). SMEs are the backbone in most of the economies and they contribute significantly to productivity growth and employment (Haltiwanger, 2012; Adelino, Ma, and Robinson, 2017). However, these firms are financially constrained because of severe information asymmetry problem (Stiglitz and Weiss, 1981; Berger and Udell, 1998; Holtz-Eakin, Joulfaian, and Rosen, 1994). Therefore, SMEs financing has been a primary focus for both policymakers and academics (e.g. Stein, Ardic, and Hommes, 2013; Banerjee and Duflo, 2014, etc.). In this paper, we examine how home equity-based borrowing from critical owners (the entrepreneurs) helps alleviate financial constraints faced by their closely held SMEs in the seed round[2].

Houses are usually the largest assets on households' balance sheets, and the housing market has a

[1]The limited attention theory asserts that information processing is costly in terms of time and cognitive resources, and that inattentive investors tend to underreact to important information related to firm evaluations (DellaVigna and Pollet, 2009; Hirshleifer, Lim, and Teoh, 2009).

[2]In this round, funding is usually provided by founders, their family members, friends and angel investors.

huge impact on financial markets [3]. A growing body of literature has shed light on how households can pledge their homes to finance start-ups (e.g. Fairlie and Krashinsky, 2012; Adelino, Schoar, and Severino, 2015; Corradin and Popov, 2015; Schmalz, Sraer, and Thesmar, 2017, etc.). The mechanism of the collateral channel of housing is straightforward: an appreciation in regional house prices increases households' home equity. This enhances collateral value and consequently boosts a bank's willingness to lend to homeowners' business ventures.

Nevertheless, owing to data limitation,extant literature focuses on the relationship between home equity and firm creation. The extent to which home equity alleviates financial constraints among existing private firms has rarely been analyzed in the literature. Among others, Bahaj, Foulis, and Pinter (2020) documents a positive relationship between an appreciation in the value of a director's home and firm investment using UK microdata. In their study, directors' homes were used as a guarantee for corporate borrowing. Nonetheless, there is still little evidence of how firm owners extract home equity to fund existing firms on an on-going basis.

This study aims to bridge this gap by providing more evidence on the collateral channel of home equity. Our goal is to investigate whether home equity-based borrowing alleviates financial constraints among existing private firms. We use the comprehensive Norwegian tax administrative data which cover the entire universe of private firms and their shareholders in Norway from 2009 to 2015. The tax data are collected, digitized, and maintained by the Norwegian Tax Authority, which ensures a high standard of accuracy and integrity. By matching the owners to their firms, we can directly observe a link between the changes in each owner's mortgage value and the changes in her firm ownership.

Our main findings can be summarized as follows. First, we show that owners' home equity withdrawals are positively associated with new equity injections into closely held existing private firms. The log likelihood of a new equity injection is 34% when an owner extracts a mortgage. Conditional on mortgage extraction, the marginal propensity to inject equals 38 øre per extracted kroner. Second, we test whether this behavior is associated with financial constraints of the owners or the firms. We find that the relationship is more pronounced when a firm is farther from urban settlements, larger in size, and the owner's home is relatively valuable. The findings suggest firm-level constraints to be

[3]For example, Bajaj, V. wrote "The slumping housing market has become the biggest worry for the stock market...because of its potential impact on the broader economy and financial system." in his article "Top lender sees mortgage woes for 'good' risks" in The New York Times, July 25, 2007

more relevant. Third, we analyze the post-injection outcomes. We observe that firms demonstrate significant and long-lasting operational improvements, as well as higher survival rates in the post-extraction period. Moreover, home equity extraction encourages these experienced owners to repeat their success by setting up a new company in the same industry.

Our paper advances our understanding on home equity-based borrowing. First, we document that the injection of firm equity accounts for only a small proportion of the extracted home equity, suggesting that the majority of the withdrawals are used for other purposes. This relates to several earlier studies show that credit constrained households borrow against their home equity to smooth consumption (e.g. Hurst and Stafford, 2004; Greenspan and Kennedy, 2008; Mian and Sufi, 2011; Mian, Rao, and Sufi, 2013, etc.). Second, while the existing entrepreneurial finance literature emphasizes firm creation (e.g. Adelino, Schoar, and Severino, 2015; Corradin and Popov, 2015; Kerr, Kerr, and Nanda, 2015; Schmalz, Sraer, and Thesmar, 2017, etc.), we provide direct evidence on how home equity-based borrowing helps alleviate the financial constraints faced by existing SMEs. The nature of the Norwegian data allows us to precisely observe the funding flows between an owner's mortgage account and the equity account of his/her closely held firm. We further document improved firm performance and long-term survival in the post-injection period. This suggests that existing owners rather invest more financing value creating growth than saving their struggling firms. Taken together, our findings shed light on the need for credit relaxation.

3 The costs and benefits of cornerstone investors

The third paper focuses on one of the most important topics in entrepreneurial finance literature, namely the initial public offering (IPO) process. An IPO is the tipping point where a private firm's equity becomes publicly available. It is considered as an exit option, alongside mergers and acquisitions, for founders and early stage investors. In this paper, we study a special institutional arrangement of the IPO process in the Nordic market, which is known as cornerstone investors[4].

In Europe, especially the Nordic market, a group of potential (institutional) investors[5] are approached long before the IPO is announced by investment bankers through the IPO pre-marketing

[4]The Nordic countries in our sample are Denmark, Finland, Norway and Sweden.

[5]These investors have not invested in the firm through a pre-IPO funding round

meetings[6]. Cornerstone investors are the investors who commit to buying a certain amount of shares at the IPO price as a result of these meetings. This process is fundamentally different from the IPO process most researchers are familiar with [7]. Yet it is not clear that such institutional arrangements are necessarily optimal for other countries. Therefore, the purpose of our paper is to understand the role cornerstone investors played in this process.

Involving cornerstone investors in an IPO process introduces costs and benefits. On one hand, by pre-committing to buy a certain fraction of the shares being offered during the IPO, cornerstone investors may increase the likelihood of the IPO succeeding. Pre-commitment may signal early demand and hence convince others to invest (Welch (1992)). On the other hand, such a pre-commitment likely comes at a cost, namely lower price efficiency. They signal the demand for the issuer's shares to other potential investors. We would expect cornerstone investors to be compensated for this service - they are essentially shouldering some of the risks of the IPO, in particular, if demand for the IPO is weak.

To understand the trade-off, we first investigate how cornerstone investors affect the price-setting efficiency, which is the cost side. In particular, we find that cornerstone investments and fixed-price offerings are highly correlated. Fixed-price offerings are a form of IPOs that have almost disappeared from US markets[8]. We find that both cornerstone investments and fixed-price offerings are correlated with higher underpricing (or higher first-day returns), suggesting that cornerstone investors lead to less efficient prices during the IPO[9]. We then use the Lee (1978) sample selection model to correct for the possible endogeneity of the decision to include cornerstone investors, and we find that the expected increase in underpricing negatively and significantly affects the decision to use cornerstone investors.

We then verify how cornerstone investors in the IPO process increases the probability of IPO success, which is the benefit side. We analyze the speed at which the books of IPO firms fill and

[6]This process is known as pilot-fishing. These meetings are split up into two parts: initial meetings are called "early-look" and a second round of later meetings which incorporate the feedback from investors met during the early-look meetings are called "pilot-fish". Such discussions are also possible in the US, but in the Nordics, the price can also be discussed.

[7]In the U.S. market, such pre-commitment of shares is prohibited under Section 5(c) of the Securities Act.

[8]Welch (1992) shows that fixed-price offerings can be as efficient in the IPO process as book-building if they are combined with a positive cascade. Such processes can often be found in fund-raising, for example in crowdfunding. Private Equity with its multiple closings is another example of such a mechanism.

[9]Pezier (2021) finds similar results for cornerstone investments in Europe.

find that both cornerstone investors and fixed-price offerings lead to considerably higher demand for shares during book-building. Hence our results suggest two different channels at which cornerstone investors affect the likelihood of IPO success: prior to the IPO process, as the firm receives signals much earlier than in a US-style IPO process, reducing the likelihood of a withdrawn IPO dramatically, and during the IPO process, as the speed at which the book fills is significantly higher.

How do the cornerstone investors profit from this arrangement? Our results indicate that they are compensated in two different ways: first, underpricing is higher for firms with cornerstone investors. Second, we find that cornerstone investors almost always get a full allocation of shares whereas normal investors are usually rationed to receive only ten percent of the shares they demand (as measured by their demand during the last day of book-building). We further observe that not only cornerstone investors are rewarded but also early-look and pilot-fish investors[10] get a higher allocation than normal investors, conditional on their participation during book-building. Our results generally suggest that investors are rewarded for information revelation during the IPO process[11].

[10]Investors that participate in early-look and pilot-fish meetings.

[11]See Benveniste and Spindt (1989) for a formal model and Cornelli and Goldreich (2001) and Jenkinson, Jones, and Suntheim (2018) for empirical evidence.

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Does entrepreneur divorce affect firm performance: Evidence from Norway*

Jing Lan †

Abstract

How does entrepreneurial attention affect the performance of their closely held small and medium-sized enterprises (SMEs)? I investigate the impact of attention on firm performance around the entrepreneur divorce period by using a large sample of Norwegian SMEs and their owners. I find that firm performance, in terms of asset growth, operational profitability and three-year survival rate, significantly decreases during this period. Underperformance is temporary and follows a U-shaped curve, which is likely due to a limited period of distraction. Inattentive entrepreneurs are less engaged in investment activities that generate growth and profitability, whilst still able to manage regular business operations. In addition, entrepreneurs who manage more firms, take the chair role and run larger firms are more adversely affected in the divorce event. These findings highlight the importance of managerial decision making in corporate investment policies.

Keywords: *Entrepreneurship, divorce, limited attention, corporate investment*

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1 Introduction

How much of the differences in firm performance can be attributed to differences in the leader's behavior? An emerging body of literature has documented that CEOs' personal traits and life experiences can affect firm performance (e.g. Bertrand and Schoar, 2003; Cronqvist, Makhija, and Yonker, 2012; Yermack, 2014; Bennedsen, Pérez-González, and Wolfenzon, 2020, etc.). However, as the "core" of a firm (Becker and Hvide, 2022), entrepreneurs are relatively understudied compared with CEOs. This is largely because of the severe information asymmetry problem associated with small and private firms (Berger and Udell, 1998). Nevertheless, CEOs are subject to stricter restrictions due to better corporate governance correlated with large publicly listed firms, whereas entrepreneurs possess more autonomy given greater controlling power over their private limited firms. Therefore, studying entrepreneurial behavior should provide more insights into assessing the direct impact of leadership on firm performance.

An entrepreneur is often both a significant shareholder and the manager of a firm. She oversees various firm decisions that can be sort into two categories (Bandiera, Prat, Hansen, and Sadun, 2020). Some tasks are considered to be leader-type decision-making tasks. They are more complicated, require a longer planning horizon and focus on growth strategies, such as, firm investment tasks. Other assignments are considered as manager-type decision-making tasks. They are more straightforward, require a short planning horizon and focus on the execution of existing plans, such as daily operation tasks. On one hand, an entrepreneur has the skills and specific knowledge of the firm to perform these tasks. On the other hand, she also has limited capacity to work. She must decide how to divide her scarce attention across these tasks to accommodate the firm's needs (Dessein and Santos, 2021). The matching between firm needs and entrepreneur behavior makes the empirical investigation of attention to firm performance, especially on different task performance, difficult.

To overcome this challenge, I follow Lu, Ray, and Teo (2016) and use divorce as an quasi-exogenous shock to an entrepreneur's attention level. The research questions then become whether the entrepreneur will change her style of managing the firm during the period of divorce. If so, how will it affect the performance in both types of tasks? Divorce is a deeply personal event that triggers economic, legal and emotional consequences. Usually, it takes more than one year to finalize a divorce in Norway. However, a divorce usually does not force an entrepreneur completely out of

business. This allows me to hold the management team stable to a certain extent when studying the entrepreneurs' behavioral changes. Divorce is common in developed economies nowadays. According to Statistical Norway, one of every two married couples ends up in marital dissolution.[1] Given its disruptive and pervasive nature, divorce provides a good avenue for understanding the important role that an entrepreneur and her attention plays in firm performance.

Norwegian administrative data are used to examine the impact of entrepreneurs' attention on closely held private firms during the divorce period. I define closely-held private firms as small and medium-sized enterprises (SMEs) with no more than three individual owners. I define the sample entrepreneurs as the critical owners of the firm, with at least a 20% ownership stake. The sample consists of 50,713 unique Norwegian entrepreneurs who controlled 32,188 unique private firms in Norway from 2009 to 2016. This gives me the whole population of small and medium-sized firms closely held by entrepreneurs. The advantage of using this database is that it mitigates the selection bias. Moreover, the database contains rich details on entrepreneurs' demographic and socioeconomic information, such as gender, age, salary, marital status, wealth portfolio composition, as well as firm accounting and corporate details. The comprehensiveness of the database allows me to conduct an in-depth analysis of firm performance changes around entrepreneurial divorce.

Cross-sectional analyses reveal that divorce is strongly related to the deterioration of firm performance. Firm size and operational profitability start to decrease even three years before the year of divorce, and the probability of going bankrupt soars. Moreover, divorce affects task performance in different ways. Entrepreneurs are more distracted from firm investment activities, especially for fixed asset investments. However, they are still able to perform daily operations. Operational tasks such as sales, job creation, and operational efficiency are generally unaffected during the divorce period. The affected performance measures reach the bottom in the year of divorce and recover in the post-divorce period. This U-shaped relationship between entrepreneurial divorce and firm performance holds after controlling for firm characteristics, year, industry and regional fixed effects. To capture the exogenous influence of entrepreneur divorce on the firm, I further apply an instrument variable approach. The findings are robust across model specifications, event windows, and firm and entrepreneur characteristics.

[1] In the U.S. the divorce rate in 10 years is around 36% (Neyland, 2020).

Next, I verify whether limited attention prohibits the entrepreneur from pursuing a growth strategy measured by firm investment activities. I sort entrepreneurs into high- and low- bandwidth subsamples based on the number of firms they hold. The results show that the performance reduction around divorce is more pronounced when entrepreneurs have low bandwidth (more firms held). In addition, larger firms which are more profitable and require more managerial skills, are more adversely affected during the divorce period. Further, the performance of entrepreneurs with a chair role is also more negatively impacted than that of entrepreneurs who only take on the daily manager role. Finally, I compare firm investments from divorced entrepreneurs with those from entrepreneurs who stay in separation, [2] where one can assume that the conflicts between the spouses are not resolved and the entrepreneurs are still distracted. Investment activities do not recover ex-post when firms are run by stay-in-separation entrepreneurs.

These findings are compatible with the limited attention theory. The limited attention theory asserts that information processing is costly in terms of time and cognitive resources, and that inattentive investors tend to underreact to important information related to firm evaluations (DellaVigna and Pollet, 2009; Hirshleifer, Lim, and Teoh, 2009). Divorce is a deeply traumatic personal experience that causes emotional distraction. My key finding suggests that inattentive entrepreneurs tend to underperform in firm investment tasks, because these tasks can be more complex and demanding for entrepreneurs to execute. Reduced capacity for investment decision-making processes can be harmful to firms' long-term survival, growth and profitability. Nevertheless, divorce can impact entrepreneurs' professional performance in several ways, for example, through distraction, the change of risk attitude and the loss of control (Larcker, McCall, and Tayan, 2013). In the robustness section, I further discuss why alternative explanations such as changes of risk attitude and loss of control are unlikely to explain my results.

This paper contributes to the literature in at least two ways: First, it highlights the importance of entrepreneurs' human capital and capacity. A growing body of literature on leadership asserts that managerial behavior helps explain cross-sectional differences in various firm policies (Bertrand and Schoar, 2003). Several papers argue that CEOs' significant life events, such as sudden deaths (Johnson, Magee, Nagarajan, and Newman, 1985), the gender of the first child (Bennedsen, Nielsen, Pérez-

[2] In Norway, couples must be separated for at least one year before they can divorce. A separation license will be granted by the county governor.

González, and Wolfenzon, 2007), vacation trips (Yermack, 2014), and hospitalization (Bennedsen, Pérez-González, and Wolfenzon, 2020), affect firm decision-making. This strand of literature usually emphasizes the role of CEOs in large public firms. Whether an entrepreneur is critical to the firm is still under debate (e.g. Kaplan, Sensoy, and Strömberg, 2009; Becker and Hvide, 2022). I use rich and unique population data from Norway to demonstrate that an entrepreneur's human capital is important to SME firm performance, especially in terms of firm investment policy. Entrepreneurship plays a crucial role in providing innovation, employment and economic growth to an economy (e.g., Haltiwanger, Jarmin, and Miranda, 2013; Acemoglu, Akcigit, Alp, Bloom, and Kerr, 2018, etc.). When entrepreneurs are distracted from investment activities, this typically hurts the long-term growth and profitability of SMEs and, therefore, is costly to the overall economy.

Second, my research is linked to the literature on investor limited attention and underinvestment behavior. Prior literature suggests that attention is a scarce cognitive resource. Investment decision-making relies heavily on processing information. In secondary markets, inattentive investors tend to neglect important information (Cohen and Frazzini, 2008), underreact to earnings announcements (e.g., Hirshleifer, Lim, and Teoh, 2009; DellaVigna and Pollet, 2009), and exhibit stylized investment behaviors (Barberis and Shleifer, 2003; Teo and Woo, 2004). Among them, Lu, Ray, and Teo (2016) demonstrated that hedge fund managers distracted by marital events produce poorer risk-adjusted returns compared with their peers. Indeed, divorce is a significant traumatic life experience and introduces chronically emotional distraction (e.g., Larcker, McCall, and Tayan, 2013; Lin, Brown, Wright, and Hammersmith, 2019, etc.). My paper uses the same attention shock, namely divorce, as in Lu, Ray, and Teo (2016) and extends this strand of literature to the context of corporate performance in SMEs. An entrepreneur performs both a leadership role and a managerial role in a firm. A leader is expected to take care of the long-term, investment-related tasks whereas a manager is expected to execute more short-term operational tasks (Bandiera, Prat, Hansen, and Sadun, 2020). I find that inattentive entrepreneurs are discouraged from performing the "leader" style tasks as the firm investment decreases during the divorce period. Nevertheless, they are still capable to performing operational duties, as daily managers. The results shed light on the crucial role of attention in performing complicated tasks with a long-term planning horizon.

The reminder of this paper is organized as follows. Section 2 provides the institutional background

of divorce in Norway. Section 3 develops the study's main hypotheses. Section 4 presents the Norwegian data sample. Section 5 presents both univariate and multivariate results on how entrepreneur divorce relates to firm performance and explores the mechanism. Section 6 discusses alternative explanations and robustness of the main results. Section 7 concludes the paper.

2 Institutional Background

According to Statistics Norway, almost 70% of Norwegian residents aged between 16 and 80 years stay in a live-in relationship, among which 50% are married couples.[3] However, statistics reveal that approximately 40% of marriages in Norway are dissolved by divorce[4]. As we can see from figure 1, the divorce rate (purple line) rose sharply from the 1970s to the 1990s and was relatively stable in the post-2000 era. It fluctuates around 10,000 cases per year, with a slight decline in recent years, ranging from 9,000 to 10,000 cases. The latest numbers from 2020 show that 16,151 marriages have been contracted whereas 9,355 divorces have been filed.

In Norway, the dissolution of marriage is regulated by the Marriage Act introduced in 1991. Most divorces are handled by administrative procedure (by the county governor) rather than judicial process (by the court system). If a spouse wishes to terminate their marriage, the consent from another spouse is not required. In general, there are four main grounds for divorce (Sverdrup, 2002). *One year de jure separation*: a spouse can apply to the county governor for a license to separate. After one year of separation, one or both parties can demand divorce. This constitutes the vast majority of divorce cases in Norway (appr. 94%), as reflected by the yellow line in figure 1. *Two years de facto separation*: if the couple has not cohabited for more than two years, the county governor can grant a divorce at the demand of each spouse. Approximately 4% of marriages were dissolved due to the termination of cohabitation over two years. During the separation period, couples remained legally married. *Abuse or forced marriage*: A spouse can demand an immediate divorce without a prior separation period or termination of cohabitation if "the other spouses have intentionally attempted to kill him or her or their children or willfully exposed them to severe maltreatment, or if the other spouse has behaved in

[3]Homosexual couples have been registered as civil partnerships since 1993, and can marry since 2009. The registered partnership can then be converted into a marriage. Homosexual marriages are entitled to have the same legal rights and obligations as in heterosexual marriages and are regulated by the Marriage Act. In the sample, they were treated as heterosexual couples with no difference.

[4]In the U.S., the divorce rate in ten years is around 36% (Neyland, 2020).

a manner that is likely to arouse grave fear of such behavior" according to the Marriage Act section 23. If a spouse is forced by unlawful conduct into the marriage, either by the other spouse or by other parties, he or she can also demand divorce. Marriage dissolution out of this ground accounts for less than 1%. *Bigamous or incestuous marriage*: Marriage should be dissolved if the couple are close relatives or if the previous marriage of either spouse subsists. This contributes to the rest of the grounds for the divorce.

Marital dissolution is not merely a change in legal status, but also associated with several important processes. *Mediation process*: Married couples with children under 16 years old must undergo a mediation process before they initiate the divorce process with the county governor. The purpose of the mediation process is to arrange parental responsibilities and custody rights for the children, with no intention to prohibit the marriage from dissolving. This process begins with the application of a separation license. *Divorce settlement*: Divorce settlement should follow the principle of equal division of assets net of common debts created within the marriage. A spouse's assets acquired prior to marriage, inheritance or a gift from a third party should be granted the right to withhold. Pension and insurance benefits are usually exempted from division.[5] In general, it is quite rare in Norway to pay maintenance to a divorced spouse only if the spouse is financially unable to support him/herself. However, the Marriage Act grants freedom for spouses to enter into their own agreement for divorce settlement, and public administration has no civil rights to intervene. Such a wealth statement can be submitted together with the application of a divorce license to the public administration. Usually, it takes a few weeks to several months to finalize the transfer of asset ownership. If the couple fails to reach an agreement on divorce settlement, they can bring the case to court.

3 Hypotheses Development

Disruptive life events, such as marital transition, can cause dramatic changes in a person's emotional, legal and economic status. This may trigger paradigm shifts in people's behavioral patterns and, consequently, lead to changes in their professional performance.

Divorce can affect an entrepreneur's performance in at least two ways. The first is an attention impact. Divorce introduced a significant period of distraction, starting before the actual event took

[5]Unless the spouse is in an unfairly adverse economic situation.

place. Sources of distraction can be either internal, such as increasing levels of distress, anxiety, and depression, or external, given the considerable amount of time spent on filings and legal procedures. Evidence suggests that the average psychological distraction lasts for over two years (Lin, Brown, Wright, and Hammersmith, 2019). Previous studies also show such distraction can reduce professional productivity, for example, for employees (Wheatley, Vogl, and Murrell, 1991) and for hedge fund managers (Lu, Ray, and Teo, 2016). Therefore, I expect divorce to have a similar negative impact on entrepreneurs' professional performance and subsequently affect firm performance. The main hypothesis considers a broad set of firm performance measures and posits the following.

H1: *Around divorce period, entrepreneurs have lower attention level, their firm performance will become worse, compared with peer firms.*

Additionally, divorce may affect an entrepreneur's task performances inside a firm. Psychological evidence reveals that it is difficult to simultaneously perform multiple tasks and achieve good performance in all of them, especially when the tasks are very dissimilar (Treisman and Davies, 1973). Bandiera, Prat, Hansen, and Sadun (2020) suggests that CEO affects firm performance through two types of behaviors: first is the manager-type tasks and second is the leader-type tasks. Manager-type tasks focus on daily operational activities, whereas leader-type tasks focus on long-term strategies, value creation and profitability. Since an entrepreneur's role largely overlaps with a leader's and manager's role, I sort firm activities into operational activities (related to manager-type tasks) and investment activities (related to leader-type tasks), following this specification. Investment activities are more significant, complex and costly in terms of cognitive resources than operational activities. Given the fundamental difference in the decision making process between these two types of tasks, I expect them to be differently affected during the entrepreneur divorce period. However, how do entrepreneurs decide to reallocate attention across these tasks is remains poorly understood in the literature. Therefore, the second set of hypotheses is as follows:

H2a: *Around divorce period, entrepreneurs have lower attention level, firm investment activities will be of lower quality, compared with peer firms.*

H2b: *Around divorce period, entrepreneurs have lower attention level, firm operating activities will be of lower quality, compared with peer firms.*

The second major impact of divorce is the wealth impact associated with divorce settlement. A detailed discussion is provided in section 6.

4 Data and Sampling

4.1 Data Sources

To analyze the relationship between entrepreneurs' divorce and the performance of their closely held private firms, I use a comprehensive and longitudinal dataset from the Norwegian Tax Authority from 2009 to 2016.[6] The supplementary data come from two sources: the Norwegian Corporate Accounts database and the personal tax data. The Norwegian Corporate Accounts database contains complete firm financial accounting data, such as assets, sales revenue, profitability and so on, and corporate information, such as firm identity, address, industry classification, for the entire universe of Norwegian firms which have to report to the business registry. [7] Each firm is assigned a unique national organization number that facilitates the matching of firm information to other databases.

Personal tax data are drawn from an individual's annual tax reports. All tax-liable personals in Norway are assigned unique tax numbers (IDs) and must file annual tax reports with the tax administration. Besides personal identity information, full disclosure of assets and liabilities is required to prohibit tax evasion. This makes a personal database highly accurate and trustworthy. This database provides detailed information on individuals' marital status, address, income, employment, house ownership, and wealth composition. Most of these items are automatically collected from various sources. For instance, equity trading and holding information are collected directly from underlying companies and the Norwegian Central Securities Depository (VPS). A notable feature is that shareholder data document an individual's full transaction history in the equity market regardless of whether the underlying assets are public or private firms. Therefore, I am able to connect individual entrepreneurs to their privately held firms, and map their personal data to firm accounting and corporate information.

[6]The approval to use this database was granted and extended by the Norwegian Tax Administration on 4 April 2019 with strict confidential agreement on the usage, access and non-disclosure rule of the firms and shareholders' identities.

[7]The database is compiled and maintained by the Institute for Research in Economics and Business Administration AS (Samfunns-og Næringslivforskning) and Norwegian School of Economics (NHH).

In Norway, personal marital status is classified into nine different categories and revealed in the annual tax report for each individual: unmarried (not previously married), married, widow/widower, divorced, separated, registered partner, separated partner, divorced partner, and surviving partner.[8] Same-sex marriages were treated in the same manner as hetero-sex marriages in the sample. Marriage involving foreign citizens, either side or both, is recognized in the same manner if one person is tax-liable and the marriage has been verified by the Tax Authority. The panel data capture the dynamism of personal marital status change which gives us an opportunity to explore the divorce impact of firm owners on the corporate decision-making process. Unfortunately, no information on cohabitation is available from the National Population Registry. [9] No information is held for divorce settlements either, as this part is mainly settled through private arrangements or by the court.

4.2 Sample Characteristics

I focus on a sample of entrepreneurs running private limited liability companies (AS) in Norway from 2009 to 2016. The sample is restricted to significant entrepreneurs only because I expect them to be able to exert sufficient influence on the firms they hold. I achieve this by imposing three criteria in the sample selection: First, there should be no more than three personal owners in the fiscal year end for each firm. Second, each personal owner should hold no more than three private firms simultaneously. Third, the minimum ownership threshold is set at 20% for each individual. I further narrowed down my sample to active firms with at least three years of records. The Norwegian government has attempted to promote a business-friendly environment in which starting a firm in Norway is rather easy and brings tax benefits. Many individuals establish companies with no operations to enjoy the tax benefits for their investment portfolio returns.[10] Hence, I filter out zero-sales revenue firms and require at least one employee to be hired by the firm and at least 100 thousand kroner in total assets. Sole-proprietorship is not included in the sample because this type of self-employment is reported separately in a different taxation system. I also exclude entrepreneurs with marital status other than

[8]Since the change of the Marriage Act in 2009, homosexual partnerships are no longer registered. Registered partners prior December 2008 had the freedom to convert the partnership into a marriage.

[9]See quoted: "Cohabitation is the term used to describe two people living together under circumstances which are like a marriage without actually having entered into marriage, is neither formally registered in Norway nor regulated by law in the same way as marriage... The Norwegian Tax Administration also does not provide cohabitation agreement..." from https://www.skatteetaten.no/en/person/national-registry/marriage-and-cohabitation/registering-cohabitation/

[10]The minimum capital requirement to register a private limited liability firm (AS) has been NOK 30,000 (roughly 5400 USD) since 2012.

married, separation or divorce to mitigate the noise of cohabitants. I exclude entrepreneurs and firm observations with missing data on key information and control variables in the regressions. Table 10 provides important variable definitions and sample construction information.

In total, this procedure provides a sizable sample of 217,845 owner-firm-year paired observations, with 32,188 unique firms and 50,713 unique entrepreneurs. Among these entrepreneurs, 1444 entrepreneurs experienced divorce with full coverage of the data over the sample period. Table 1 reports the industry distribution of newly divorced entrepreneurs over the sample period, using the entire sample industry distribution as a benchmark. Overall, newly filed divorces disperse across various sectors, with most divorces occurring in other service industries (36.3%), followed by wholesale/retail (24.8%) and construction (23.5%) industries. The distribution is quite similar to that of the entire sample, with clusters in relatively labor-intensive industries. In later regression analyses, industry-fixed effects are controlled for.

Table 2 provides descriptive statistics on entrepreneur-year personal characteristics grouped by whether the entrepreneur is divorced or not. The divorced entrepreneurs are, on average, one year older, holding a slightly larger ownership stake in the firm. The average portfolio value on their privately held equity is around 907 thousand kroner,[11] which is about 80 thousand lower than that of their married counterparts. They are also relatively more indebted, given that the mean of the debt portfolio is about 125 thousand kroners higher than that of the married entrepreneurs. This may due to the fact that divorce settlement makes the divorced entrepreneurs more distressed. Both divorced and non-divorced entrepreneurs receive salaries from firms, with approximately 53% receiving salaries from their holding firms. The average salary is approximately 440 thousand kroners, which is about 25% lower than the median income (578 thousand kroners) of a Norwegian household over the sample period[12]. In general, divorced entrepreneurs are more centrally located than married entrepreneurs. Table 2 suggests that although divorced entrepreneurs are statistically different from married entrepreneurs in terms of personal characteristics, the economic magnitude is not large.

[11] 907 thousand Norwegian Kroner equals to appr. 108 thousand U.S. dollar. as of October 2021.

[12] Household income from ssb.no

5 Empirical Analyses

5.1 Univariate Analyses

In this section, I perform univariate analyses as a prelude to investigate whether entrepreneurial divorce has any impact on firm performance. Both cross-sectional and time-series tests were conducted to explore the influence.

5.1.1 Cross-sectional Evidence

Table 3 presents the univariate cross-sectional analysis of entrepreneurial divorce and firm performance. Firms are grouped by the number of entrepreneurs who stay divorced. The first three columns show the means of firm characteristics with 0, 1 and two divorced entrepreneurs. Column 4 displays the mean difference between the firms held by one divorced entrepreneur and those held by non-divorced entrepreneurs. Column 5 reports the mean difference between the firms held by two divorced entrepreneurs and those held by non-divorced entrepreneurs. I report the means for both firm performance measures and important control variables used in the regressions later. All variables were winsorized at the 1% and 99% levels to remove outliers.

As we can see from Table 3, firms are significantly smaller in asset value when the entrepreneur's civil status appears to be "divorced". The size difference is larger when there are more divorced entrepreneurs running a firm. Operational profits are significantly lower among firms run by divorced entrepreneurs. The more divorced owners a firm has, the lower its operational profits. With regard to investments, capex decreases alongside the number of divorced entrepreneurs. Firm sales exhibited different patterns. Sales revenue rises when there is one divorced entrepreneur controlling the firm but decreases when there are two divorced entrepreneurs. For inventory turnover, the ratio is the highest when there is one divorced entrepreneur, followed by zero divorced entrepreneurs and two divorced entrepreneurs. Other operational ratios, such as the working capital and cash ratio are worse when firms are led by more divorced entrepreneurs. However, we do not observe a significant difference in employee number with regard to the number of divorced entrepreneurs. The average number of employee is approximately six. Finally, firms with one divorced entrepreneur are most likely to pay dividends.

5.1.2 Time-series evidence

Table 4 presents the time-series mean differences in firm characteristics within a 7-year event window for firms that experienced an entrepreneurial divorce during the sample period. Column 1 reports the average firm characteristics three years before divorce, column 2 reports the means from the divorce year, and column 3 reports the means in the three-year post divorce period. Columns 4 to 6 show the paired two-sample mean difference t-test results for each period, with column 4 for pre-divorce and divorce periods, column 5 for the post-divorce and divorce periods, and column 6 for the post-divorce and pre-divorce periods.

The univariate results in Table 4 provide rich insights into how firm performance changes around the entrepreneur's divorce period. As we can see, firm size (logAssets) and operating profitability (OROA) follow a similar pattern: they first become worse from the pre-divorce period to the event year, then improve from the divorce year to the post-divorce period, although the change in size is not as significant as operational profitability. Firm investment in fixed assets, Capex, follows a similar U-shaped pattern as logAssets around the divorce event, although none of them are statistically different at the conventional level. For operational activities, firm sales (sales revenue, log sales and sales growth) are not affected by the divorce event as they maintain at the growing trend from the previous period. Inventory turnover decreases from the pre-divorce period to the post-divorce period. The number of employee continued to increase throughout the entire event window.

Figure 2 supplements the findings in table 4 with more straightforward visualization of the main performance changes. As we can see from figure 2a, logAssets demonstrates a clear U-shape pattern. A pre-trend can be easily observed, then it bottoms at the year of divorce. The average firm size climbs back in the post-divorce period, however, it does not reach the original level. Figure 2b reveals that OROA declines from the pre-divorce period but the recovering is slower than the trend of firm size. Investment activities are plotted in the left panel of figure 3. Operational measures from figure 2c, figure 2d and figure 2e also echo the outcomes in table 4.

Overall, the results from the univariate analyses demonstrate that firm performance changes around the entrepreneur divorce event, which rejects the null hypothesis that entrepreneur divorce is irrelevant to firm performance. Evidence also suggests a pre-trend before an actual divorce event. The declining trend started even earlier than in the year of separation.

5.2 Multivariate Results

In this section, I assess the impact of entrepreneurial divorce on firm performance using multivariate regression. In addition, I explore this mechanism and provide causal explanations.

5.2.1 Baseline Analyses

To examine the overall effect of entrepreneurs' attention on the performance of privately held firms during the divorce period, I propose the following baseline model:

$$\begin{aligned} FirmPerformance_{i,j,t} =& \beta_1 DivorcePre_{i,j,t} + \beta_2 Divorce_{i,j,t} + \beta_3 DivorcePost_{i,j,t} \\ &+ \Sigma\beta FirmControls_{j,t-1} + \Sigma\beta PersonalControls_{i,t-1} \\ &+ \alpha_j + \tau_j + \mu_t + \varepsilon_{i,j,t} \end{aligned} \tag{1}$$

where i denotes the entrepreneur, j represents the firm held, and t indicates the year. Three sets of dependent variables were used to test the hypotheses. The first set of dependent variables tests **H1**. It consist of standard firm characteristics to measure general firm performance following the classic entrepreneur literature, such as firm size (logAssets), profitability (OROA) and mid-term survival (bankrupt in three years) (Hvide and Panos, 2014). The second set of dependent variables accounts for the second hypotheses, namely investment activities (**H2a**) versus operating activities (**H2b**). For investment activities, I follow Bahaj, Foulis, and Pinter (2020) using total firm investment (Investment) and further decompose it into fixed asset investment (Capex) and intangible asset investment (Intangible). For operational activities, I borrow measures from Hvide and Panos (2014), such as sales revenue (log sales) and job creation (number of employees), as well as an efficiency proxy (inventory turnover).

Being aware of the time-variant divorce impact, the main independent variables are three dummy proxies indicating different stages regarding divorce. $DivorcePre_{i,j,t}$ is a dummy variable indicating the three-year period before the year of divorce, $Divorce_{i,j,t}$ indicates the year of divorce, and $DivorcePost_{i,j,t}$ is a dummy for the three-year period after divorce has been filed.

My control variables cover a group of standard firm control variables in the empirical corporate finance literature indicating the financial health of a firm from the fiscal year $t-1$: leverage, cash

ratio, tangibility, sales growth, working capital, firm age, dividend payer and so on. Performance measures serve as control variables in regressions of the other performance proxies. I further added the entrepreneur's gender and age to control for the possible influence of entrepreneurs' different risk preferences on firms. Fixed effects were used to control for heterogeneous unobservable at the year, industry and regional levels. Robust standard errors are clustered at the firm-year level in all regressions.

Table 5 provides the baseline cross-sectional multivariate regression results. Models 1 to 8 present the results from ordinary least square regressions, and Model 9 shows the result of the logit regression for bankruptcy estimation. Besides the general analyses on firm performance, the investment activity analyses are presented in Model 3 to 5, whereas the operational activity analyses are presented in Model 6 to 8. All firm control variables are included, together with year-, industry-, and regional fixed effects.

Regression results in Table 5 confirm the curvature relationship between entrepreneur divorce and firm performance. Firms that experience entrepreneurial divorce show a decrease in total assets. Compared with other firms, firm size ($logAssets$) decreased significantly by -4.5% in the pre-divorce period. The decrease is largest in the year of divorce (-7.4%) and remains at -7.1% in the post divorce period. Operating profitability ($ORO A$) also worsens significantly since the pre-divorce period, deteriorates even more in the divorce year, and improves slightly in the post-divorce period compared to firms held by married, non-divorcing entrepreneurs.

For investment activities, both total investment ($Investment$) and fixed asset investment ($Capex$) display a highly significant decrease starting from the pre-divorce period to the divorce year. The coefficients in the post-divorce period are no longer significant, suggesting that investment patterns recover once the divorce is fully settled. Moreover, intangible investments are not significantly affected. The change in total investment is driven mainly by fixed asset investments. It is plausible that, because these entrepreneurs run relatively small firms (with six employees on average), intangible asset investment is relatively negligible.

For operational activities, all three measures, sales revenue ($logSales$), job creation ($Employees$) and efficiency ($Inventoryturnover$) are not significantly impacted either during the pre-divorce period or in the divorce year. This is consistent with Neyland (2020),which also finds insignificant

evidence for firm sales using a sample of CEOs from U.S publicly listed firms. We can see a significant increase in logSales in the post-divorce period, however, the economic magnitude is rather small. The coefficients for both employee and inventory turnover are statistically insignificant in the post-divorce period.

In column 9, I run a logit model to estimate the likelihood of bankruptcy in the three years associated with the entrepreneurial divorce. The log likelihood ratio of bankrupt in three years rises sharply by 32% in the pre-divorce period, which equals an average marginal effect of 0.75 percentage point. This is in parallel with the deterioration of overall firm performance, such as shrinking firm size, lowering profitability, and a surging leverage ratio.

In general, we see a deterioration in firm performance around the entrepreneur divorce event, which rejects the null hypothesis **H1**. Moreover, the tests for hypotheses **H2a** and **H2b** show that investment activities are seriously affected whereas operational activities are less impacted during this event. This suggests that the divorcing entrepreneurs perform worse in leader-type tasks, but are still able to perform manager-type tasks normally.

5.2.2 Instrumental Approach

Thus far, the underlying assumption is that divorce distracts the entrepreneur and leads to poor firm performance. However, one may be concerned that although divorce has an exogenous part, it also has an endogenous part. First, entrepreneurs may self-select for divorce. Second, the direction can work the other way around: bad firm performance intensifies the entrepreneur's family-work conflicts and causes the divorce decision.

To alleviate these concerns, I adopt a multistage framework with an instrumental variable using the following system of equations:

$$\begin{aligned} Divorce_{i,j,t} =& \beta_1 NeighborhoodDivorce_{i,j,t-1} + \Sigma\beta FirmControls_{j,t-1} + \alpha_j + \tau_j \\ &+ \mu_t + \varepsilon_{i,j,t} \end{aligned} \tag{2}$$

$$\begin{aligned} FirmPerformance_{i,j,t} =& \beta_1 \widehat{Divorce_{i,j,t-1}} + \Sigma\beta FirmControls_{j,t-1} + \alpha_j + \tau_j \\ &+ \mu_t + \varepsilon_{i,j,t} \end{aligned} \tag{3}$$

In the first stage, I used a probit regression model with an instrument variable to estimate the entrepreneur's probability of getting divorced. In the second stage, I assess the impact of attention on various firm performance measures, as well as the investment activities versus operating activities, using the instrumented probability of divorce. I add firm characteristics and regional, industry, and time controls in both regression stages.

The choice of the instrument variable was inspired by Neyland (2020). Neyland (2020) exploits the difference in divorce rates across states in the U.S. to indicate the general costs and benefits of getting divorced in that area. I follow this approach and use a binary indicator reflecting the dynamics in the Norwegian kommune[13] level entrepreneur divorce rate in the previous year as the instrumental variable. The dummy variable takes a value of one if there are more divorced entrepreneurs in the area last year compared with the previous year, and 0 otherwise. On one hand, the neighborhood entrepreneur divorce rate is insignificantly associated with firm performance, which satisfies the exclusion condition. On the other hand, peer divorce rates in close local networks should be a precise proxy capturing the emotional and economic costs and benefits of getting divorced as an entrepreneur in the neighborhood. In Norway, there is sufficient geographical variation in divorce rates. Figure 4 illustrates the number of divorces filed across Norwegian counties as a brief overview, using 2016 as an example year. The Norwegian government has aimed to foster a better business environment and has kept facilitating business networking. Institutions and business clusters for young firms are built in many cities and local network forums are organized on an annual basis.[14] These efforts make it possible for entrepreneurs to know each other beyond their professional level.

Table 6 present the results from the two-stage least square regression with the instrumented divorce variable. The first stage regression is reported in the first column of table 6. The previous year entrepreneur divorce rate in one's neighborhood can significantly and positively predict the entrepreneur's divorce. Results from table 6 are mostly in line with the baseline findings. The instrumented divorce proxies report significant and negative coefficients for general firm performance and investment activities. These findings are consistent with hypotheses **H1** and **H2a**. The coefficients for firms' operating activities remain positive and insignificant, except for sales revenue. This is similar

[13] similar to municipality (MSA) in the U.S.

[14] Institutions, such as Innovation Norway, SME Norge, Bergen camber of finance etc., provide networking service to enhance local business communities.

to the baseline results that the operating activities are not significantly affected during the disturbance event. The improvement in operating activities seems somewhat puzzling. This may due to other reasons such as corporate restructuring associated with the event, which calls for additional investigation. Nevertheless, the results confirm that during the divorce period, significant change is observed regarding entrepreneur's leadership performance.

5.2.3 Entrepreneur Bandwidth

Thus far, evidence has shown that firm performance significantly worsens during divorce periods. The deterioration in firm performance follows a U-shaped curve, indicating it is due to a period of distraction. Furthermore, the firm investment activities are more negatively affected than firms' operating activities, suggesting that attention is more crucial for long-term planning. To better understand this mechanism, I exploit the heterogeneity within the sample entrepreneurs and their privately held firms and conduct subsample analyses.

First, I examine how does entrepreneur bandwidth affects the results. I follow Lu, Ray, and Teo (2016) and split my sample according to how busy the entrepreneur is based on the number of firms held by entrepreneurs. Busier (low bandwidth) entrepreneurs are defined as entrepreneurs holding two private firms, whereas non-busy (high bandwidth) entrepreneurs are entrepreneurs holding only one private firm. When an entrepreneur runs two firms, her energy and attention are divided by the two holding firms. The underlying hypothesis based on limited attention theory is that a busier entrepreneur is less able to afford such attention distraction; hence, worse performance is expected during divorce.

The results are collected in Table 7. Panel 1 presents the regression results for non-busy entrepreneurs whereas panel 2 displays the results for busy entrepreneurs. These results are consistent with the limited attention proposition. I find that firm size and operational profitability reduce more (with greater negative coefficients) during the divorce period when the entrepreneur is busier. The probability of going bankrupt in three years increases significantly for both types of firms, and a larger impact is found within the busier entrepreneur group.

The investment activities of firms run by busy entrepreneurs are significantly negatively affected. Both total investment and fixed asset investment decrease, whereas the proportion of intangible asset

investment increases. These coefficients are insignificant for entrepreneurs with single holding firms. Operational activities are not seriously impacted in either type of firm.

The results are consistent with the findings from Lu, Ray, and Teo (2016) that marital events damage the professional performance of busy managers the most. Moreover, my evidence suggests that in the context of corporate behavior, activities with regard to long-term planning are more affected by attention than daily operating activities.

5.2.4 Entrepreneur Role

Previous analyses have indicated that attention is more important in making capital allocation decisions. If this is true, a stronger impact should be expected when investment tasks are executed more frequently. To investigate this, two sets of tests were performed.

The first test accounts for the entrepreneur's role inside the firm. There can be heterogeneous demand for investment decision-making when an entrepreneur takes different firm roles. An entrepreneur can be the chair, daily manager, or contact person of the firm she held. As the chair of a firm, an entrepreneur is expected to make more important decisions, such as investment strategies, that guide the direction of future development. Therefore, this role is associated with greater investment in tasks. As a daily manager, an entrepreneur may focus more on daily business operations. Thus, investment tasks are performed less frequently when performing a managerial role. When divorce reduces the level of the entrepreneur's attention, the chair entrepreneur should be more negatively affected.

To investigate this, I sort the sample entrepreneurs into two subsamples based on their professional roles: manager or chair. I performed the baseline analysis using the subsamples and collected the results in Table 8. Panel 1 presents the regression results when the entrepreneur takes the daily managerial role while panel 2 demonstrates the results when the entrepreneur is the chair of the firm. When the divorcing entrepreneur is also the chair of the firm, the proxies for general firm performance are more negative and significantly affected, as measured by the magnitude of the coefficients. When comparing the investment activities, distinctive patterns were found between the two subsamples. Around the divorce event, chair entrepreneurs are more adversely affected in making capital allocation decisions compared to the manager entrepreneurs. While previous literature has established the

importance of CEO human capital(Bennedsen, Pérez-González, and Wolfenzon, 2020, e.g.), the results in this section highlights the crucial role that a chair plays in corporate decision-making and the functional difference among various corporate positions.

5.2.5 Firm Size

The final test considered the firm size. Firms differ in size and firm size correlates with the requirement for leadership skills (Bandiera, Prat, Hansen, and Sadun, 2020). In general, large firms are more profitable and complex in their organization structures. Usually, these firms demand more managerial skills and have more investment needs for long-term planning than do smaller firms. Therefore, entrepreneurs from larger firms should be more sensitive to attention shock.

To test this view, I sort the sample firms into quartiles based on the previous year's total firm assets. Table 9 collected the results of the size subsample analysis. The upper panel shows the results for the firms in the smallest quartile and the lower panel displays the results for the firms in the largest quartile. For small firms, negative and significant coefficients are found for firm general performance around the divorce period. Significant improvement is also observed in the post-divorce period for firm operating activities, but not for firm investment activities. For large firms, general firm performance is not heavily impacted. Rather, dramatic changes occur in firms' investment activities. Firm investment activities decreased significantly during the divorce period. These findings are consistent with hypothesis. [15] Entrepreneurs in larger firms are expected to practice more investment tasks. Inattentive entrepreneurs do not have the capacity to make appropriate investment decisions. This eventually hurts the long-term growth and profitability of firms.

6 Alternative Explanations and Robustness

In this section, I address concerns about alternative explanations and evaluate the robustness of the results.

[15] I use alternative measure firm size, in terms of employee numbers, and find similar results.

6.1 Alternative Explanation

A major concern is the wealth shock introduced by the divorce. A sudden change in wealth status may shape entrepreneurial behavior and can subsequently affect firm performance. However, wealth division mainly occurs in the post divorce period, which allows me to distinguish the wealth impact from the attention impact to a great extent.

Divorce settlement can influence an entrepreneur's privately held firm in at least three ways: through personal wealth, risk attitude and ownership and controlling power. First, with regard to the change in personal wealth, divorce settlement reduces the amount of entrepreneurs' personal wealth and debt capacity, which can potentially be used for firm financing; therefore, it may have a negative impact on firm performance. However, this means that the firm performance should decline even further ex-post, given that the actual wealth splitting happens after divorce is filed. However, previous evidence shows a bounce-back of firm performance rather than a continuation of the worsening trend.

Second, entrepreneur's risk attitude may be changed due to a sudden loss in wealth (Larcker, McCall, and Tayan, 2013). However, the previous literature on CEO divorce shows mixed evidence in the direction of change. On the one hand, the relatively wealthier spouse (the entrepreneur) may become more risk averse as his or her risk appetite decreases (Neyland, 2020). However, this cannot explain why the post divorce trend recovers so quickly that immediately after the divorce is filed, firm performance and investment begin to improve. On the other hand, divorced people might become less risk averse as they want to win-back their previous wealth status by engaging in more risk-seeking investments (Roussanov and Savor, 2014; Nicolosi and Yore, 2015). Nevertheless, following this argument, we should not observe any declining trend in the pre-divorce period as their wealth status had not changed before the settlement.

Finally, wealth division may lead to a loss of ownership and controlling power of the divorcing entrepreneur over the firm. First, its impact on firm performance is uncertain. It is hard to attribute the ex-ante governance quality of the firm to the managerial skills of the divorcing entrepreneur. Second, this did not drive the results of the sample. The sample entrepreneurs show no dramatic change in ownership stake, as shown in Table 2. They are left with a marginal increase rather than a decrease ownership of their privately held firm in the post-divorce period. This is in line with

anecdotal evidence that CEOs tend to pay cash or external liquid assets instead of firm shares for divorce settlement (Neyland, 2020).

6.2 Alternative Approach

There might also be a concern that the number of firms experiencing entrepreneurial marital dissolution is relatively small compared to the whole sample observations. Therefore, I used a staggered difference-in-differences (Diff-in-Diff) analysis with a matched sample.

I first adopt the propensity score matching (PSM) approach to pair each firm that experiences an entrepreneur divorce event (treated firm) with a firm that experiences no such event (control firm) using three-year firm financials from the pre-divorce period. Thus, the control group consists of firms operated only by married entrepreneurs. Firms that experienced multiple entrepreneurial divorce events were excluded from the sample. Matching is performed with a logit regression on a one-to-one basis with no replacement. The matched sample summary statistics are reported in Appendix Table 11, with two sample means, mean differences and the corresponding t-scores. The treated and control groups are statistically indifferent in terms of firm characteristics as shown in Appendix Table 11.

The difference-in-differences model specification is as follow:

$$\begin{aligned} FirmPerformance_{j,t} =& \beta_1 Treated_j * Post_t + \beta_2 Treated_j + \beta_3 Post_t \\ &+ \Sigma\beta FirmControls_{j,t-1} + \alpha_j + \tau_i + \mu_t + \varepsilon_{j,t} \end{aligned} \tag{4}$$

$Post_t$ is a dummy indicator that equals to 1 if the time period is in the three-year window after entrepreneur divorce, and 0 otherwise. $Treated_j$ is a dummy indicator that takes the value of one if firm j has a newly divorced entrepreneur within the sample period and zero otherwise. The coefficient of interest is β_1 for the treated group in the post-event period, while the benchmark is the control group in the pre-divorce period.

Appendix Table 12 presents the staggered difference-in-differences regression results on how entrepreneur divorce impacts firm performance. The coefficient of interest is for an interaction term of $Treat * Post$. Compared with the control group, the firm size ($logAssets$) of the treated firms in the post event period is significantly larger. Coefficient for the interaction term of operating prof-

itability ($OROA$) is positive but trivial. With regard to investment activities, both total investment ($Investment$) and fixed assets investment ($Capex$) are significantly better for treated firms in the post event period. However, the coefficient of the interaction term for intangible asset investment is not statistically significant. The coefficients of the interaction terms of operating activities are mostly insignificant, except for job creation ($Employees$).

The results from the Diff-in-Diff analysis provide a more complete picture of how attention influences firm performance during the entrepreneur divorce period. Together with the declining trend in figure 2, the results in Table 12 indicate that divorce should not be considered as a purely harmful event. It can be tension, stress or conflicts between the couple that distract the entrepreneur from corporate duties and lead to worse firm performance. This happens even before divorce takes place. Divorce instead dissolves these conflicts and brings the business back to normal.

6.3 Placebo test

The previous results show that entrepreneur attention is especially important for firms' investment activities. Although a U-shaped curve can be observed, one concern is that it might be other trends such as mean reversion that drive the results. Therefore, I identify a group of entrepreneurs who stay in separation without getting divorced and compare their investment activities with those of divorced entrepreneurs. Separated entrepreneurs experience a similar amount of distraction as a result of their marriage conflicts. Without dissolution of the marriage, their wealth status does not change as much, whereas the distracting factors, such as tension and depression, are not alleviated. Hence, the deterioration of investment activities is supposed to persist with the firms led by separated entrepreneurs.

The results are illustrated with figure 3. The left panel displays the investment activities of firms run by divorced entrepreneurs, while the right panel shows the investment activities of firms run by separated entrepreneurs. As we can see from the right panel, both total firm investment and capex show a declining pre-trend. However, unlike the divorced group, the curves from separated entrepreneurs remain low instead of bouncing back during the separation period.

6.4 Entrepreneur Gender

Another concern is the influence of entrepreneur's gender on the results. Prior studies suggest that the traditional labor division within a marriage is unequal and women usually undertake more housework (Becker, Landes, and Michael, 1977). This implies that female entrepreneurs should be distracted more, especially within a marriage, than male entrepreneurs.

To gauge the impact of gender, I perform the baseline analysis in the gender subsamples and collect the results in Appendix Table 13. The upper panel shows the results for female entrepreneurs and the lower panel presents the results for male entrepreneurs. First, the results for male entrepreneurs are more consistent with the main finding because they are the dominant gender group of the main sample. Second, there were performance differences across gender groups during the divorce period. Female entrepreneurs are more negatively affected in the pre-divorce period, in terms of both general firm performance and firm investment activities. However, after divorce is filed, the unequal division of housework disappears, and female entrepreneurs demonstrate a faster recovery in professional performance than male entrepreneurs.

6.5 Primary Employer

If the entrepreneur also works inside the firm, his or her attention level is more critical to firm performance. Otherwise, the firm only enters into the entrepreneur's wealth portfolio. Fortunately, the data allow me to identify whether the firm is the primary employer of the entrepreneur. The test results in Appendix Table 14 are in line with the prediction. When the entrepreneur works for the firm, the negative impact on firm performance is more pronounced in the pre-divorce period. When the entrepreneur only owns the firm as a part of personal wealth, the negative effect on firm performance starts to be revealed from the divorce year onwards. While the upper panel results can be explained by the attention impact, the lower panel results seem more in line with the wealth impact of divorce.

6.6 Alternative Time Window

In the baseline analyses, the event window was seven years in total, with three years before and three years after the entrepreneur divorce year. To gain a better understanding of the divorce effect

begins to manifest, I vary the event window and break down the period year by year relative to the divorce event in Appendix Table 15. The results show that time-wise speaking, divorce impacts different firm aspects in a non-uniform manner. Although a pre-trend is observed from the year prior to divorce, some firm aspects unveil the worst effect earlier, whereas others have the worst consequences in the first year after divorce. The duration also varied from one to four years.

6.7 Firm Distress Level

Finally, I also examine whether entrepreneur divorce affects firms that were in distress before the event. I sort firms into distressed and safe group follows Altman Z-score (Altman, Iwanicz-Drozdowska, Laitinen, and Suvas, 2017) for private companies. Appendix Table 16 displays the results in two panels, where the distressed firms results are shown in the upper panel and the safe firms results are presented in the lower panel. I find that performance from both types of firms is negatively associated with entrepreneurial divorce. However, distressed firms are more adversely affected during the divorce period. It might be because entrepreneurs in this group have been busy ex-ante saving firms from bankruptcy.

7 Conclusion

This study investigates the relationship between entrepreneur's attention and corporate performance using a comprehensive dataset of Norwegian entrepreneurs and their controlling private firms. I use entrepreneurial divorce to introduce a quasi-exogenous shock to entrepreneur's attention level. I find that during the divorce period, entrepreneurs' privately held firms show poorer firm performance in terms of smaller firm size, lower profitability, and a higher likelihood of going bankrupt in three years. The evidence is in line with the view that leaders' human capital is critical to firm performance (Bennedsen, Pérez-González, and Wolfenzon, 2020).

My evidence sheds light on the importance of entrepreneurs' attention to leadership skills, especially in capital allocation decision-making. I show that during the marriage dissolution period, the inattentive entrepreneurs under-perform in "leader" tasks, measured by firm investment activities, whereas they can still perform well in "manager" tasks, measured by firm operational activities. The finding is closely related to Lu, Ray, and Teo (2016) and is consistent with the limited attention theory.

This theory asserts that inattentive investors tend to neglect important trading signals in the market and make worse investment decisions than their peers.

To verify the mechanism, I further show that during the divorce period, the negative impact on investment activities is stronger when the entrepreneur has low bandwidth. The adverse influence on investment performance is also stronger where leadership skills are required: when the entrepreneur takes the chair role and when the entrepreneur runs a larger firm.

Therefore, this study provides direct evidence for understanding how the limited attention theory works in the field of corporate decision-making. The findings highlight that entrepreneurs' inattention is devastating to the long-term growth and profitability of SME firms. Given the importance of SMEs, distracting events such as divorce can have a long-lasting impact on the economy (Haltiwanger, Jarmin, and Miranda, 2013). Simplifying the divorce procedure may shorten the distraction period and bring positive economic benefits.

My findings also add to the discussion on corporate disclosure requirements. The crucial personal life events of managers are not always disclosed to the public. However, such information can determine firm valuation and provide insights to external investors and creditors. For instance, venture capitalists can exploit profitable investment opportunities during divorce periods. Banks may consider the necessity of information disclosure regarding borrowers' marital status for better screening purposes.

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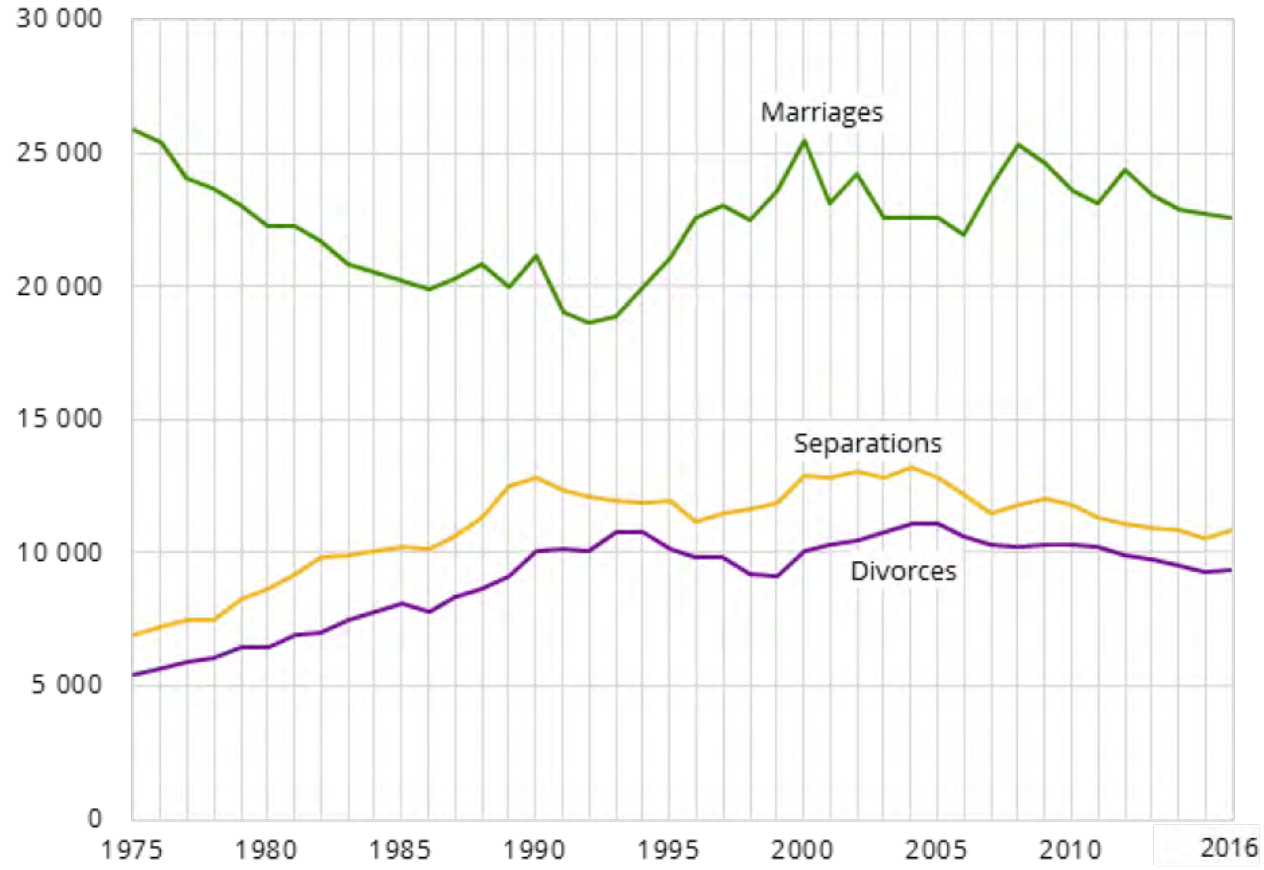
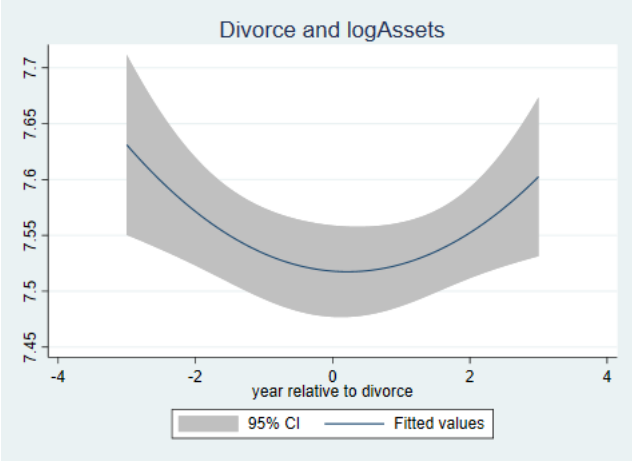
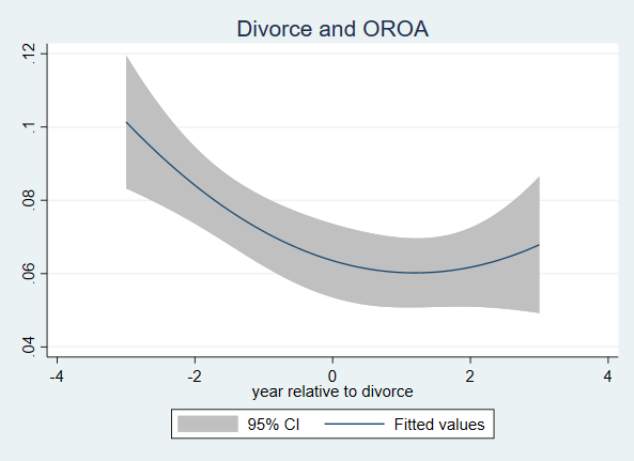


Figure 1: Marriage and divorce in Norway

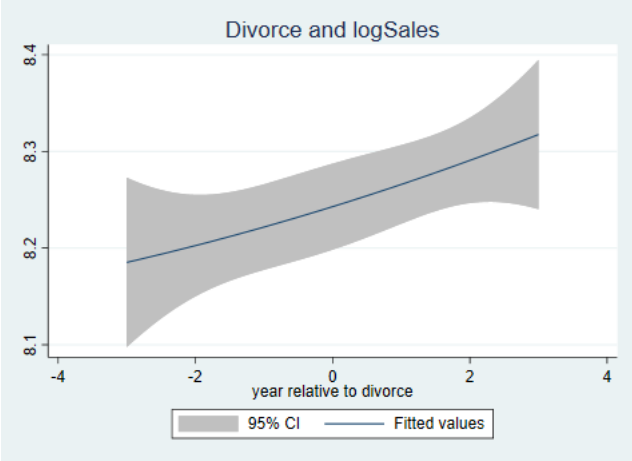
This figure illustrates population marriage and divorce trends in Norway from 1975 to 2016. The green line indicates the annual new marriage filed, the yellow line indicates new separations and the purple line indicates newly filed divorces. Source: Statistics Norway (ssb.no).



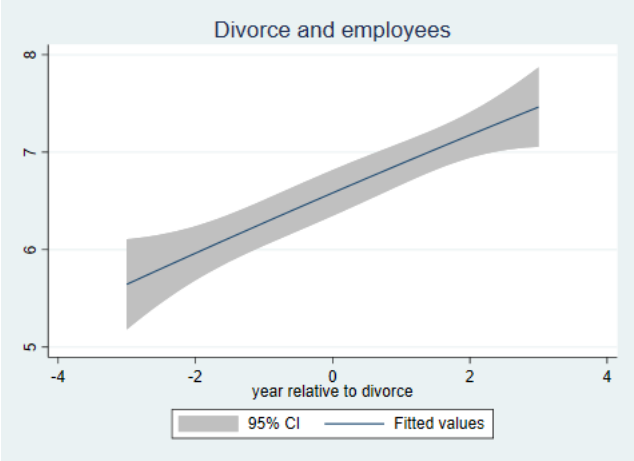
(a) Divorce and logAssets



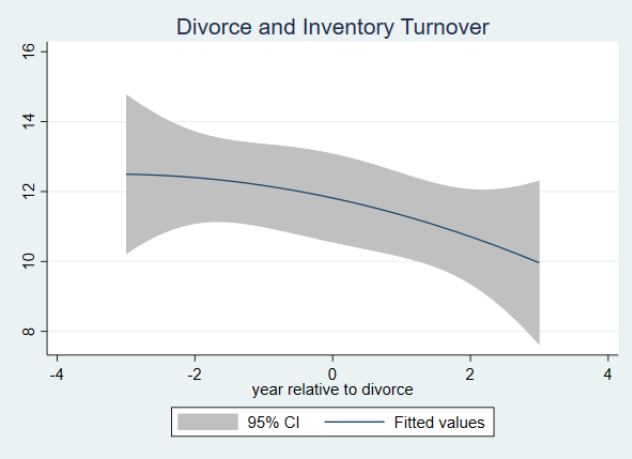
(b) Divorce and OROA



(c) Divorce and logSales



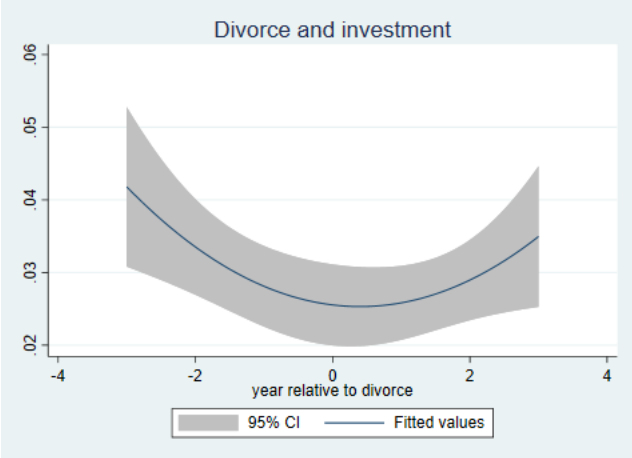
(d) Divorce and Employees



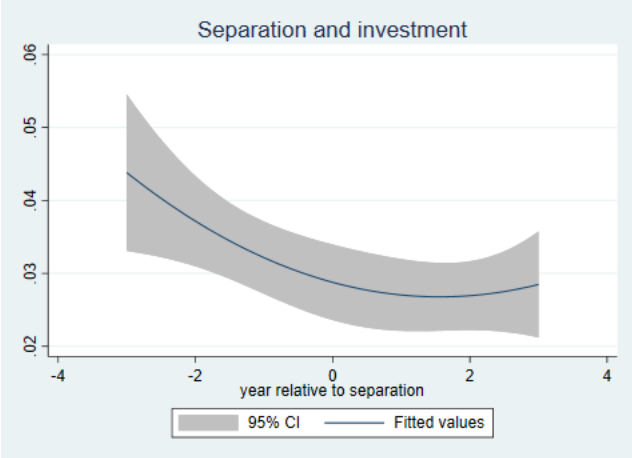
(e) Divorce and Inventory Turnover

Figure 2: Firm performance relative to divorce years

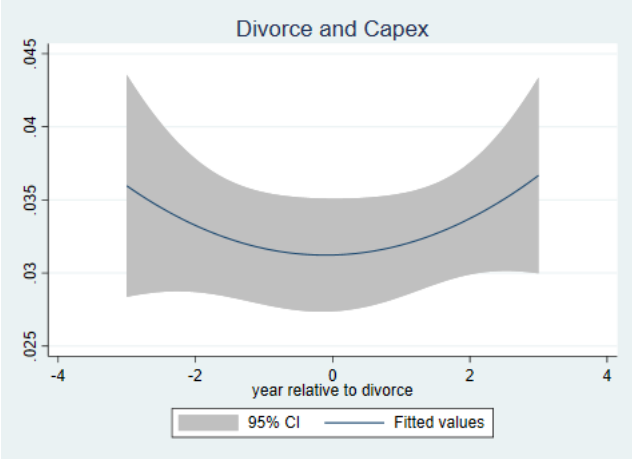
These figures illustrate the sample firm performance measures relative to the divorce year in a 7 year event window. Figure 2a plots the relationship between entrepreneurial divorce and firm size (log assets). Figure 2b shows the relationship between divorce and operational profitability (OROA). Figure 2c shows the sales revenue (log Sales), figure 2d shows employees and figure 2e shows inventory turnover. Variable definitions follow the Appendix Table 10.



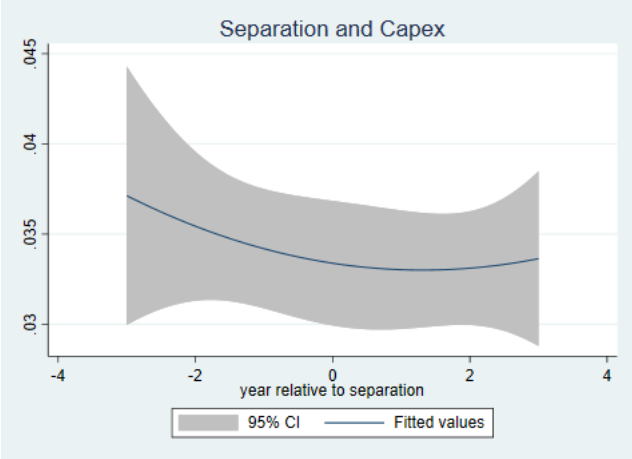
(a) Divorce and investment



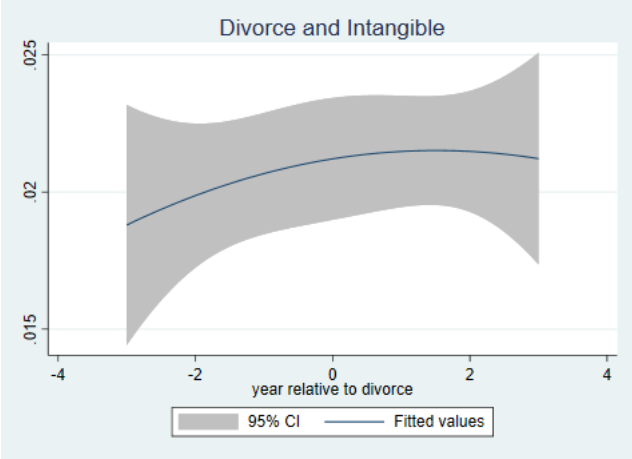
(b) Separation and investment



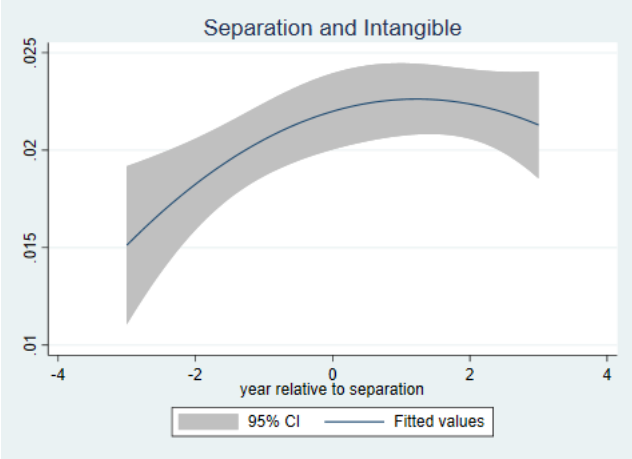
(c) Divorce and Capex



(d) Separation and Capex



(e) Divorce and Intangible



(f) Separation and Intangible

Figure 3: Firm investment relative to divorce years

These figures illustrate the sample firm investment relative to entrepreneurial divorce and separation in a seven-year event window. The figures in the left panel show the relationship between entrepreneurial divorce and investment proxies, whereas the figures in the right panel plot the relationship between separation and investment proxies. The separation group consisted of entrepreneurs who stayed separated without filing a divorce. Variable definitions follow the Appendix Table 10.

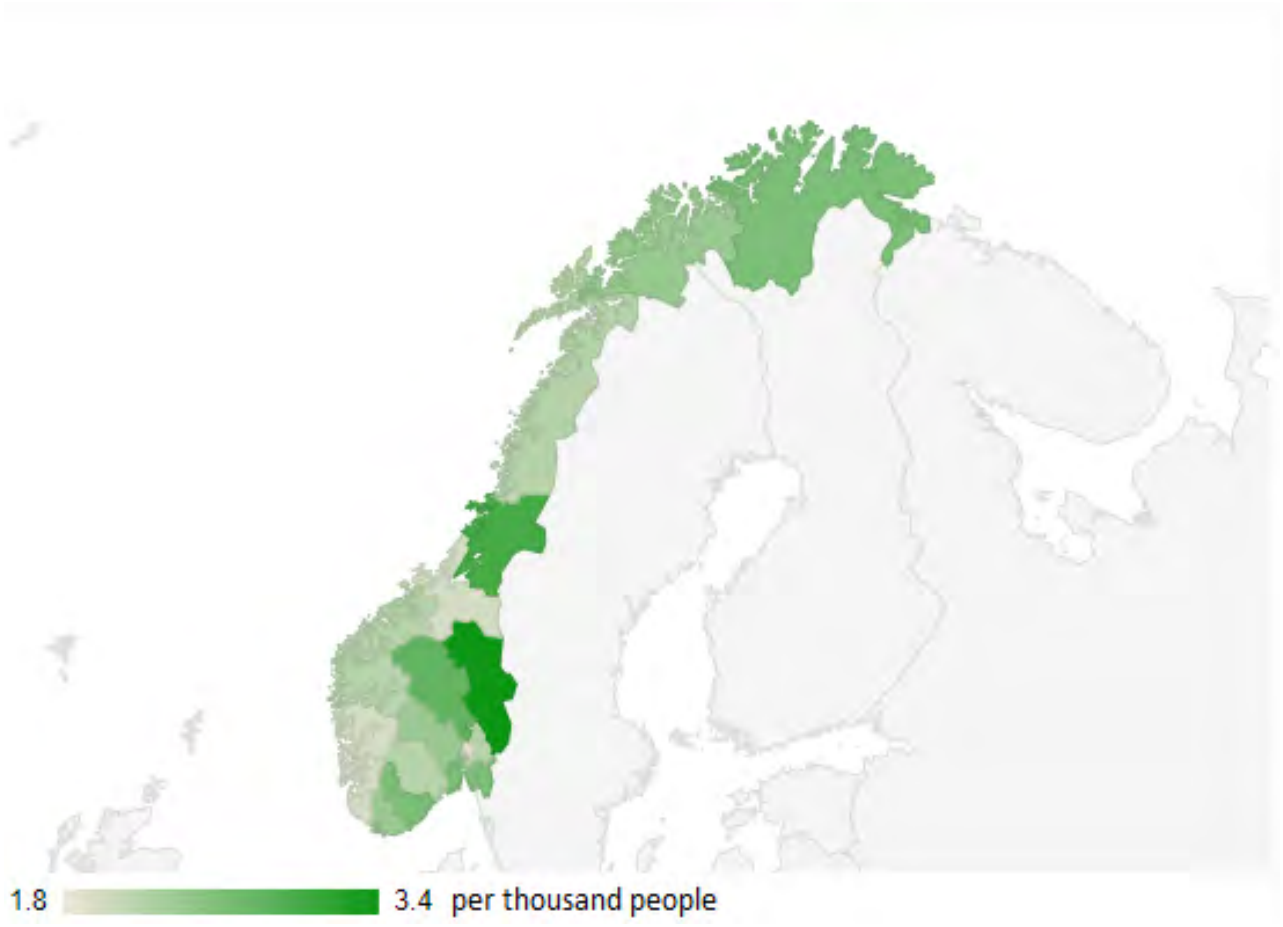


Figure 4: Divorces in Norway 2016

This figure illustrates the new divorced counts across Norwegian counties in 2016. The color gradient indicates the number of newly filed divorces, the darker the color the higher the density. Source: Statistics Norway (ssb.no).

Table 1: Distribution of Newly Divorced Entrepreneurs

This table provides the industry distribution of the sample Norwegian entrepreneur divorces from 2009 to 2016. Columns 1 and 2 show the number of observations and the frequency (in percentage) of firms that experienced an entrepreneur divorce event in the sample period. Columns 3 and 4 provide the industry distribution of the entire sample in the same period, regardless of the entrepreneur's marital status. The entrepreneur's marital status information was drawn from individual annual tax reports, provided by the Norwegian Tax Authority. The industry classification follows common industry groups SN2002 SN2007, according to the Norwegian Corporate Accounts database.

	Newly Divorced		Whole Sample	
	Obs.	Frequency	Obs.	Frequency
Agriculture	39	2.70	709	2.20
Offshore/Shipping	4	0.28	173	0.54
Transport	61	4.22	1257	3.91
Manufacturing	73	5.06	1916	5.95
Telecom/IT/Tech	44	3.05	960	2.98
Electricity	1	0.07	22	0.07
Construction	339	23.48	7478	23.23
Wholesale/Retail	358	24.79	8227	25.56
Finance	1	0.07	87	0.27
Other services	524	36.29	11359	35.29
Total	1444	100.00	32188	100.00

Table 2: Summary Statistics Sample Entrepreneurs Characteristics

This table reports the entrepreneur characteristics grouped by whether the entrepreneur's marital status was divorced during the sample from 2009 to 2016. Column 1 reports the mean values for non-divorced entrepreneurs whereas column 2 reports the means for divorced entrepreneurs. Column 3 shows the mean differences, and the corresponding t-statistics are presented in column 4. Variable definition follows Appendix table 10. All personal wealth variables are winsorized by year and municipality at 1% and 99% level. $***$ Significant at the 1% level, $**$ at the 5% level, and $*$ at the 10% level.

	Marital Status			
	Married	Divorced	Diff	t-stat.
Age	51.11	52.53	-1.42***	-19.99
Gender	0.70	0.69	0.01**	2.22
Ownership	0.49	0.51	-0.01***	-11.19
Private portfolio	988.27	907.78	80.48***	3.50
Personal debt	1199.05	1324.46	-125.41***	-10.57
Salary	442.64	439.86	2.78	1.31
Centrality	4.40	4.17	0.23***	12.22
Obs.	175,657	23,703		

Table 3: Univariate Analysis Divorce vs. Non-Divorce

This table reports the univariate cross-sectional analysis of entrepreneurial divorce and firm performance. Firms were grouped by the number of divorced entrepreneurs running the firm over the sample period between 2009 and 2016. Divorced entrepreneurs were defined using their marital status from their annual tax reports. Column 1 reports the characteristics of firms operated by 0 divorced entrepreneurs, column 2 reports the means of firms with one divorced entrepreneur and column 3 reports the means of firms with two divorced entrepreneurs. The mean differences are reported in column 4 for firms with 0 and 1 divorced entrepreneur, and column 5 between firms with 0 and 2 divorced entrepreneurs. Variable definitions are presented in Appendix Table 10. All firm variables are winsorized by year and industry at the 1% and 99% level. $***$ Significant at the 1%, $**$ at the 5%, and $*$ at the 10% levels.

	Number of divorced entrepreneurs			Difference	
	No divorced (1)	One divorced (2)	Two divorced (3)	No - One (1) - (2)	No - Two (1) - (3)
Total Assets	4355.97	4200.08	3076.46	155.89***	1279.51***
Size (logAssets)	7.59	7.56	7.34	0.03***	0.26***
OROA	0.08	0.07	0.05	0.01***	0.03***
Sales	7278.70	7823.13	6887.40	-544.43*	391.30*
logSale	8.15	8.26	8.12	-0.11	0.03
Sale Growth	0.11	0.09	0.10	0.02	0.01
Inventory Turnover	10.57	11.03	9.03	-0.46**	1.55**
Asset Turnover	2.52	2.76	3.00	-0.24***	-0.48***
Working Capital	0.20	0.17	0.08	0.03***	0.12***
Leverage	0.19	0.19	0.22	0.00***	-0.03***
Tangibility	0.18	0.17	0.18	0.01	-0.00
Capex	0.03	0.03	0.03	0.00**	0.00**
Cash Ratio	0.33	0.33	0.30	0.01***	0.03***
Dividend Payer	0.24	0.25	0.20	-0.01***	0.04***
Firm Age	13.11	13.75	12.46	-0.64***	0.65***
Employees	6.23	6.48	6.10	-0.25	0.13
Centrality	4.42	4.19	4.11	0.23***	0.31***

Table 4: Univariate Analysis Divorce Pre vs. Post

This table reports the univariate time-series analysis of firm performance for firms experiencing an entrepreneur divorce from 2009 to 2016. Firm characteristics are reported according to the year of divorce. Column 1 reports the means from three-year period prior to the divorce year, column 2 reports the means from the divorce year, and column 3 reports the means in the three-year period after divorce. The mean differences between the two periods are collected in column 4 (Pre-divorce and event), column 5 (Post-divorce and event), and column 6 (Post- and Pre-divorce). Variable definitions follow the Appendix Table 10. All firm variables are winsorized by year and industry at 1% and 99% levels, respectively. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	Year relative to divorce			Difference		
	Pre-Divorce (1)	Divorce Year (2)	Post Divorce (3)	Pre - Event (1) - (2)	Post - Event (3) - (2)	Post - Pre (3) - (1)
Size(logAssets)	7.57	7.50	7.56	-0.06	0.05	-0.01
OROA	0.09	0.06	0.06	-0.03***	0.01***	-0.02***
Sales	7181.12	7466.27	8070.99	288.73***	606.37***	892.00***
logSales	8.21	8.23	8.29	0.02**	0.06**	0.08**
Sale Growth	0.10	0.12	0.15	0.02**	0.03**	0.06**
Inventory Turnover	12.40	11.38	10.91	-1.02	-0.47	-1.49
Asset Turnover	2.63	2.90	2.90	0.28***	-0.01***	0.27***
Working Capital	0.16	0.10	0.11	-0.05***	0.01***	-0.04***
Leverage	0.20	0.20	0.19	0.00	-0.01	-0.01
Tangibility	0.19	0.18	0.18	-0.01***	-0.01***	-0.02***
Capex	0.03	0.03	0.03	-0.00	0.00	0.00
Cash Ratio	0.31	0.31	0.31	-0.01	0.00	-0.00
Dividend Payer	0.27	0.24	0.26	-0.02	0.01	-0.01
Firm Age	12.11	12.13	12.65	0.03**	0.52**	0.55**
Employees	6.04	6.80	7.10	0.77***	0.30***	1.07***

Table 5: Baseline Regressions: Divorced Event and Firm Performance

This table presents the multivariate regression analysis of entrepreneurial divorce and firm performance. The first eight columns show the OLS regression results whereas column nine shows the logit regression results. The dependent variables are firm size (logAssets), operation profitability (OROA), firm investment activities, firm operational activities and three-year survival(bankrupt in three years). Firm investment activities include total investment (Investment), fixed asset investment (Capex), and intangible asset investment (Intangibles). Firm Operational activities cover productivity (logSales), job creation (employees) and operational efficiency (Inventory Turnover). The main independent variables are dummy indicators for different periods around the entrepreneurial divorce event. Divorce Pre takes a value one if it is in the three-year period prior to entrepreneur divorce, and zero otherwise. Divorce event equals one if it is in the entrepreneur year of divorce, and zero otherwise. Divorce Post takes a value one it is in the three-year period immediately after entrepreneur divorce, and zero otherwise. All firm variables are winsorized by year and industry at the 1% and 99% levels, and are described in Appendix Table 10. The year, industry and regional fixed effects are shown in the lower panel. Robust standard errors are clustered at the firm-year level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	OLS								Logit
			Investment Activities			Operational Activities			
Y-variable	logAssets	OROA	Investment	Capex	Intangible	logSales	Employees	Inventory Turnover	Bankrupt in 3 years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Divorce Pre	**-0.046***	**-0.013****	**-0.006*****	**-0.004*****	0.000	0.005	-0.111	0.346	**0.320*****
	(-2.009)	(-2.731)	(-3.634)	(-3.752)	(0.608)	(0.286)	(-1.030)	(0.412)	(3.414)
Divorce Event	**-0.074***	**-0.026***	**-0.010****	**-0.005*****	-0.001	0.006	0.190	-0.050	0.158
	(-2.222)	(-2.103)	(-2.964)	(-3.508)	(-0.975)	(0.189)	(1.077)	(-0.055)	(0.965)
Divorce Post	**-0.071****	**-0.020*****	-0.005	-0.003	0.000	**0.038***	0.353	-0.736	0.153
	(-2.790)	(-5.000)	(-1.280)	(-1.166)	(0.799)	(2.055)	(1.807)	(-0.562)	(1.083)
lag Size		0.014***	0.001*	0.000	0.001***	0.815***	3.057***	2.951***	-0.148***
		(15.609)	(2.262)	(1.240)	(9.812)	(59.190)	(30.711)	(12.496)	(-5.949)
lag Tangibility	0.755***	0.014**				-0.458***	0.585*	5.736***	-1.085***
	(14.908)	(2.731)				(-7.566)	(2.118)	(4.498)	(-9.005)
lag Leverage	-0.080***	0.007	-0.009***	-0.005**	-0.002***	-0.151***	-0.436***	-2.017***	0.319***
	(-3.414)	(0.674)	(-4.050)	(-2.475)	(-4.813)	(-8.464)	(-5.232)	(-4.639)	(5.971)
lag Assets Turnover	-0.085***	0.000	0.004***	0.002***	0.000***	0.258***	0.835***	2.149***	0.076***
	(-9.914)	(0.226)	(9.066)	(7.929)	(5.280)	(10.281)	(11.583)	(8.649)	(7.871)
lag Sale Growth	0.009**	-0.000	0.001***	0.001***	0.000		-0.168***	-0.587***	0.037***
	(2.479)	(-0.331)	(4.503)	(4.390)	(1.668)		(-9.948)	(-14.142)	(4.084)
lag ROA	0.379***		0.030***	0.029***	0.001*	0.058	-1.051***	-0.330	-0.421***
	(9.776)		(8.250)	(11.119)	(2.207)	(1.224)	(-6.059)	(-0.877)	(-7.828)
lag Working Capital	0.333***	-0.031***	0.006***	-0.005***	0.002***	-0.057	-0.811***	-0.629	-0.145***
	(10.406)	(-5.036)	(6.510)	(-4.915)	(6.602)	(-1.671)	(-5.418)	(-1.444)	(-3.889)
lag Cash Ratio	-0.890***	0.116***	0.021***	-0.001	0.002***	-0.192***	0.300*	7.619***	-2.795***
	(-28.937)	(27.896)	(12.346)	(-0.691)	(4.371)	(-6.359)	(2.288)	(7.100)	(-19.841)
Dividends Payer	0.722***	0.192***	-0.011***	-0.008***	-0.002***	0.190***	-0.153	1.500***	-1.536***
	(44.005)	(75.579)	(-14.857)	(-16.125)	(-7.802)	(18.539)	(-1.592)	(3.357)	(-13.511)
Firm Age	0.017***	-0.001***	-0.000***	-0.000***	0.000**	-0.002***	0.011**	0.021	-0.037***
	(10.770)	(-6.403)	(-5.675)	(-7.703)	(2.991)	(-4.039)	(2.705)	(0.931)	(-8.458)
Gender	0.245***	0.007***	0.006***	0.004***	0.000**	0.085***	-0.358***	1.927***	0.016
	(21.602)	(3.527)	(10.507)	(9.658)	(3.295)	(7.529)	(-6.289)	(6.247)	(0.365)
Owner Age	-0.005***	-0.000***	-0.001***	-0.000***	0.000	-0.008***	-0.029***	-0.095***	-0.016***
	(-8.442)	(-3.396)	(-10.666)	(-14.401)	(0.060)	(-9.743)	(-5.744)	(-5.377)	(-7.111)
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	217845	217845	217845	217845	217845	217845	217845	217845	217732
adj. R^2	0.299	0.111	0.020	0.022	0.007	0.614	0.316	0.042	
pseudo R^2									0.142

Table 6: Instrumented Divorce and Firm Performance

This table reports the multivariate regression analysis of entrepreneurial divorce and firm performance using an instrument variable approach. Column 1 presents the first-stage analysis with a probit model, columns 2 to 6 display the second-stage least square regression results, and column 7 presents the second-stage logit model result. The dependent variables are firm size (logAssets), operational profitability (OROA), firm investment activities, firm operational activities and three-year survival(Bankrupt in 3 years). Firm investment activities include total investment (Investment), fixed asset investment (Capex) and intangible asset investment (Intangibles). Firm Operational activities include productivity (logSales), job creation (employees) and operational efficiency (Inventory Turnover). The probability of entrepreneurial divorce is instrumented by a dummy indicator capturing the dynamics of the municipality entrepreneur divorce rate from the previous year. The dummy variable takes a value one if the entrepreneur divorce rate from the municipality is higher last compared to the previous year, and zero otherwise. All firm variables are winsorized by year and industry at 1% and 99% levels, and are described in Appendix Table 10. Firm characteristics, year, industry and regional controls are indicated in the lower panel. Robust standard errors are clustered at the firm-year level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	First-Stage	2 - SLS								
										IV logit
				Investment Activities			Operational Activities			
Y-variable	Divorce	logAssets	OROA	Investment	Capex	Intangible	logSales	Employees	Inventory Turnover	Bankrupt in 3 years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$\widehat{DivorceEvent}$		**-23.114*****	**-1.381*****	**-0.317***	**-0.270***	-0.004	**2.270***	11.644	46.488	**24.280*****
		(-6.730)	(-4.396)	(-2.156)	(-2.060)	(-0.184)	(2.131)	(1.196)	(0.826)	(3.560)
lag Divorce Kommune	**0.286*****									
	(13.082)									
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	195862	217845	217845	217845	217845	217845	217845	217845	217845	217732
adj. R^2		0.301	0.111	0.021	0.023	0.007	0.614	0.316	0.042	
pseudo R^2	0.034									0.142

Table 7: Bandwidth: Divorce, Holding Number and Firm Performance

This table presents the multivariate regression analysis of firm performance around the entrepreneur divorce event, considering heterogeneous entrepreneur bandwidth. The upper panel shows the results for entrepreneurs holding one firm (high bandwidth) whereas the lower panel shows the results for entrepreneurs holding two firms (low bandwidth). The baseline analysis was performed for both subsamples. The dependent variables are firm size (logAssets), operational profitability (OROA), firm investment activities, firm operational activities and three-year survival(Bankrupt in 3 years). Firm investment activities include total investment (Investment), fixed asset investment (Capex), and intangible asset investment (Intangibles). Firm Operational activities include productivity (logSales), job creation (employees) and operational efficiency (Inventory Turnover). The main independent variables are dummy indicators for different periods around the entrepreneurial divorce event. Divorce pre equals one if it is in the 3-year period before the entrepreneur divorces, and zero otherwise. Divorce event equals one if it is in the entrepreneur's year of divorce, and zero otherwise. Divorce Post takes a value one in the three-year period immediately after entrepreneur divorce, and zero otherwise. All firm variables are winsorized by year and industry at 1% and 99% levels, and are described in Appendix Table 10. The firm characteristics, year, industry, and regional fixed effects are indicated in the lower panel. Robust standard errors are clustered at the firm-year level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

			Investment Activities			Operational Activities			
Y-variable	logAssets	OROA	Investment	Capex	Intangible	logSales	Employees	Inventory Turnover	Bankrupt in 3 years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Owner with 1 holding firm									
Divorce Pre	-0.009	-0.006	-0.002	-0.002	0.000	0.001	-0.068	-0.558	**0.250****
	(-0.364)	(-1.253)	(-0.781)	(-0.990)	(0.876)	(0.063)	(-0.581)	(-0.770)	(2.455)
Divorce Event	**-0.084*****	**-0.021****	0.007	0.004	-0.000	-0.027	0.092	-0.976	**0.453*****
	(-2.959)	(-2.423)	(1.463)	(1.059)	(-0.014)	(-1.134)	(0.683)	(-1.136)	(2.998)
Divorce Post	**-0.048***	-0.004	0.002	**0.004***	-0.001	-0.013	0.107	-0.759	**0.421*****
	(-1.704)	(-0.660)	(0.692)	(1.720)	(-1.206)	(-0.596)	(0.859)	(-0.873)	(3.298)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	142749	142749	142749	142749	142749	142749	142749	142749	142681
Panel B. Owner with 2 holding firms									
Divorce Pre	**-0.089***	-0.017	0.006	0.000	0.000	-0.045	-0.359	1.024	**0.605*****
	(-1.864)	(-1.293)	(0.880)	(0.025)	(0.585)	(-1.057)	(-1.170)	(0.740)	(3.122)
Divorce Event	**-0.163***	**-0.039***	**-0.028****	**-0.026*****	**0.004***	-0.047	-0.649	3.430	0.682**
	(-2.288)	(-2.153)	(-3.238)	(-5.979)	(2.255)	(-0.793)	(-1.678)	(0.877)	(2.353)
Divorce Post	-0.001	-0.029	-0.010	**-0.010****	0.000	-0.024	0.240	0.199	0.349
	(-0.014)	(-1.478)	(-1.389)	(-3.039)	(0.211)	(-0.446)	(0.531)	(0.115)	(1.360)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	28919	28919	28919	28919	28919	28919	28919	28919	28813

Table 8: Leadership: Divorce, Entrepreneur Role and Firm Performance

This table presents the multivariate regression analysis for firm performance around entrepreneurial divorce events with regard to the different entrepreneur roles. Panel A demonstrates the results when the entrepreneur plays the role of a daily manager, and panel B shows the results when the entrepreneur is the chair of the firm. The baseline analysis was performed for both subsamples. The dependent variables are firm size (logAssets), operational profitability (OROA), firm investment activities, firm operational activities and three-year survival(bankrupt in 3 years). Firm investment activities include total investment (Investment), fixed asset investment (Capex) and intangible asset investment (Intangibles). Firm Operational activities include productivity (logSales), job creation (employees) and operational efficiency (Inventory Turnover). The main independent variables are dummy indicators for different time periods related to the divorce event. Divorce event equals one if it is in the entrepreneur's year of divorce, and zero otherwise. Divorce Post takes a value of one in the three-year period immediately after entrepreneur divorce, and zero otherwise. All firm variables are winsorized by year and industry at the 1% and 99% levels, and are described in Appendix Table 10. The firm characteristics, year, industry and regional fixed effects are indicated in the lower panel. Robust standard errors are clustered at the firm-year level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	OLS								Logit
			Investment Activities			Operational Activities			
Y-variable	logAssets	OROA	Investment	Capex	Intangible	logSales	Employees	Inventory Turnover	Bankrupt in 3 years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Entrepreneur as the Daily Manager									
Divorce Pre	-0.047	**-0.011***	**-0.006***	-0.002	0.001	0.026	-0.072	0.149	**0.308****
	(-1.520)	(-1.828)	(-1.762)	(-1.129)	(1.156)	(1.326)	(-0.515)	(0.135)	(2.400)
Divorce Event	**-0.108****	**-0.034****	-0.011	-0.007	-0.001	0.039	0.352	-0.607	0.328
	(-2.496)	(-2.399)	(-1.432)	(-1.230)	(-0.686)	(1.083)	(1.403)	(-0.421)	(1.402)
Divorce Post	**-0.101****	**-0.022***	-0.002	-0.003	0.001	**0.068****	**0.443***	-1.785	0.202
	(-2.293)	(-1.768)	(-0.308)	(-0.732)	(1.308)	(2.232)	(1.722)	(-0.875)	(0.924)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	77172	77172	77172	77172	77172	77172	77172	77172	77138
Panel B. Entrepreneur as the Chair									
Divorce Pre	**-0.064***	**-0.012***	**-0.006****	-0.003	-0.000	0.021	-0.151	1.975	**0.377*****
	(-2.057)	(-1.873)	(-2.453)	(-1.621)	(-0.050)	(0.919)	(-1.307)	(1.566)	(2.982)
Divorce Event	-0.087	**-0.039****	**-0.013***	**-0.010***	-0.001	0.021	0.126	1.800	0.273
	(-1.713)	(-2.585)	(-1.896)	(-1.981)	(-0.594)	(0.485)	(0.659)	(1.265)	(1.216)
Divorce Post	-0.082	**-0.026****	-0.006	-0.002	-0.001	**0.079****	**0.520****	0.508	0.304
	(-1.855)	(-3.161)	(-0.841)	(-0.412)	(-1.026)	(2.517)	(2.359)	(0.300)	(1.565)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	99320	99320	99320	99320	99320	99320	99320	99320	99274

Table 9: Leadership: Divorce, Firm Size and Firm Performance

This table presents the multivariate regression analysis for firm performance around entrepreneurial divorce events for different firm sizes. Firms were sorted into quartiles according to the log total assets in the previous year. Panel A shows the results when the entrepreneur runs a firm in the smallest quartile, and panel B shows the results when the entrepreneur runs a firm in the largest quartile. The baseline analysis was performed for both subsamples. The dependent variables are firm size (logAssets), operational profitability (OROA), firm investment activities, firm operational activities and three-year survival(bankrupt in 3 years). Firm investment activities include total investment (Investment), fixed asset investment (Capex) and intangible asset investment (Intangibles). Firm Operational activities include productivity (logSales), job creation (employees) and operational efficiency (Inventory Turnover). The main independent variables are dummy indicators for different time periods related to the divorce event. Divorce event equals one if it is in the entrepreneur's year of divorce, and zero otherwise. Divorce Post takes a value one in the three-year period immediately after entrepreneur divorce, and zero otherwise. All firm variables are winsorized by year and industry at the 1% and 99% levels, and are described in Appendix Table 10. The firm characteristics, year, industry and regional fixed effects are indicated in the lower panel. Robust standard errors are clustered at firm-year level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	OLS								Logit
			Investment Activities			Operational Activities			
Y-variable	logAssets	OROA	Investment	Capex	Intangible	logSales	Employees	Inventory Turnover	Bankrupt in 3 years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Small firms									
Divorce Pre	**-0.040***	**-0.024***	-0.001	0.002	-0.000	0.021	0.068	1.994	**0.470*****
	(-1.762)	(-1.740)	(-0.141)	(0.542)	(-0.152)	(0.834)	(0.617)	(1.550)	(3.131)
Divorce Event	-0.020	**-0.051****	-0.008	-0.009	0.000	0.010	0.058	2.315	0.229
	(-0.603)	(-1.993)	(-0.847)	(-1.352)	(0.155)	(0.231)	(0.300)	(1.331)	(0.915)
Divorce Post	**0.081*****	-0.003	0.001	0.000	0.002	**0.073****	**0.454***	0.859	**0.362***
	(2.962)	(-0.174)	(0.131)	(0.042)	(1.024)	(2.286)	(1.880)	(0.780)	(1.785)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	54458	54458	54458	54458	54458	54458	54458	54458	54458
Panel B. Large firms									
Divorce Pre	0.039	0.000	**-0.009***	**-0.007****	0.000	-0.017	-0.328	-2.536	0.415
	(1.173)	(0.077)	(-2.301)	(-2.766)	(0.458)	(-0.448)	(-1.054)	(-1.211)	(1.517)
Divorce Event	-0.045	**-0.017***	**-0.014*****	**-0.009***	-0.000	-0.029	0.618	**-4.836****	0.250
	(-1.186)	(-2.165)	(-4.142)	(-1.919)	(-0.329)	(-0.496)	(1.176)	(-3.189)	(0.519)
Divorce Post	0.012	-0.016	**-0.011***	**-0.010****	-0.000	-0.045	0.622	-1.794	-0.563
	(0.274)	(-1.232)	(-2.110)	(-2.617)	(-0.311)	(-0.808)	(1.514)	(-0.548)	(-1.215)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	54456	54456	54456	54456	54456	54456	54456	54456	53239

Appendix

Table 10: Variable Definitions

This table provides the definition of the variables used in the analyses of the Norwegian entrepreneur divorce sample from 2009 to 2016. I retain firms with no more than three individual owners and with non-missing information on key variables. Values on financial statements, both firms and owners, are expressed in thousand kroners, inflation-adjusted (I use 2015 as base year). Firm accounting information is lagged by one year. All variables are winsorized at the 1% and 99% levels by year and industry (for firms), and by year and municipality (for entrepreneurs). Panel A defines firm-level features. Panel B defines the entrepreneur-level characteristics.

Panel A. Firm Characteristics	
Variable	Definition
Total Assets	Total assets of a firm, in thousand kroners, CPI adjusted.
Size	Natural logarithm of the total assets.
OROA	Operational profitability, the ratio of ebitda over total assets.
Sales	The sales revenue of a firm, in thousand kroners, CPI adjusted.
logSale	Natural logarithm of the sales revenue.
Working Capital	The ratio of current assets minus short-term liabilities to total assets.
Inventory Turnover	The ratio of cost of goods sold over the average value of inventory.
Assets Turnover	The ratio of total sales revenue over total assets.
Leverage	The ratio of total debt over total assets.
Investment	Ratio of investments to total assets of a firm. Investments include changes in tangible fixed asset, intangible asset, and long-term financial asset.
Capex	Ratio of property, plant and equipment (PPE) investment to total assets.
Intangible	Ratio of intangible investment to total assets of a firm. Intangible asset includes research and development (R&D), patents, deferred tax asset, and goodwill.
Cash Ratio	Ratio of cash and cash equivalent over total asset.
Firm Age	The age of the firm, using current year minus the founding year.
Dividend Payer	Dummy variable, equals one if the firm pays dividends, and zero otherwise.
Employees	Number of employees of a firm.
Centrality	Centrality score of a Norwegian municipality, scaling from 1 (the most central municipality) to 10 (the most remote municipality), from Statistics Norway.
Panel B. Entrepreneur Characteristics	
Variable	Definition
Ind_Age	The age of an individual owner.
Gender	The binary gender indicator, takes a value of one for men, and zero for women.
Ownership	Owner's ownership stake of the firm.
Divorced Owner	A binary marital status indicator, takes a value of one as divorced, and zero as non-divorced.
Divorce Event	A binary divorce event proxy, takes a value of one in the year of divorce, and zero otherwise.
Salary	An individual's annual salary income from firms, in thousand kroners, CPI adjusted
Public portfolio value	A wealth proxy to measure the value of an individual's total public equity holdings, in thousand kroner, CPI adjusted.
Private portfolio value	A wealth proxy to measure the value of an individual's total private equity holdings, in thousand kroners, CPI adjusted.
Personal debt	An individual's total debt outstanding, in thousand kroners, CPI adjusted.

Table 11: Summary Statistics Propensity Score Matched Sample

This table reports the descriptive statistics of the propensity score-matched firms. Firms experienced an entrepreneurial divorce event were sorted into the treated group. The control group consisted of firms that did not experience entrepreneur divorce. I match the control group with the treated group based on the pre-divorce period financials in the same year and industry on a one-to-one basis with no replacement through a propensity score matching approach. The sample means are reported in columns 1 (treated) and 2 (control group). Column 3 presents the mean differences and column 4 reports the t-scores. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	Treated	Control	Diff.	t
logAssets	7.501	7.467	0.034	0.792
Leverage	0.200	0.198	0.001	0.110
logSales	8.053	8.085	-0.033	-0.824
Sale Growth	0.384	0.313	0.071	1.489
Asset Turnover	2.844	2.938	-0.094	-1.185
OROA	0.112	0.117	-0.005	-0.409
Working Capital	0.120	0.128	-0.008	-0.406
Tangibility	0.191	0.189	0.002	0.228
Capex	0.036	0.037	-0.001	-0.179
Cash Ratio	0.313	0.321	-0.008	-0.942
Dividend Payer	0.239	0.240	-0.001	-0.083

Table 12: Staggered Difference-in-Difference: Divorce and Firm Performance

This table presents the staggered difference-in-differences analysis of entrepreneurial divorce and firm performance using a propensity score-matched sample. The dependent variables are firm size (logAssets), operational profitability (OROA), and firm investment activities and operational activities. Firm investment activities include total investment (Investment), fixed asset investment (Capex) and intangible asset investment (Intangibles). Firm Operational activities include productivity (logSales), job creation (employees) and operational efficiency (Inventory Turnover). The treated group consists of firms that experienced one divorce event during the sample period. The control group consists of firms that experienced no divorce events over the sample period. Post is a dummy that equals one if it is in the post event period, and zero otherwise. Firms are matched using a PSM method with no replacement, based on pre-divorce financials. All variables are winsorized by year and industry at the 1% and 99% levels, and are described in Appendix Table 10. The year, industry, and regional controls are indicated in the lower panel. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

			Investment Activities			Operational Activities		
Y-variable	logAssets	OROA	Investment	Capex	Intangible	logSales	Employees	Inventory Turnover
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Treat * Post	**0.101*** **	0.023	**0.024***	**0.021****	-0.001	0.041	**-1.042****	14.124
	(3.022)	(1.240)	(1.856)	(2.265)	(-0.564)	(0.643)	(-2.316)	(0.952)
Treat	-0.107***	-0.038**	-0.028**	-0.026***	0.002	-0.097	1.422***	-13.038
	(-3.374)	(-2.226)	(-2.228)	(-2.866)	(1.314)	(-1.391)	(2.922)	(-0.861)
Post	-0.087***	-0.022	-0.024**	-0.020**	-0.001	-0.068	0.927**	-18.852
	(-2.707)	(-1.265)	(-1.984)	(-2.266)	(-0.628)	(-1.142)	(2.135)	(-1.280)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	11497	11497	11497	11497	11497	11497	11497	11497
adj. R^2	0.911	0.132	0.019	0.022	0.006	0.591	0.400	0.046

Table 13: Robustness: Divorce, Entrepreneur Gender and Firm Performance

This table presents a robustness analysis of entrepreneurial divorce and firm performance with regard to gender. Panel A shows the results when the divorced entrepreneur is female, and panel B shows the results when the divorced entrepreneur is male. The baseline analysis was performed for both subsamples. The dependent variables are firm size (logAssets), operational profitability (OROA), firm investment activities, firm operational activities, and three-year survival (bankrupt in 3 years). Firm investment activities include total investment (Investment), fixed asset investment (Capex) and intangible asset investment (Intangibles). Firm Operational activities cover productivity (logSales), job creation (employees) and operational efficiency (Inventory Turnover). The main independent variables are dummy indicators for different periods related to the divorce event. Divorce event equals one if it is in the entrepreneur year's of divorce, and zero otherwise. Divorce Post takes a value one in the three-year period right after entrepreneur divorce, and zero otherwise. All firm variables are winsorized by year and industry at the 1% and 99% levels, and are described in Appendix Table 10. Firm characteristics, year, industry, and regional fixed effects are indicated in the lower panel. Robust standard errors are clustered at the firm-year level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	OLS								Logit
			Investment Activities			Operational Activities			
Y-variable	logAssets	OROA	Investment	Capex	Intangible	logSales	Employees	Inventory Turnover	Bankrupt in 3 years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Female Entrepreneurs									
Divorce Pre	**-0.063***	**-0.022***	**-0.008***	**-0.005****	0.001	-0.000	0.218	0.239	**0.519*****
	(-1.879)	(-1.943)	(-1.995)	(-2.352)	(1.416)	(-0.001)	(1.197)	(0.270)	(3.551)
Divorce Event	-0.033	-0.021	-0.003	-0.002	0.000	0.031	0.461	-0.418	0.377
	(-0.664)	(-0.874)	(-0.526)	(-0.408)	(0.105)	(0.737)	(1.345)	(-0.553)	(1.441)
Divorce Post	-0.026	**-0.027****	0.004	0.001	0.002	0.034	0.584	**-1.342***	0.085
	(-0.604)	(-3.290)	(0.709)	(0.210)	(1.705)	(0.969)	(1.611)	(-2.051)	(0.304)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	63500	63500	63500	63500	63500	63500	63500	63500	63422
Panel B. Male Entrepreneurs									
Divorce Pre	-0.036	**-0.010****	**-0.006****	**-0.003****	0.000	0.005	**-0.242***	0.388	**0.224****
	(-1.383)	(-2.886)	(-2.787)	(-2.505)	(0.201)	(0.302)	(-1.971)	(0.356)	(2.120)
Divorce Event	**-0.092****	**-0.028****	**-0.013****	**-0.006***	**-0.001***	-0.009	0.058	0.013	0.055
	(-2.539)	(-2.793)	(-2.765)	(-2.267)	(-2.060)	(-0.251)	(0.376)	(0.009)	(0.289)
Divorce Post	**-0.085****	**-0.017****	**-0.008****	**-0.005***	-0.000	0.033	0.229	-0.697	0.163
	(-2.745)	(-3.286)	(-2.315)	(-1.892)	(-0.102)	(1.694)	(1.134)	(-0.404)	(1.034)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	154345	154345	154345	154345	154345	154345	154345	154345	154253

Table 14: Robustness: Divorce, Entrepreneur Employment and Firm Performance

This table presents a robustness analysis for entrepreneurial divorce and firm performance, considering whether the firm also employs the entrepreneur. Panel A considers the situation in which the firm is the primary employer of the entrepreneur, whereas panel B displays the results when the entrepreneur is employed elsewhere. The baseline analysis was performed for both subsamples. The dependent variables are firm size (logAssets), operational profitability (OROA), firm investment activities, firm operational activities, and three-year survival(bankrupt in 3 years). Firm investment activities include total investment (Investment), fixed asset investment (Capex) and intangible asset investment (Intangibles). Firm Operational activities include productivity (logSales), job creation (employees), and operational efficiency (Inventory Turnover). The main independent variables are dummy indicators for different time periods related to the divorce event. Divorce event equals one if it is in the entrepreneur's year of divorce, and zero otherwise. Divorce Post takes a value one in the three-year period immediately after entrepreneur divorce, and zero otherwise. All firm variables are winsorized by year and industry at the 1% and 99% levels, and are described in Appendix table 10. Firm characteristics, year, industry, and regional controls are indicated in the lower panel. Robust standard errors are clustered at the firm-year level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	OLS								Logit
			Investment Activities			Operational Activities			
Y-variable	logAssets	OROA	Investment	Capex	Intangible	logSales	Employees	Inventory Turnover	Bankrupt in 3 years
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A. Firm as primary employer									
Divorce Pre	**-0.069****	**-0.013****	**-0.008****	**-0.007*****	**0.001****	-0.004	-0.128	0.604	**0.281****
	(-2.437)	(-2.769)	(-3.167)	(-4.464)	(2.723)	(-0.230)	(-0.902)	(0.577)	(2.214)
Divorce Event	**-0.067***	-0.009	-0.007	-0.005	0.001	0.038	0.138	-0.671	0.134
	(-2.192)	(-0.714)	(-1.516)	(-1.359)	(1.013)	(1.610)	(0.559)	(-0.692)	(0.559)
Divorce Post	-0.056	**-0.029*****	-0.001	-0.001	0.001	**0.047****	0.337	0.157	0.165
	(-1.770)	(-3.932)	(-0.307)	(-0.234)	(0.701)	(2.767)	(1.707)	(0.094)	(0.846)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	114871	114871	114871	114871	114871	114871	114871	114871	114816
Panel B. Employed elsewhere									
Divorce Pre	-0.015	**-0.013***	-0.005	-0.000	-0.000	0.017	-0.071	0.123	**0.423*****
	(-0.441)	(-1.831)	(-1.404)	(-0.178)	(-0.908)	(0.684)	(-0.464)	(0.126)	(3.431)
Divorce Event	**-0.077***	**-0.045*****	**-0.014****	-0.006	**-0.003****	-0.025	0.266	0.750	0.300
	(-1.786)	(-3.214)	(-2.025)	(-1.230)	(-2.153)	(-0.577)	(1.001)	(0.538)	(1.440)
Divorce Post	**-0.094****	-0.008	**-0.009***	**-0.007****	0.000	0.020	0.374	-1.654	0.242
	(-2.135)	(-0.832)	(-1.817)	(-2.029)	(0.254)	(0.518)	(1.470)	(-1.581)	(1.226)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	102974	102974	102974	102974	102974	102974	102974	102974	102916

Table 15: Robustness: Divorce, Time Dynamics and Firm Performance

This table presents a robustness analysis considering the time dynamism of entrepreneurial divorce and firm performance. The dependent variables are firm size (logAssets), operational profitability (OROA), firm investment activities, and firm operational activities. Firm investment activities include total investment (Investment), fixed asset investment (Capex), and intangible asset investment (Intangibles). Firm Operational activities include productivity (logSales), job creation (employees) and operational efficiency (Inventory Turnover). The independent variables were dummy indicators relative to the entrepreneur's divorce year. All variables are winsorized by year and industry at the 1% and 99% levels, and are described in Appendix Table 10. Firm and personal characteristics, year, industry and regional controls are indicated in the lower panel. Robust standard errors are clustered at the firm-year level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

			Investment Activities			Operational Activities		
Y-variable	logAssets	OROA	Investment	Capex	Intangible	logSales	Employees	Inventory Turnover
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Divorce_{t-1}	**-0.059****	**-0.020*****	-0.008***	**-0.004*****	0.000	0.019	-0.055	0.656
	(-2.157)	(-3.576)	(-3.222)	(-2.696)	(0.530)	(1.094)	(-0.417)	(0.732)
Divorce_{t}	**-0.075*****	**-0.025*****	**-0.011****	**-0.006***	-0.001	0.011	0.200	-0.082
	(-2.598)	(-2.895)	(-2.288)	(-1.882)	(-0.721)	(0.450)	(1.138)	(-0.088)
Divorce_{t+1}	**-0.085*****	**-0.030*****	-0.008	**-0.007***	-0.000	**0.047***	0.235	0.557
	(-2.768)	(-2.640)	(-1.517)	(-1.920)	(-0.088)	(1.856)	(1.365)	(0.434)
Divorce_{t+2}	**-0.070*****	**-0.007****	-0.002	**-0.001***	0.000	**0.040*****	0.104	-0.365
	(-4.274)	(-2.543)	(-1.506)	(-1.812)	(1.216)	(3.029)	(1.214)	(-0.746)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Personal Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	194527	194527	194527	194527	194527	194527	194527	194527
adj. R^2	0.303	0.110	0.022	0.024	0.007	0.610	0.312	0.041

Table 16: Robustness: Divorce, Firm Financial Health and Firm Performance

This table presents a robustness analysis for entrepreneurial divorce and firm performance under different firm stress levels. The upper panel shows the results from entrepreneurs running a distressed firm whereas the lower panel shows the results from entrepreneurs running a relatively safer firm. The division of whether firm is in a distressed status follows Altman Z-score for private firms (Altman, Iwanicz-Drozdowska, Laitinen, and Suvas, 2017). The dependent variables were firm size (logAssets), operation profitability (OROA), asset turnover, sales revenue (logSales), and job creation (employees). The main independent variables are dummy indicators for different periods related to the divorce event. Divorce event equals one if it is in the entrepreneur's year of divorce, and zero otherwise. Divorce Post takes a value one in the three-year period immediately after entrepreneur divorce, and zero otherwise. All firm variables are winsorized by year and industry at the 1% and 99% levels, and are described in Appendix table 10. Firm characteristics, year, industry, and regional controls are indicated in the lower panel. Robust standard errors are clustered at the firm-year level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

			Investment Activities			Operational Activities		
Y-variable	logAssets	OROA	Investment	Capex	Intangible	logSales	Employees	Inventory Turnover
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Distressed firms								
Divorce Pre	-0.100	-0.030	-0.007	0.003	0.002	0.068	-0.394	-0.907
	(-1.494)	(-1.283)	(-0.808)	(0.673)	(1.283)	(1.120)	(-1.778)	(-1.188)
Divorce Event	**-0.214***	-0.064	**-0.056****	**-0.023***	**-0.012*****	0.010	0.916	-0.503
	(-1.903)	(-1.551)	(-2.946)	(-2.020)	(-5.100)	(0.105)	(1.199)	(-0.368)
Divorce Post	-0.094	-0.031	-0.013	-0.014	0.002	0.007	0.090	-0.725
	(-1.087)	(-0.794)	(-1.720)	(-1.415)	(0.780)	(0.081)	(0.234)	(-0.872)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	22254	22254	22254	22254	22254	22254	22254	22254
Panel B. Safe firms								
Divorce Pre	**-0.046***	**-0.010***	-0.003	-0.003	0.000	0.012	0.129	1.171
	(-2.002)	(-2.161)	(-1.000)	(-1.662)	(0.268)	(0.631)	(0.891)	(1.048)
Divorce Event	-0.048	**-0.028****	-0.001	-0.003	0.001	-0.004	0.275	0.880
	(-1.773)	(-2.388)	(-0.244)	(-0.910)	(0.757)	(-0.135)	(1.263)	(0.617)
Divorce Post	**-0.068****	**-0.023*****	-0.003	-0.002	0.000	0.020	0.313	-0.289
	(-2.658)	(-3.998)	(-0.848)	(-0.828)	(0.282)	(0.782)	(1.315)	(-0.155)
Firm Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	141780	141780	141780	141780	141780	141780	141780	141780

Home Equity-Based Borrowing and Corporate Financing: Evidence from Norwegian Private Firms *

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Abstract

Home equity-based borrowing has been blamed in the literature for causing financial instability (e.g., Mian and Sufi, 2011). In this study, we examine the bright side of home equity-based borrowing. Using Norwegian administrative data, we investigate the relationship between financial constraints and business activities through the collateral channel. The finding suggests that owners' home equity withdrawals are positively associated with new equity injections into their closely held existing private firms. We show that this relationship is more pronounced when a firm is farther from urban settlements, larger in size, and the owner's home is more valuable. Firms demonstrate significant and long-lasting operational improvements as well as higher survival rates in the post extraction period. Finally, we find that home equity extraction encourages these experienced owners to repeat their success by setting up a new company in the same industry. Our findings provide insightful evidence for understanding how owners of small and medium-sized enterprises (SMEs) finance their firms. The findings in our paper generate important policy implications in that support a need of credit relaxation and assessment on ultimate impacts of lending policies.

Keywords: *Home equity, Entrepreneurship, Household finance, SME finance*

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1 Introduction

Small and medium-sized enterprises (SMEs) are the backbone in most of the economies, they contribute significantly to productivity growth and employment (Haltiwanger, 2012; Adelino, Ma, and Robinson, 2017). However, several influential studies have established that these firms are financially constrained owing to severe information asymmetry problem (Stiglitz and Weiss, 1981; Berger and Udell, 1998; Holtz-Eakin, Joulfaian, and Rosen, 1994). Alleviating the financial constraints faced by SMEs has been a primary focus of both policy makers as and the academics (e.g. Stein, Ardic, and Hommes, 2013; Banerjee and Duflo, 2014).

Nevertheless, an emerging body of literature has shed light on how households can pledge their homes to finance entrepreneurial activities (Fairlie and Krashinsky, 2012; Adelino, Schoar, and Severino, 2015, e.g.). Houses are usually the largest assets on households' balance sheets and housing has a huge impact on financial markets[1] (Chetty, Sándor, and Szeidl, 2017). Although Mian and Sufi (2011) argues that the rise of home equity-based borrowing is responsible for the 2007 - 09 U.S. subprime mortgage crisis, others claim that housing collateral plays a critical role in entrepreneurial finance (e.g., Corradin and Popov, 2015; Kerr, Kerr, and Nanda, 2015; Schmalz, Sraer, and Thesmar, 2017). These studies show that regional houses price appreciations, which increase households' home equity, can translate into aggregate new business formation. The mechanism of the collateral channel of housing is straightforward: an increase in households' home equity enhances collateral value and consequently boosts a bank's willingness to lend to homeowners' business ventures.

Extant literature shows that housing as collateral helps entrepreneurs overcome barriers to business entry. Owing to data limitation, the extent to which home equity alleviates financial constraints among existing private firms has rarely been analyzed in the literature. Bahaj, Foulis, and Pinter (2020) documents a positive relationship between an appreciation in the value of a director's home and firm investment using UK microdata. In their study, directors' homes were used as a guarantee for corporate borrowing. Nonetheless, there is still little evidence of how owners extract their home equity to fund existing firms on an on-going basis.

[1]For example, Bajaj, V. wrote "The slumping housing market has become the biggest worry for the stock market...because of its potential impact on the broader economy and financial system." in his article "Top lender sees mortgage woes for 'good' risks" in The New York Times, July 25, 2007

This study aims to bridge this gap by providing more evidence on the collateral channel of home equity. Our goal is to investigate whether home equity-based borrowing alleviates financial constraints among existing private firms using comprehensive Norwegian tax administrative data. The database covers the entire universe of private firms and their shareholders in Norway, from 2009 to 2015. The database contains detailed information from the shareholders' annual tax reports, including the tax value of their homes, personal liabilities and equity transactions in all companies, regardless of whether they are public or private. We also have access to annual corporate and accounting information for all private firms in the country.[2] The tax data are collected, digitized and maintained by the Norwegian Tax Authority, which ensures a high standard of accuracy and integrity. By matching the owners to their firms, we can directly observe a link between the changes in each owner's mortgage value and changes in firm ownership. We retain all private firms that are closely held by the owners, namely, up to three individual owners, so that the owners can be expected to have a strong incentive to extract home equity for firm financing.

Our main result suggests a positive and strong relationship between home equity-based borrowing and new equity injection behaviors among the critical owners to their closely held private firms. The log likelihood of a new equity injection is 34% when the owner extracts a mortgage. Conditional on mortgage extraction, the marginal propensity to inject equals 38 øre per extracted kroner. The magnitude suggests that the owner does not inject the extracted mortgage volume in full, which echoes the findings in the home equity-based borrowing and consumption literature (Greenspan and Kennedy, 2008).

In addition, we find this behavior to be more pronounced when the firm is financially constrained than the owner. We show that the relationship between home equity extraction and new equity injections is stronger when firms are located further from urban settlements, which provides easier access to bank finance. Moreover, larger firms with greater capital demand for investment are more likely to receive injections financed by home equity than small firms. Finally, we examine owners' levels of financial constraints by exploiting the variation in their home values. We document a higher chance of home equity-related injection when owners' homes are more valuable relative to both their neighbors' home values and the firm's assets. We consider these owners to be wealthier, and thus, less financially

[2]See detailed description in data sources section.

constrained. However, for owners running large firms, the value of the home is less important in making the injection decision, regardless of the valua of the home.

Next, we investigate how injected home equity affects the business activities of the firm. We demonstrate that firms show improved operational performance, measured in sales and profitability, after injection. These effects last for at least two years. Enhanced financial performance further prevents these firms from going bankrupt in the near future. Moreover, home equity-based borrowing enables owners to start new firms in the same industry based on their capabilities from their earlier firms.

We also consider several sources of endogeneity that may have affected our results. First, the decision to own a home is endogenously determined by the owner. Owing to rich Norwegian data, we can observe the residence address of an owner at the zipcode level. This allows us to hold the ownership of a home constant from the beginning of our sample to mitigate this concern. Second, regional economic conditions have been frequently mentioned as a possible confounder that correlates with the housing market in the literature (Mian and Sufi, 2011). We follow Schmalz, Sraer, and Thesmar (2017) to include regional-time fixed effects to control for unobserved economic trends at the local level. We include the industry-time fixed effect for a similar reason. We further control for potential regional credit shocks by fixing the bank-firm relationship in our geographical analyses. Third, we include a large set of owner characteristics along with firm characteristics in our analyses to account for owner-level heterogeneity. Finally, we conduct a series of additional tests to ensure our results are robust across different specifications on mortgage extraction thresholds, ownership stakes that affect owners' incentives to inject, and owners' preferences with regard to capital structure.

Our study builds on the extant literature on home equity-based borrowing. Several earlier papers show that credit constrained households borrow against their home equity to smooth consumption, improve homes, and repay debts (e.g. Hurst and Stafford, 2004; Greenspan and Kennedy, 2008; Mian, Rao, and Sufi, 2013; Berger, Guerrieri, Lorenzoni, and Vavra, 2018, etc.). This contributes to the real estate bubble, amplifies shocks to the real economy, and was responsible for the 2007-09 financial crisis (Mian and Sufi, 2011). We have added new evidence to the literature in two ways. First, we show that home equity-based borrowing connects the housing market to the real economy through the channel of corporate equity. Second, we document that the injection of firm capital accounts for only

a small proportion of the extracted home equity, suggesting that the majority of the withdrawals are used for other purposes.

Our study contributes to an emerging body of literature on housing collateral and entrepreneurial activities. This literature focuses on how home equity alleviates households' financial constraints and supports entrepreneurship (e.g., Adelino, Schoar, and Severino, 2015; Corradin and Popov, 2015; Kerr, Kerr, and Nanda, 2015; Schmalz, Sraer, and Thesmar, 2017, etc.). While these studies emphasize firm creation, Bahaj, Foulis, and Pinter (2020) shows how housing collateral facilitates corporate borrowing for existing private firms. We complete this literature by providing direct evidence on how home equity extraction relates to existing private firms' equity. The nature of Norwegian data allows us to precisely observe the funding flows between an owner's mortgage account and the equity account of his or her closely held firm. The data also allowed us to track firm performance after the injection. While Jensen, Leth-Petersen, and Nanda (2014) shows that households use the unlocked home equity to start firms with poorer than average quality in industries with no prior experience of the Danish mortgage reform, we argue that experience can make a significant difference. We document improved firm performance and long-term survival in the post injection period, suggesting that existing owners invest more financing value-creating growth than in saving struggling firms.

Our paper is closely related to Bahaj, Foulis, and Pinter (2020), where they show that a director's residential property is pledged as a guarantee to facilitate corporate borrowing from banks using a group of private firms in the UK. They found that a one-pound increase in directors' home value leads to a three-pence increase in corporate investment among these firms. Our study provides direct evidence of an alternative mechanism by showing how critical owners extract home equity and inject new equity into closely held firms.

The reminder of this paper is organized as follows. Section 2 provides the institutional background of the Norwegian housing market and formulates our main hypotheses. Section 3 describes the data sources, how we construct our sample and the key proxies, and provides the corresponding summary statistics. Section 4 presents the main analyses of extensive and intensive margins, explores financial constraints at the firm and owner levels, and performs post-extraction analyses. Section 5 tests the robustness of the results. Finally, section 6 concludes the study.

2 Home Equity and Corporate Financing

2.1 Institutional Background

Norway has higher than average home ownership among all OECD countries.[3]. Around 75% of the households own their houses (Almaas, Bystrøm, Carlsen, and Su, 2015). Usually, a home in Norway costs several millions NOK, [4] and the value of the house accounts for more than 60% of the gross wealth of Norwegian households (Statistics Norway). High demand for housing assets corresponds to a steadily growing Norwegian housing market. Figure 1 illustrates the overview of Norwegian housing prices in the post-financial crisis period from 2009 to 2015, using the 2010 price as an index. As we can see, the housing price shows a stable and significant increase from approximately 95% to over 115% of the 2010 house price.

The Norwegian housing market also leaves homeowners heavily indebted. According to the OCED database, approximately 2/3 of the Norwegian home owners have outstanding mortgages. A mortgage originates when a home owner buys a home. It equals the difference between the home's value, namely the asset value, and the homeowner's down payment, that is, the equity value. Therefore, the home owner actually owns the home's equity value. the equity value of the home is therefore the part actually owned by the home owner. Home equity is not constant over time; it can be changed either by an appreciation in house value or by the amortization of the mortgage.

In many countries, such as the U.S., mortgages can be refinanced with a new loan or at a different interest rate after a period of amortization. In the first case, the principal of the new loan is used to pay off the existing loan (the original mortgage minus the amortized part), and the owner can cash out the difference. In this case, the owner is cashing out the home equity. In Norway, mortgage refinance has been extremely convenient since the introduction of the "flexible credit" policy in 2005. This policy allows Norwegian homeowners to access the cash-out service of home equity, as if they were granted a renewable credit line. They can apply for this service at the same lending institution where they borrow mortgages. Once approved, they have the flexibility to withdraw money up to a certain limit,

[3]From OECD affordable housing database.

[4] The average home price was about NOK 4 million by the end of 2021. Source: https://eiendomnorge.no/housing-price-statistics
The average exchange rate of NOK/USD was 6.29 over the sample period. Source: norges-bank.no

usually at a 60% Loan-to-Value ratio and 5 Loan-to-Income ratio [5], for a period of 5 to 25 years.

This gives a homeowner an opportunity to raise a considerable amount of capital at mortgage rates, regardless of the purpose of use. Almaas, Bystrøm, Carlsen, and Su (2015) reports this amount to be over half a million per Norwegian household. Such borrowing is purely backed by home equity, using one's home as collateral. According to survey evidence by TNS Gallup in 2010, many Norwegian homeowners use home equity withdrawal for consumption smoothing, such as the purchase of a car, boat or cabin house. The usage of "flexible credit" by an average Norwegian homeowner is consistent with the findings from Mian and Sufi (2011). Mian and Sufi (2011) claim that home equity-based borrowing is mainly used for consumption purposes and introduces financial instability to an economy.

2.2 Hypotheses Development

Although many households extract home equity to smooth consumption, an emerging body of literature has shown that home equity can foster entrepreneurial activities. This is because young and small businesses often face financial constraints (e.g. Berger and Udell, 1998; Saunders and Steffen, 2011; Robb and Robinson, 2014, etc). Hence, entrepreneurs usually pledge their homes to obtain bank financing for start-ups. It is a common practice in many other countries, such as the U.S., the UK, Denmark, and France (e.g. Jensen, Leth-Petersen, and Nanda, 2014; Adelino, Schoar, and Severino, 2015; Schmalz, Sraer, and Thesmar, 2017; Bracke, Hilber, and Silva, 2018). By studying the behavior of Norwegian private firm owners, we intend to understand the impact of home equity-based borrowing on the existing private firms.

Home equity helps to alleviate financial frictions in at least two ways. On the one hand, an appreciation of housing value (an increase in home equity) increases the household's personal wealth, making entrepreneurship more affordable and encouraging her to experiment with business venture (e.g. Manso, 2016). This has been classified as a wealth effect which mainly impacts on new business creation. On the contrary, home equity-based borrowing helps mitigate the information asymmetry problem. A house can serve as a valuable asset to a bank upon liquidation. When an owner pledge his/her home as collateral which boosts banks' willingness to lend to the firm (e.g. Chaney, Sraer, and

[5] see: https://www.regjeringen.no/en/topics/the-economy/finansmarkedene/utlansforskriften/id2791101/

Thesmar, 2012). This is known as the collateral effect. A growing body of literature has built on this link (e.g. Corradin and Popov, 2015; Connolly, La Cava, Read, et al., 2015). In addition, pledging private home as collateral has a signaling effect. Housing has unique value to its owners and has been considered as one of the most effective methods to provide collateral (Coco, 2000). When an owner puts her home at stake, she also sends a strong signal to the bank that she has less incentive to shirk (Tirole, 2010).

Despite the fact that the focus of these studies is on start-up financing, they provide strong evidence that home equity can serve as an alternative source of financing to meet firm demands. We argue that the same logic can be applied to existing private firms. When a private firm faces financial constraints, we expect the firm owner to have an incentives to use home equity as an alternative source of firm financing. Bahaj, Foulis, and Pinter (2020) provides supportive evidence using a group of British private firms. They showed that directors pledged their homes as a guarantee to finance their firms on an on-going basis. They find this impact to be stronger when the firm is financially constrained, the residential property is valuable relative to the firm's assets, and the director is highly leveraged.

Thanks to the "flexible credit" policy, Norwegian private firm owners have more convenient access to home equity than UK owners. They can freely cash out home equity and inject funds as equity capital to ease the financial constraints of these firms. Therefore, we expect to observe a direct link between the extraction of home equity and the injection of firm equity among Norwegian private firm owners. We expect this relationship to be positive, and formulate the following main hypothesis below:

Hypothesis: *Home equity extraction is positively correlated with new equity injection behavior from owners to their closely held firms.*

We also expect this relationship to be pronounced when the firm or the owner faces financial constraints, as suggested in the literature. Thus, we modify the main hypothesis to the following two versions:

H1a: *Critical owners are more likely to withdraw home equity for firm equity injections, when the owners are financially constrained.*

H1b: *Critical owners are more likely to withdraw home equity for firm equity injections, when the firms are financially constrained.*

3 Data, Variables and Statistics

3.1 Data Sources

To analyze the relationship between home equity extraction and private firm equity injections, we constructed our main sample based on the annual tax declaration of the population of Norwegian private limited liability companies and their shareholders[6]. The data contains complete information on the unique identities, shareholdings, and equity transactions of Norwegian firms' shareholders from 2004 to 2016. Each equity transaction or holding record provides detailed documentation on the transaction type, date, price, share amount, tax, and total value. Each firm is assigned a unique organization number by the register of company accounts, whereas each shareholder is identified by his or her Norwegian personal ID number. Using this information, we can construct an annual ownership structure per firm and an annual holding portfolio per individual owner. The longitudinal dataset allows us to keep track of these firms' ownership changes, not only in the year of incorporation, like most of other entrepreneurship studies, but also in the continuous paid-in equity in the long run.

The Norwegian Tax Administration granted us access to personal debt and property items on shareholders' annual tax reports from 2009 to 2015. Personal debt and interest payment items are reported by banks and other financial intermediaries automatically at the end of the year to the Norwegian tax authorities, which is highly trustworthy. The tax value of the house is an estimated measure taking the size, age, and purchase price of the dwellings into account and is computed based on the regional house index. Therefore, it is a perfect proxy for home ownership and a good measure of relative property wealth. Using Norwegian personal ID numbers, we can identify firm owners and match their personal financial status with that of their privately held firms. The comprehensive nature of the dataset brings our research down to an individual level. The data also makes it feasible to control for many sources of unobserved heterogeneity in other studies.

[6]The approval to use this confidential database was granted and extended by the Norwegian Tax Administration on April 4, 2019, with strict confidential agreement on the usage, access and non-disclosure rules of the firms and shareholders' identities.

Using the firm organization number, we can link shareholders to their privately held firms using Norwegian Corporate Accounts with annual firm accounting and corporate information. The database covers all Norwegian public and private firms in Norway from 1992 to 2015 and is maintained by the Institute for Research in Economics and Business Administration AS (SNF) at the Norwegian School of Economics. [7] The database includes firms' balance sheets, income statements, and general corporate information, such as location, industry group, and board member constitution. In addition, we append tax data on bank-firm relationships using firm organization numbers. This allows us to trace the annual changes in firms' bank accounts.

3.2 Sample Construction

We construct our sample from 2009 to 2015 subject to the duration of the tax data. Over this period, the total number of firms grew gradually from 238,000 to 302,000, of which 85% were private limited liability firms (AS) and 85% of the private limited liability firms had no more than three personal owners. Given that they are representative components of Norwegian private firms, it is crucial to understand their financing behaviors.

Private limited liability ("AS") firms with no more than three owners allows us to gain a better understanding of how owners' newly contributed equity can affect their firms. We exclude shareholders with no home ownership or missing mortgage data, because these are the main factors assessed in our model. We filter out firms with no industry classifications. We exclude observations with missing control variables of our baseline regression, especially for firm assets. We also exclude owners holding more than three firms simultaneously because they tend to have more comprised cash flows across holding firms. Our final sample consisted of 315,945 owner-firm-year observations. These were 75,205 unique private firms and 87,761 unique shareholders. The firms and owners were from 433 municipalities in Norway.

Figure 2 shows that the total number of sample firms grew smoothly from 2009 to 2015. We split the sample firms according to their life stage: newly established entry firms, young firms at one or two years of age, and mature firms that are three years old and onward. The figure highlights the significant proportion of existing firms (young and mature firms) constituted among all the private firms

[7] See Berner, Mjøs, and Olving (2016) for detailed description of the database

compared with the newly established firms, whereas the latter is the focus of the start-up literature (e.g. Adelino, Schoar, and Severino, 2015; Schmalz, Sraer, and Thesmar, 2017).

Figure 3 shows the industry distribution of the sample private firms. These firms cluster in the construction, wholesale/retail, finance and other services industries. The firms in the construction sector are mainly real estate agencies, whereas the finance firms in our sample are predominantly financial consultancy firms. Therefore, the majority of the sample firms engage in light-capital industries with low entry barriers and quick exit possibilities. This is consistent with the findings from Adelino, Schoar, and Severino (2015).

Regarding the ownership variations, almost half (47%) of our sample firms have only one owner, approximately 37% have two owners, and about 15% have three owners. Most of our owners (79%) hold only one private firm in a firm year, and 16.5% hold two private firms simultaneously. Very few owners have significant holdings in more than three SME firms. Therefore, we retain our sample with owners possessing no more than three firms held simultaneous.

3.3 Key Proxies

$Equity\ Injection$ When new equity capital is injected into a firm, it is directly reflected in the financial statement for tax purposes. The data allow us to distinguish whether the equity injected is the incorporation capital or later rounds capital after the foundation stage. The later rounds equity injection of an owner is defined as an increase in the equity stake of privately held firms, including within-group transfers of capital (such as shareholder loans) and excluding incorporation capital. Figure 4 illustrates the magnitude of the aggregate equity injections received by these firms. Later rounds equity injections are of great importance to existing private firms. Each year, the overall injected equity amount is larger for existing firms than for new firms. The aggregate difference varied from appr. 100 million to 300 million NOK (equivalent to appr. 11 to 34 million USD). Therefore, later rounds equity injection is the variable of interest in our main analyses.

$Mortgage Extraction$ We then considered the source of funding from the owners' balance sheets. Our key source of funding was the owners' home equity. The richness of Norwegian tax data allows us to directly observe the change in owners' personal balance sheets at the portfolio level. [8] Noticing that

[8]The detailed subcategory data has been applied and is on the way of delivery.

mortgages have the lowest interest rate among all types of loans in Norway, we proxy the mortgage extraction using the following criteria: 1) the person should be a house owner (non-zero tax value of the house); [9] 2) the total loan amount compared with the previous year should increase; 3) the interest rate for the entire loan portfolio compared with the previous year should decrease; 4) the marginal interest rate should be lower than 5%. [10] The marginal interest rate for an owner i at the end of year t is estimated using the following formula:

$$Marginal\ Interet\ Rate_{i,t} = \frac{\overline{r}_{i,t} - \overline{r}_{i,t-1}}{\Sigma D_{i,t} - \Sigma D_{i,t-1}} \tag{1}$$

where $\overline{r}_{i,t}$ is the average interest rate of the total loan portfolio outstanding for an individual owner i at year t. $\Sigma D_{i,t}$ is the summation of all outstanding loan volumes that owner i have at year t. This estimate magnifies the marginal interest rate over the two years. Therefore, when the real marginal interest rate of an additional loan is less than 5%, this approach produces a stringent estimate. Section 5, we discuss alternative caps for the marginal interest rate in detail.

Figure 5 shows the aggregate home equity extraction from these firm owners. We also separate mortgage extractions from new firm owners and existing firm owners. As we can see, new firm owners extract more home equity using their houses as collateral than existing firm owners. However, when we look at the new equity injection behaviors of owners who extract home equity, it tells a different story. Figure 6 demonstrates the owners' new equity injections into their firms conditional on mortgage extraction. The aggregate injection volume from existing owners into their privately held firms is almost two to three times greater than the aggregate volume of equity capital owners use to found new firms every year.

3.4 Summary Statistics for Owners and Firms

3.4.1 Whole Sample

Table 1 provides summary statistics, by firm mean, for the owners and their privately held firms. Panel A demonstrates the owner's characteristics, and Panel B displays the firm's characteristics. We

[9] Throughout the analysis, we assume the owner does not purchase a second house if her primary address does not change.

[10] The highest mortgage rate was close to 5% in the beginning of the sample period.
See https://www.finansportalen.no/bank/boliglan-historikk.
Other loans, such as car, boat and consumer loans, have an interest rate above 5%.

adjust all absolute accounting values with the annual CPI and winsorize all continuous variables at the 1% and 99% levels by year and municipality for owners and by year and industry for firms. Detailed definitions of the key variables are provided in Appendix Table 12.

Panel A shows that the average age of the owners was approximately 49 years, and the majority of these owners were male (81%). With regard to their wealth portfolios, these people are all homeowners, and most of their wealth is allocated to their privately held firms, whereas only a small proportion goes to the public stock market. On average, firm owners have 2.16 million NOK of debt outstanding throughout the sample period. The average annual interest rate is 5% for these loan portfolios. Given that the mortgage enjoyed the lowest personal borrowing rate in Norway, and it mainly fluctuated under 5% throughout the sample period, we can expect that the main part of a representative owner's loan portfolio is the mortgage. The majority of the sample owners show an decrease in annual personal debt outstanding, which is reasonable because of the annual amortization of a mortgage. However, there is a certain proportion of owners who are increasing their borrowing, and we are interested in whether this behavior is related to equity injections. Equity injection does not seem to be very frequent, and only around 2% of owners exhibit this behavior each year. Nevertheless, equity injections from owners are nontrivial. The aggregated equity injection amount is considerable when compared to the foundation capital, as shown in the Figure 4.

Panel B shows the characteristics of firms privately held by these owners. These firms are considered as standard SMEs, given that the average number of employees is four and the average firm size is approximately 5.47 million NOK. They have 23% in terms of leverage and 11% in terms of operating profitability (ROA). Tangibility and capital expenditure are very low, which is in line with the fact shown in the industry distribution in Figure 3 that the majority of these firms operate in capital-light industries. We used the Norwegian centrality score to measure the geographical location of these firms. The centrality score is assigned by the Norwegian government on a scale from 1 to 10 to measure the geographical location of a municipality to the center of higher-order functions (urban settlements), such as banks, post offices, hospitals. The lower the score, the more central the municipality is. The centrality score reveals that many of these firms are remote. Moreover, many do not obtain new loans from banks. This is consistent with the literature that suggests small businesses have relatively limited access to bank financing owing to the information asymmetry problem (Berger and

Udell, 1998; Robb and Robinson, 2014). Limited access to bank financing makes equity financing financed by the home equity, even more relevant for these firms.

3.4.2 Owners with vs. without Extraction

Table 2 compares the owners' characteristics, conditional on whether the owner extracts mortgages or not, using the mortgage extraction criteria defined earlier. The left panel presents the characteristics of owners who perform mortgage extraction, whereas the right panel shows the characteristics of owners who do not extract mortgages. The differences between the two subsamples are shown in the last column, with levels of significance indicated.

As shown, owners with extractions are slightly younger and live in relatively more expensive houses. These owners have much higher personal debt outstanding, with a mean difference of 857 thousand NOK. The average interest rate of the loan portfolio was lower for the extraction group than for the group without mortgage extraction. With regard to mortgage extraction, they take out on average 808.79 thousand NOK, whereas owners in the group without extraction exhibit a mortgage amortization of 141 thousand NOK. The difference was close to one million NOK. The extraction group showed a slightly higher injection probability. However, the conditional probability was 50% higher. This also corresponds to almost double the equity injection amount compared to the non-extraction group. The mean injection amount was small because the frequency of injection was low in both groups. Considering income and private and public portfolio wealth, the differences between these two groups are not very large.

3.4.3 Firms with vs. without Injection

Next, we compare the firm characteristics between firms that receive owners' equity injections and firms that do not receive owners' equity injections conditional on owners' extract mortgages, and report the results in Table 3. When an owner extracts a mortgage, he/she can decide whether to inject capital into his/her closely held firm. The left panel shows the characteristics of firms with new equity injections, and the right panel presents the characteristics of firms without new equity injections. The mean differences are shown in the last column, with levels of significance indicated.

The results suggest that firms that received injection are almost 20% smaller in total assets than firms in the other group. They are also relatively higher in terms of leverage and lower in terms of

operating profitability. These firms are slightly more tangible, with more capital expenditure, although insignificant. The firms also have significantly lower working capital and cash ratios. However, with regard to the assets turnover ratio, firms that received injections were significantly more efficient. On average, they also have one more employee than firms in the other group. The results suggest that firms that received injections are apparently more constrained, compared with firms that do not receive owners' equity injections. Moreover, firms with injections have a small but slightly higher chance of obtaining new loans from banks. These firms seem to be in a stage demanding more capital, and their owners decide to use their home equity as a complementary source of financing to bank capital to develop their businesses.

4 Empirical Analyses

4.1 Baseline Results

To estimate the likelihood of an owner's mortgage extraction and new equity injection, we use the following logit equation for our baseline model:

$$\begin{aligned} Injection_{i,j,t} =& \beta_1 Mortgage\ Increase_{i,t} + \beta Bank\ Finance_{j,t} + \beta Firm\ Controls_{j,t-1} \\ &+ \beta Owner\ Controls_{i,t-1} + \alpha_{i,j} + \mu_{j,t} + \eta_{j,t} + \varepsilon_{i,j,t} \end{aligned} \tag{2}$$

The dependent variable $Injection_{i,j,t}$ is a dummy variable indicating new equity injection behavior from owner i to firm j at time t. It takes a value of one if there is an injection in the owner-firm-year, and zero otherwise. $MortgageIncrease_{i,t}$ is the key binary independent variable that equals one if an owner extracts mortgage in a particular year and zero otherwise. Regional economic development is typically correlated with the local housing market and may influence an owner's mortgage extraction decision as well as a firm's financing needs (Mian and Sufi, 2011). We use $\mu_{j,t}$ and $\eta_{j,t}$, the regional-time and industry-time fixed effects, to account for unobserved potential confounding effects at the regional and industry levels. We also use the same-year changes in firm bank financing as financing controls and lagged year firm balance sheet items as accounting controls. The rationale to include contemporaneous bank financing is because they are alternatives to equity money from mortgage extraction. In addition, we control for a large set of owner characteristics, such as income, marital status, and wealth portfolio components, to take care of owner-level heterogeneity. Robust standard errors are clustered at the firm-level.

Table 4 reports the full sample analyses of firm owners' mortgage extractions in relation to new equity injection decisions to their privately held firms based on different versions of baseline equation 2. From columns 1 to 6, we gradually append the additional controls specified in the lower panel. Column 1 shows pooled bivariate estimates between the owner's mortgage extraction and the new equity injection behavior. The coefficient indicates a positive and statistically significant relationship between the two behaviors. Column 2 adds the time fixed effect, column 3 includes the regional and regional-time fixed effects, and column 4 incorporates the industry and industry-time fixed effects. The coefficients of log likelihood gradually increase in magnitude from 0.363 to 0.376, when additional levels of fixed effects are involved. This means that the time-variant factors at the regional and industry levels cannot fully explain the correlation between owners' mortgage extraction and new equity injection behaviors.

In column 5, we add firm-level control variables including both concurrent bank financing indicators and lagged firm accounting variables. In column 6, we add the owner's personal characteristics. The additional firm- and owner-level control variables reduce the magnitude of the coefficients to 0.338 in the most exhausted model, resulting in an estimated average marginal effect of 0.65%. This means that after we take all firm and personal levels of controls and multiple levels of fixed effects into account, an owner's mortgage extraction behavior is associated with a 0.65% increase in the probability of new equity injection into his or her privately held firm. The magnitude, although quite small, is very similar to previous findings in the entrepreneurship literature. For example, Schmalz, Sraer, and Thesmar (2017) use French data and find that an increase in regional house prices increases the probability of a household in that region starting a business by 0.94%.

Moreover, home equity extraction serves as a complement to bank financing, rather than as a substitute. The coefficients of the bank loan proxy and mortgage extraction indicator share the same direction of sign and have similar magnitudes. This implies that when a firm is financially constrained, the owner of the firm may use home equity and bank financing interchangeably, as long as they are available. This largely mitigates concerns from the banking sector and policymakers regarding whether it is necessary to relax credit supply to the private sector, especially to SMEs.

Next, we considers its impact on the intensive margin. In particular, we examine the sample owners who extract mortgages and investigate the amount of money that they inject into their closely

held firms using a Tobit model. The dependent variable is the natural logarithm of the amount injected into a firm. The key independent variable was the log transformed mortgage extraction amount from the owner. When there was no injection, the dependent variable was replaced with 0. The model is censored at 0 to account for the zero-injection cases. The rest of the model specifications were similar to those of the baseline analysis.

Table 5 presets the results of the tobit model. The structure of this table follows that of the previous analysis. Column 1 shows the bivariate result, columns 2 to 4 add multiple levels of fixed effects, and columns 5 and 6 include firm- and owner-level controls, respectively. Since the analysis is performed purely on a group of owners who extract mortgages, the total number of observations is reduced from 315,945 in the baseline analysis to 80,789 in the current sample. The coefficients of interest in columns 1 to 4 gradually increase from 0.376 to 0.417. When we include firm control variables, the coefficient increases further to 0.429, suggesting that 42.9% of mortgage-extracted money is injected into the firm. Column 6 includes the owner control variables, and the coefficient drops marginally to 0.38, which is still close to 40% of the money extracted from the owner's home equity. Given that the average extraction from these owners is approximately 808 thousand NOK as shown in Table 2, the injected amount is approximately 400 thousand NOK.

In summary, our main regression results from Table 4 and Table 5 provide strong support for our main hypothesis that mortgage extraction is positively associated with new equity injection behavior among Norwegian private firm owners in terms of both probability and Kroner value. Previous U.S. studies, such as Mian and Sufi (2011) and Greenspan and Kennedy (2008), found evidence that home equity is most likely to be spent on purposes such as consumption or home improvement. Our findings suggest that, for Norwegian private firm owners, home equity is utilized as an alternative source of finance to bank credit to support existing businesses.

4.2 Heterogeneous Firm and Owner Constraint

In this section, we test hypotheses **H1b** and **H1b** by investigating how heterogeneous financial constraints at the firm and owner levels affect an owner's mortgage extraction and new equity injection behaviors.

4.2.1 Firm Location

First, we investigated how geographical location affected the sensitivity of this relationship. Although Norway is a developed country, there are substantial geographical variations across its territory. The Norwegian government developed a centrality score system to measure the geographical difference related to a center with high-order functions for each municipality.[11] High-order functions are functions usually found in urban settlements, such as banks and post offices. Since bank financing is fundamentally important to SMEs (Berger and Udell, 1998) and since bank financing largely depends on geographical distance to mitigate information asymmetry problems (e.g., Herpfer, Mjøs, and Schmidt, 2019), we expect that firms located in rural areas will face a disadvantage in accessing bank capital and rely more on home equity extraction as a critical source of finance, ceteris paribus.

We test this hypothesis by interacting mortgage extraction behavior with the proxy $Rural$. $Rural$ is a dummy proxy constructed based on the centrality scores. The scale of the centrality score ranges from 1 to 10. Scores 1 and 2 are assigned to the most popularized municipalities in Norway, such as Oslo, Bærum, Asker, Bergen, Trondheim and Stavanger, whereas scores from 3 onward are assigned to more remote areas that are further away from an urban settlement. See Appendix Table 12 for a detailed description. $Rural$ takes a value of one if a firm is assigned a centrality score greater than two and zero otherwise.

Table 6 presents the analysis results. We perform a baseline logit regression with different variations in each model and report the specification in the lower panel. Column 1 reports how geographical location changes the mortgage extraction and new equity injection relationship, controlling for the fixed effects at all different levels mentioned before. Column 2 includes the firm and owner levels of the control variables in addition to the fixed effects. Both results suggest that when a firm is located in a rural area, the owner is more likely to inject the extracted home equity into the firm, ceteris paribus.

Next, we explore whether this geographical variation derives from access to bank financing. We test this hypothesis in columns 3 and 4. In column 3 we fix the bank-firm relationship so that the firm is not able to develop a new bank-firm relationship to ease financial constraints, if there are any. The coefficient is similar to that found in column 2. Finally, we switch off this variation by allowing the

[11] The centrality score system was introduced in 1994.
See source link: https://www.ssb.no/en/klass/klassifikasjoner/128

firm to access new loans with a fixed bank-firm relationship in column 4. As shown, the significance of the coefficient of the interaction term disappears once the firm obtains new loans. The results support hypothesis **H1a** by showing that more constrained firms are more likely to receive home equity related injections. The findings highlight the importance of bank capital for SMEs financing, and the unequal distribution of such resources across urban and rural areas.

4.2.2 Firm Size

Second, we explored the influence of firm size on this relationship. Firms differ in size, and it affects the firms' demand for capital(Bahaj, Foulis, and Pinter, 2020). We expect large firms to be in greater need of additional capital to develop. Therefore, we sort firms into size quartiles based on the lagged year's total firm assets and test the sensitivity of the new equity injection to home equity extraction across different firm sizes.

Table 7 presents the results for the size subsamples. The first two columns perform logit regression models to account for the injection likelihood, while the last two columns execute the Tobit regression model to account for the volume impact conditional on home equity extraction. Columns 1 and 3 present the results for the small firm subsample, whereas columns 2 and 4 display the results for the large firm subsample. The coefficients of interest are larger for the large firm subsamples, both in terms of log likelihood and Kroner value, than those for the small firm subsamples.

This finding is in line with Bahaj, Foulis, and Pinter (2020), which studied directors' home equity and firm investment and found a stronger response among large firms. Larger firms typically have a greater funding demand for investment. They are also hurt more by negative credit shocks (Hetland and Mjøs, 2018). Pledging the director's house as collateral is one of the strongest signals to effectively mitigate the information asymmetry problem faced by SME firms (Coco, 2000). The results are also in line with hypothesis **H1a**.

4.2.3 Owner House Value

Finally, we shift the focus from firm-level constraint to owner-level constraint. In particular, we consider owners' ability to extract home equity by exploiting cross-sectional variations in their house values. We assume that an owner is less financially constrained when his or her home is more valuable. It makes more sense to pledge a more valuable home as collateral for additional financing for the firm.

We define high house value based on two standards: 1) relative to the neighbor's house value and 2) relative to the firm value. We construct a dummy proxy, $High|Neighbor$ as the first standard. An owner's house is considered valuable if the tax value of the house is above the 75th percentile of all the houses in the same municipality in a particular year. In this case, the proxy $High|Neighbor$ equals one and zero otherwise. Therefore, we benchmark the owner's house value directly to those of her neighbors. The second proxy is a binary indicator, $High|Firm$. We first construct a ratio of the tax value of the house to the assets value of the firm, following Bahaj, Foulis, and Pinter (2020). An owner's house is considered valuable if this ratio exceeds the median (36%) of the sample. In this case, the $High|Firm$ proxy takes a value of one and zero otherwise. Following this standard, we compare the owner's house value with the firm's value.

We perform an analysis on the owner's financial constraints using both standards and report the results in Table 8. The first two columns use the $High|Neighbor$ proxy; column 1 includes all the levels of fixed effects, and column 2 adds firm and owner levels of control variables. The coefficients of the interaction term are both positive and significant, suggesting that when an owner possesses a more valuable home, the likelihood of using home equity for new equity financing is higher. When we switch to the measure $High|Firm$ in columns 3 and 4, the results are similar but the coefficients are smaller in magnitude. The results reject hypothesis **H1b** by showing that home equity related injections are more common among less constrained owners.

Next, we carry out an additional test to determine whether an owner's house value or firm size influences the sensitivity of the owner's extraction and injection relationship. In columns 5 and 6, we split the firms into size subsamples based on the previous year's total assets, as in Table 7. Column 5 shows the results for the smallest quartile, and column 6 presents the results for the largest quartile. The key coefficient is still for the interaction term between mortgage extraction and high house value to the firm. We find the coefficient to be positive and significant for small firms and insignificant and negative for the largest firm group. For small firms, when an owner's house is relatively valuable to the firm, it is more likely for the owner to extract home equity and inject money into her closely held firm. However, when a firm is sufficiently large, the house value does not affect the owner's decision to use home equity for injection. The findings provide evidence that the firm size impact dominates the owner's house value impact.

It should be noted that the coefficient of mortgage extraction among large firms is still larger than of small firms, which is in line with previous findings from Table 7. Therefore, for large-firm owners, the value of the house is not an influential factor when they consider whether to inject home equity into their firms. This result is consistent with the argument of the signaling effect in Bahaj, Foulis, and Pinter (2020).

The results from this section suggest that both firm- and owner-level constraints can affect the relationship between home equity extraction and new equity injections for Norwegian private firm owners. When a firm is more constrained, as measured by the distance to urban settlements (access to bank financing) and firm size (need for development), this relationship is more pronounced. When an owner is less constrained, as measured by the relative value of the house, the response is stronger. However, the findings also indicate that the firm factor plays a more important role in owners' decision-making processes.

4.3 Post Extraction Analyses

In this section, we investigate the outcomes of home equity extractions. In other words, we are curious about what owners use for the extracted money. We conduct three sets of analyses: first, we examine firms' performance after equity injections; second, we check whether equity injections prevent these firms from bankruptcy; and third, we are interested in whether the owners intend to explore external investment opportunities.

4.3.1 Performance Analyses

Post-injection performance analyses were performed at the firm level. We construct a sample that contains only firms with owners who extract home equity. We define a year as an event year when we observe an equity injection from its owner after two years of no injection. We then exclusively keep firm-year observations within a 5-year window around the injection event, with two years before and two years after. Then, we test whether firm j improves its performance in the post injection period t using the model below:

$$Performance_{j,t} = \beta_1 Post\ Injection_{j,t} + \beta Firm\ Controls_{j,t-1} + \alpha_{i,j} + \mu_{j,t} + \eta_{j,t} + \varepsilon_{j,t} \quad (3)$$

The independent variable $Post\ Injection_{j,t}$ is a dummy proxy that takes a value of one if the observation is in the two-year period after the owner's equity injection and zero otherwise. The de-

pendent variables consider a set of firm performance measures commonly used in the entrepreneur literature(e.g. Schmalz, Sraer, and Thesmar, 2017; Aretz, Campello, and Marchica, 2020, etc.). We examined firm size ($logAssets$), profitability (ROA), sales ($logSales$), bank financing ($NewLoan$), job creation ($Employees$), and fixed asset investment ($CapEx$). We controlled for the lagged year firm characteristics in each model. We included $\alpha_{i,j}$, $\mu_{j,t}$ and $\eta_{j,t}$ as fixed effects to account for the firm, industry-time and regional-time levels of unobservables.

Table 9 presents the results of the post-performance analyses. We observe contrasting results between columns 1 to 3 and columns 4 to 6. We observe significant improvements in terms of firm size, profitability, and sales. However, no significant improvements were found for the other proxies, namely, bank financing, job creation, and fixed asset investment. This suggests that owners inject money to enhance firm operations and improve profitability, thus exploiting business opportunities. Nevertheless, we find that these firms do not recruit more employees or invest in fixed assets. The injection also does not help firms obtain more bank financing. This finding is in line with that of Banerjee and Duflo (2014). They found that constrained firms use credit to finance more production in a lending program and document a significant improvement in terms of sales and profits among these firms.

4.3.2 Exit Analyses

Thus far, evidence suggests that owners extract home equity to improve the operations of existing firms. We then examine whether home equity extractions also prevent bankruptcy. For owner i and firm j, the bankruptcy likelihood in year t is estimated using the following model:

$$\begin{aligned} Bankrupt\,N\,Years_{i,j,t} =& \beta_1 Mortgage\,Increase_{i,t} + \beta Bank\,Finance_{j,t} + \beta Firm\,Controls_{j,t-1} \\ &+ \beta Owner\,Controls_{i,t-1} + \alpha_{i,j} + \mu_{j,t} + \eta_{j,t} + \varepsilon_{i,j,t} \end{aligned} \tag{4}$$

The key dependent variables are a set of dummy indicators, $Bankrupt\,N\,Years_{i,j,t}$, taking a value of one if a firm j files for bankruptcy in N years after the owner's mortgage extraction year t, and zero if the firm does not go bankrupt. The remaining components in the model were identical to those in the baseline model.

Table 10 collects the results of the bankruptcy analyses. In columns 1 to 4, we gauge the bankruptcy likelihood from the extraction year to three years after the extraction. Mortgage extraction from an

owner significantly reduces the likelihood of a firm going bankrupt across all the models. As shown in the previous analyses, new equity is injected to improve the operations and profitability of the firm, which ultimately prevents the firm from bankruptcy.

4.3.3 Entry Analyses

Since we do not see any scale-up of the investment or job creation from existing firms, we wonder if owners extract home equity to explore external opportunities outside of existing firms. We perform an entry analysis after the owners extract mortgages, using the logit model below:

$$Entry_{i,j,t} = \beta_1 Mortgage\ Increase_{i,t} + \mu_{j,t} + \eta_{j,t} + \varepsilon_{i,t} \tag{5}$$

For owner i in year t, we check whether she establishes a new firm j. The dependent variable is the dummy indicator $Entry_{i,j,t}$. It equals one if an owner establishes a new firm, and zero otherwise. We separate two types of entry: establishing a firm in a new industry, and establishing a new firm in the same industry as the existing firm. We also control for the regional-time $\mu_{j,t}$ and industry-time $\eta_{j,t}$ confounders of the new business.

Table 11 reports the entry analysis results. Column 1 shows the pooled result for both types of entry, column 2 demonstrates the new sector result and column 3 displays the result on whether the new firm is in the same business sector where the owner already has experience. Model specifications are shown in the lower panels. We find positive and significant coefficients for mortgage extraction in column 1 and column 3, but not in column 2. The result of column 1 is mainly driven by the large weight of the subsample in column 3. The sample owners prefer to enter a familiar industry rather than explore new business opportunities in an inexperienced sector. The operating experience of the existing firm facilitates the entry decision of the owner. The result echoes the findings from the serial entrepreneur literature. For example, Lafontaine and Shaw (2016) point out that a serial entrepreneur who opens repeated businesses can utilize her prior experience to make the next business more successful.

5 Additional Robustness

Thus far we have established that owners' home equity extraction behaviors are positively associated with their new injections into their privately held firms. In this section, we provides additional robustness tests for our main results. We first consider alternative thresholds for our mortgage extraction measure and then account for owners' incentives to inject equity in terms of ownership stake and firm initial leverage.

5.1 Alternative thresholds

One of the concerns is the identification of mortgage extraction behavior. Our data allow us to directly observe the owner's balance sheet with details of personal debts at portfolio level.[12] Our mortgage proxy is defined using four criteria mentioned in section 3.3, namely home ownership, increase in debt, decrease in portfolio interest rate, and marginal interest rate below 5%. A cut-off of 5% in the marginal interest rate is decided based on the observations of historical mortgage rate over the sample period.

In this analysis, we apply alternative and stricter thresholds for the marginal interest rate, ranging from 2% to 4%, to perform the same baseline analysis. With a lower cut-off, the measure is cleaner, because personal loans other than mortgages cannot offer such a low rate as the mortgage rate. We report the results in Appendix Table 13. Columns 1 to 3 display the analysis with dummy indicators of mortgage extraction at different cut-off rates using logit models, whereas columns 4 to 6 demonstrate the log-transformed volume analyses using Tobit models. The corresponding threshold is shown in the upper panel of each column. We include all of the aforementioned control variables and specify them in the lower panel.

As we can see from columns 1 to 3, all mortgage extraction proxies have positive and significant coefficients. The coefficients of the log likelihood gradually increase from columns 1 to 3, from 0.283 to 0.335, because more extraction behaviors are considered from home equity under the corresponding standard. The right panel shows the extraction and injection amounts following the same procedure. Column 4 to 6 show a similar pattern with regard to the change in coefficients. All coefficients of

[12] Subcategory loan data will be provided by the Norwegian Tax Authority in later delivery.

the extracted amount remained significant and positive, with a gradually increasing trend from the lowest cut-off rate to the highest cut-off rate. At a 2% cut-off rate, a 1 percent increase in the owner's extraction amount is associated with a 0.22 percent increase in the equity injection amount into the firm. At a 4% cut-off rate, the injection amount increased marginally to appr. 0.25 percent. This subtle change indicates that our mortgage measure is robust toward marginal interest rate specifications.

5.2 Ownership Variation

Previous analysis shows that incentives play a role when an owner's house is relatively valuable to the firm. Another way of thinking about the incentive scheme is whether a firm is meaningful for the owner to put his or her own home at stake. Too little ownership may not give the owner enough skin in the game to risk her own house. Therefore, we expect an ownership stake inside a firm to have an impact on the owner's decision to inject home equity.

We divide our sample into five groups by an interval of 20% in firm ownership, from less than 20% to above 80%. We then perform the baseline analysis across each subsample and report the results in Appendix Table 14. As shown, the coefficient for the lowest shareholding group was the smallest, with a log likelihood of 0.297. When an owner has a low ownership stake in a firm, he/she has less skin in the game and is less likely to use his/her own house as collateral for firm financing, as predicted. However, the largest coefficient is found when the owners possess 60% to 80% of the firm's shares, rather than the above 80% ownership group. The relationship between ownership and incentives for home equity-related injections is non-linear. It seems that as long as a certain threshold has been passed, the incentive is sufficient, and the home equity-related injection is no longer aligned with the ownership stake any more.

5.3 Capital Structure

In Section 4.2, we discussed how firm-level constraints make an owner more likely to use home equity for injection. The leverage ratio plays a crucial role in determining how constrained a firm is, and also reflects an owner's risk preference (Cronqvist, Makhija, and Yonker, 2012). In this subsection, we verify whether an owner's initial risk preference influences home equity-related injection behavior.

We split our sample firms based on lagged year leverage ratio and performed a baseline analysis across these subsamples. The results are collected in Appendix Table 15. We use a separate group for zero-leverage firms because these owners may have different concerns when considering external finance (Strebulaev and Yang, 2013). We find that the highest likelihood of injection using home equity is among the group with a 0.2 to 0.4 initial leverage ratio. The most constrained group, with a leverage ratio above 0.6, also shows a high injection probability once the owner extracts home equity. Capital structure choice involves complicated decision-making. It is difficult to draw any hard conclusion on home equity-related injection behavior purely based on an owner's preference for capital structure. This is a task that we leave for future research.

6 Discussion and Conclusion

This paper investigates the relationship between home equity extraction and the owners' equity injection behavior via the collateral channel. The rich Norwegian tax administrative data allows us to directly observe the relationship between private firm owners' mortgage refinancing and the changes in their firm equity ownership at the individual level. We find that home equity extraction is positively related to an owner's continuous equity injection into his or her closely held private firm. The marginal propensity to inject is approximately 38 øre for every kroner extracted from the home equity. Given its magnitude, home equity provides great potential for SME financing.

We further document that home equity-related injection behavior is more pronounced when a firm is located further away from urban settlements, is larger in size, and the owner's home is relatively valuable. The findings suggest that home equity-related injections alleviate a firm's financial constraints. The injected capital is used to improve firm operations, prevent bankruptcy, and facilitate the owner's exploiting of business opportunities by establishing a repeated business in the same industry.

Our findings highlight the financing constraints faced by small and medium-sized enterprises (SMEs) and the degree to which home equity-based borrowing can help mitigate this problem. We provide direct evidence of how home equity-based borrowing serves as an alternative source of financing for existing private firms on an ongoing basis, offering them a real option to stay in business even with unsatisfactory financial health. Given the risks associated with small and private firms, banks may be reluctant to provide finance to these firms, leaving them with new equity capital as their sole

capital source. However, SMEs are considered the growth engine of an economy, with great potential for innovation and employment (Haltiwanger, Jarmin, and Miranda, 2013). Our study sheds light on the need for credit relaxation.

Nonetheless, home equity-related injections also tie the housing market closer to the private sector. Banks, thus, lose track of the cash flows of their lending, despite the fact that homes are pledged as collateral. The actual business risk being financed is mismatched with mortgage risk. Therefore, our study also has meaningful implications for assessing the ultimate impact of macroprudential policies.

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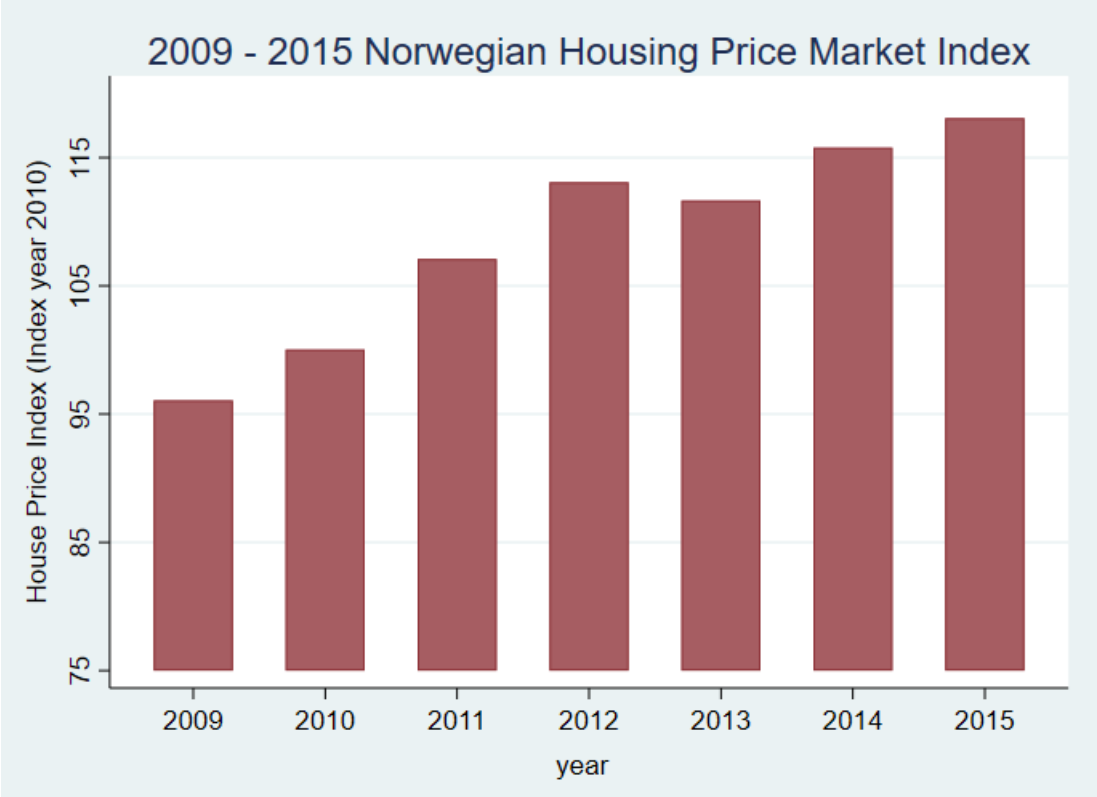

Figure 1: Norwegian Housing Market Index 2009-2015

This figure illustrates the Norwegian housing market price index from 2009 to 2015. The bar plot shows the housing price index using 2010 as the benchmark. Source: Statistics Norway and the Bank for International Settlements (BIS).

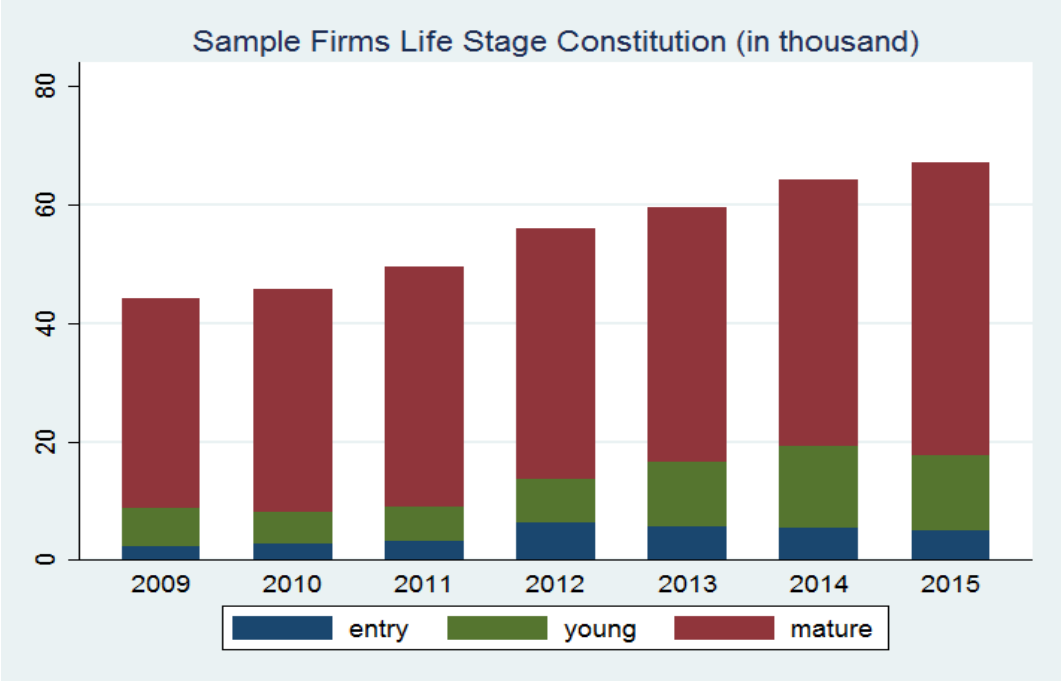

Figure 2: Sample Firms Constitution by Firm Life Stages 2009-2015

This figure compares newly established firms with existing firms in terms of the total number of firms from 2009 to 2015. The sample consists of Norwegian private limited liability firms with no more than three individual owners. We split the sample according to the firm life stage: entry firms are established within one year, young firms are firms between two and three years old, and mature firms are firms older than three years.

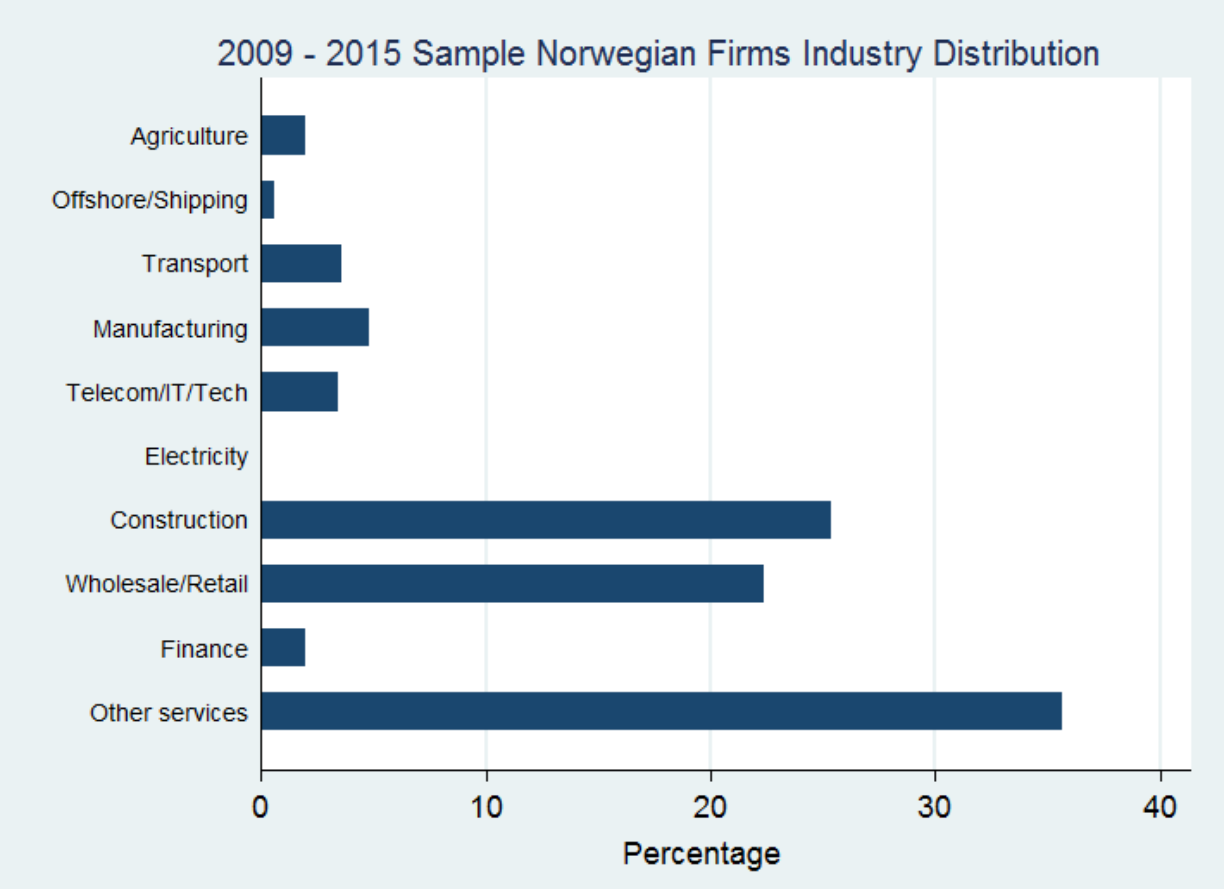

Figure 3: Sample Firms Industry Distribution 2009-2015

This figure shows the industry distribution of Norwegian private firms as percentages. We retain private firms with no more than three individual owners. Industry group is based on the variable "bransjegr_07" in the Norwegian Corporate Accounts database.

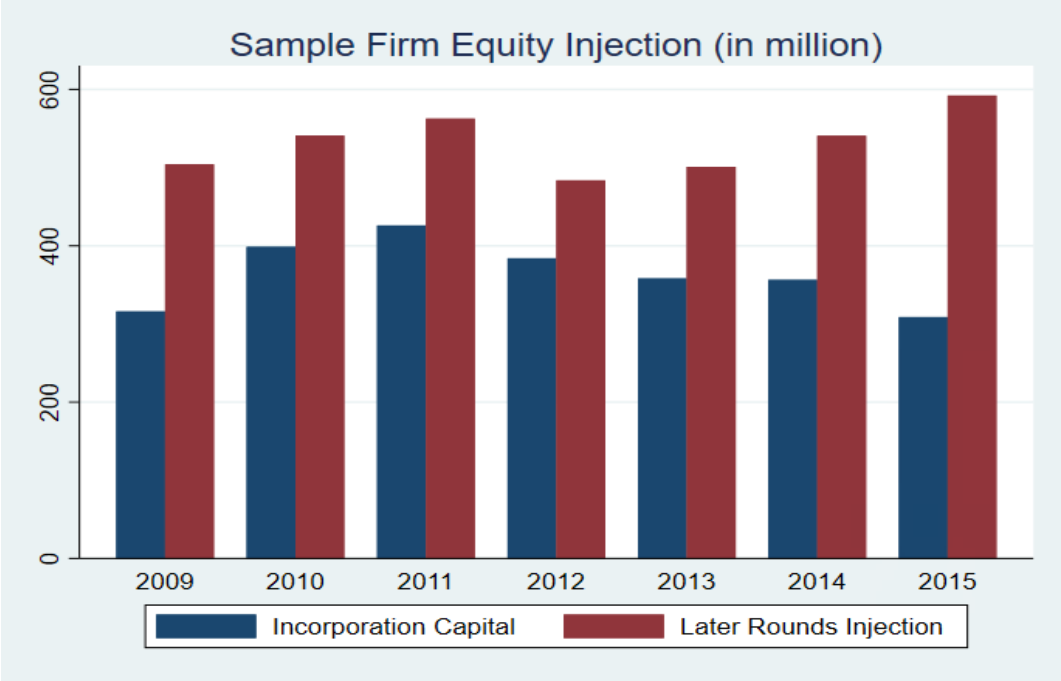

Figure 4: Sample Firms Injection Amount 2009-2015

This figure compares newly established firms with existing firms in terms of total new equity injection volumes from 2009 to 2015. The sample consists of Norwegian private limited-liability firms with no more than three individual owners. It illustrates the aggregate annual new equity injections from owners to these firms. The incorporation capital is contributed by owners in the founding year. The later rounds injection is the new equity injected from owners once the firm has been established.

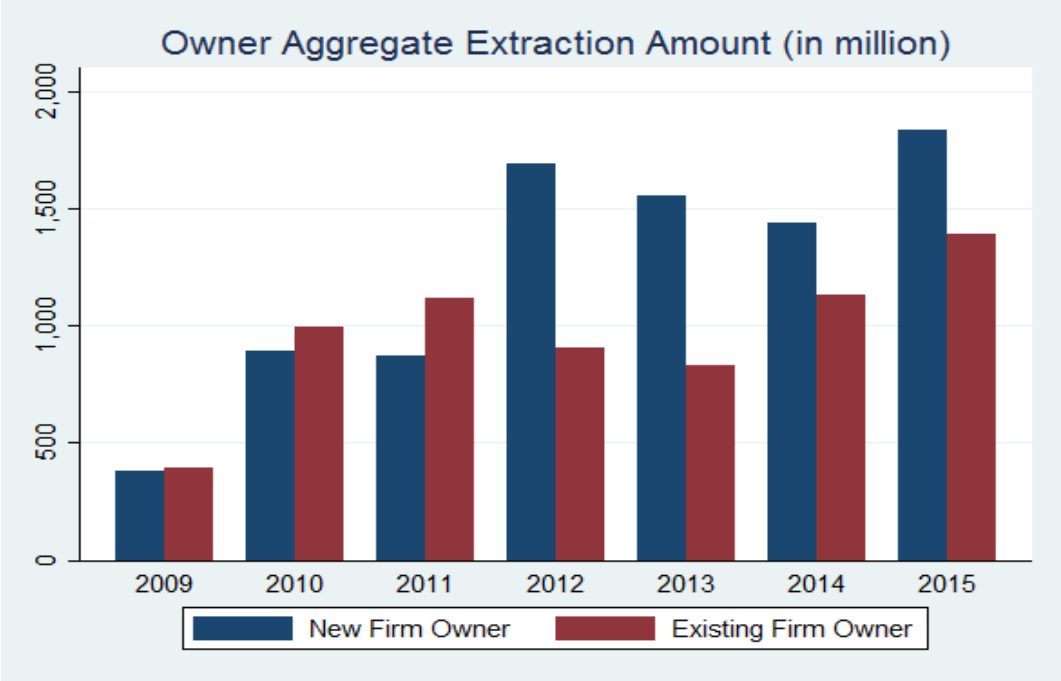

Figure 5: Sample Owners Home Equity Extraction 2009-2015

This figure compares new firm owners with existing firm owners in terms of aggregate mortgage extraction from 2009 to 2015. The sample consists of Norwegian private limited-liability firms with no more than three individual owners. New firms are firms at the age of zero whereas existing firms are firms older than one year. The figure shows how much home equity the owners extracted in each year by firm category.

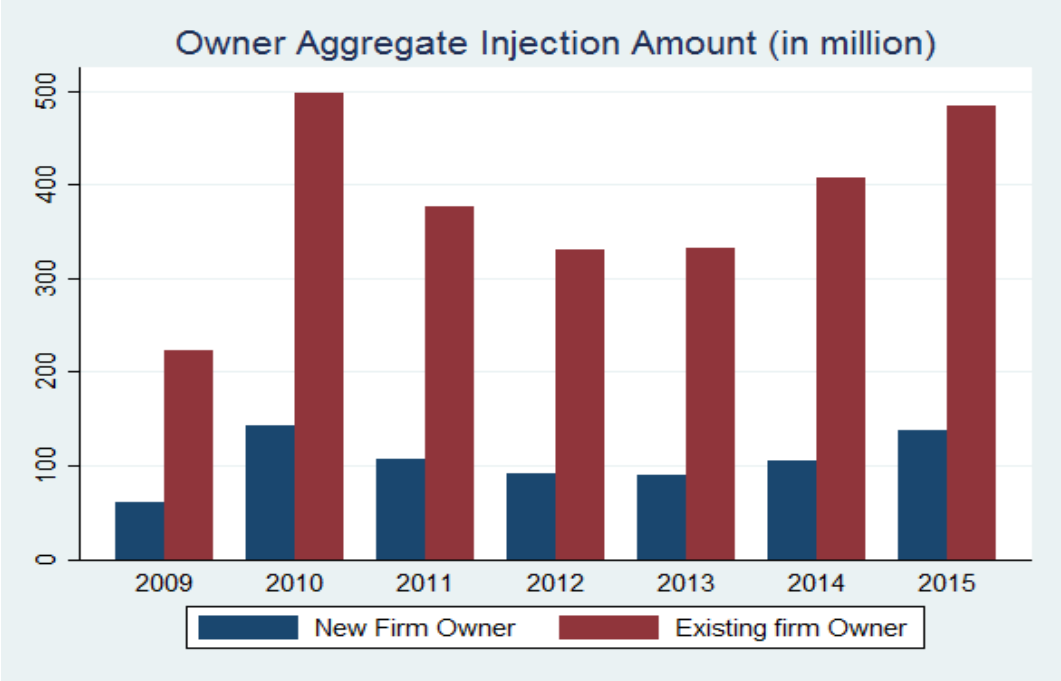

Figure 6: Sample Owners New Equity Injection Conditional On Extraction 2009-2015

This figure compares new firm owners with existing firm owners in terms of aggregate new equity injections from 2009 to 2015. The sample consists of Norwegian private limited-liability firms with no more than three individual owners. New firms are firms at the age of zero, whereas existing firms are firms older than one year. The figure demonstrates, conditional on mortgage extraction, how much equity capital the owners injected into their firms in each year by firm category.

Table 1: Summary Statistics Full Sample Owners and Firms

This table provides summary statistics fro a sample Norwegian private firms and owners from 2009 to 2015. We retain firms with no more than three individual owners and with non-missing information on key variables. Panel A describes the characteristics of the owners, and Panel B displays the characteristics of the firms. Values on financial statement are rounded to thousands of NOK, inflation-adjusted (we use 2015 as the base year). All variables are winsorized by year and municipality at the 1% and 99% levels, respectively. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	Panel A. Owner Characteristics							
	N	Mean	SD	Min.	P25	P50	P75	Max.
Ind. Age	315945	48.64	10.4	27	41	48	56	71
Male	315945	.81	.39	0	1	1	1	1
House Value	315945	900.38	911.79	142.53	403.95	627.34	1035.44	4732.88
Debt Value	315945	2159.43	2362.41	.3	639.34	1628.78	2858.2	11220.36
$\Delta Mortgage$	315945	102.12	989.43	-2836.33	-93.36	-15.24	136.84	3905.42
$D_{Injection}$	315945	.02	.14	0	0	0	0	1
Equity Injection	315945	5.75	193.62	0	0	0	0	93.3
Interest Rate	309130	.05	.95	.01	.03	.04	.05	.24
Income	315945	561.61	346.56	5.63	376.44	512.2	684.75	1774.58
Private Portfolio Value	315945	1860.88	6994.23	0	48.82	341.34	1244.06	28025.21
Public Portfolio Value	315945	26.68	159.62	0	0	0	0	646.84
Divorce	315945	.11	.31	0	0	0	0	1
Centrality	315945	4.17	2.69	1	2	4	6	10
	Panel B. Firm Characteristics							
	N	Mean	SD	Min.	P25	P50	P75	Max.
Total Assets	315945	5467.7	18447.66	34	688.55	1779	4420.8	72808
Leverage	315945	.23	.43	0	0	0	.34	1.89
ROA	315945	.11	.4	-1.32	.01	.12	.26	.85
Tangibility	315945	.2	.27	0	0	.07	.31	1
Capex	315945	.04	.12	-.25	0	0	.03	.54
Working Capital	315945	.13	.84	-2.77	.02	.21	.45	.96
Assets Turnover	315945	2.14	2.14	0	.62	1.73	2.93	10.43
Cash Ratio	315945	.32	.28	0	.07	.25	.51	1
Firm Age	315945	11.08	9.4	1	4	8	16	43
Δ Bank Loan Ratio	315945	0	.14	-.49	-.01	0	0	.52
Bank Deposit Ratio	315945	-.01	.3	-1.22	-.06	0	.1	.69
Employees	315945	4.09	5.69	0	1	2	5	27
Centrality	315945	4.17	2.69	1	2	4	6	10

Table 2: Summary Statistics Owner with vs. without Extraction

This table compares the personal characteristics of Norwegian private firms owners with and without home equity extractions from 2009 to 2015. We retain firms with no more than three individual owners and with non-missing information on key variables. The left panel shows the characteristics of owners with home equity extractions. The right panel describes the characteristics of owners without home equity extraction. The mean differences are presented in the last column. Values on financial statements are rounded to thousands of NOK, inflation-adjusted (we use 2015 as base year). All variables are winsorized by year and municipality at the 1% and 99% levels, respectively. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	Owners with Extraction				Owners without Extraction				
	N	Mean	Median	SD	N	Mean	Median	SD	Diff
Ind. Age	72685	47.85	47.00	10.27	214008	48.79	48.00	10.47	0.94***
Male	72685	0.83	1.00	0.37	214008	0.80	1.00	0.40	-0.03***
House Value	72685	933.72	643.80	946.29	214008	860.04	610.16	851.58	-73.69***
Debt Value	72685	2737.74	2142.37	2627.68	214008	1880.72	1420.85	2095.60	-857.02***
Δ Mortgage	72685	808.79	311.64	1169.35	214008	-141.28	-48.29	743.93	-950.08***
$D_{Injection}$	72685	0.03	0.00	0.16	214008	0.02	0.00	0.13	-0.01***
Equity Injection	72685	8.17	0.00	151.09	214008	4.77	0.00	214.52	-3.41***
Interest Rate	72685	0.04	0.03	0.03	207780	0.06	0.04	1.13	0.02***
Income	72685	580.31	525.76	353.47	214008	551.74	504.51	340.29	-28.57***
Private Portfolio Value	72685	1733.14	291.23	6747.91	214008	1690.15	319.99	6274.17	-42.99
Public Portfolio Value	72685	25.61	0.00	152.87	214008	25.20	0.00	148.95	-0.40
Divorce	72685	0.11	0.00	0.31	214008	0.11	0.00	0.31	0.00***
Centrality	72685	4.11	4.00	2.67	214008	4.17	4.00	2.70	0.05***

Table 3: Summary Statistics Firms with vs. without Injection Conditional On Owner Extraction

This table compares the characteristics of sample firms that receive and do not receive new equity injections from their owners, conditional on the home equity extraction of the owners from 2009 to 2015. We retain firms with no more than three individual owners and with non-missing information on key variables. The left panel reports the summary statistics of firms that received new equity injections from their owners. The right panel describes characteristics of firms that do not receive new equity injections from their owners. The mean differences are presented in the last column. Values on financial statements, both firms and owners, are rounded to a thousand NOK and inflation-adjusted (we use 2015 as the base year). Firm accounting information lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels, respectively. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	Firms with Injection				Firms without Injection				
	N	Mean	Median	SD	N	Mean	Median	SD	Diff
Total Assets	2158	4456.57	1816.59	14729.17	68368	5596.74	1731.98	17911.47	1140.17***
Leverage	2158	0.28	0.11	0.42	68368	0.24	0.01	0.43	-0.05***
ROA	2158	0.08	0.11	0.45	68368	0.10	0.11	0.42	0.02**
Tangibility	2158	0.22	0.09	0.28	68368	0.20	0.07	0.27	-0.01**
Capex	2158	0.04	0.00	0.12	68368	0.03	0.00	0.11	-0.00
Working Capital	2158	0.07	0.15	0.85	68368	0.11	0.20	0.90	0.04*
Assets Turnover	2158	2.48	2.15	2.12	68368	2.14	1.69	2.21	-0.35***
Cash Ratio	2158	0.26	0.18	0.25	68368	0.30	0.22	0.27	0.04***
Firm Age	2158	9.21	7.00	8.17	68368	10.46	8.00	9.03	1.25***
Δ Bank Loan Ratio	2158	0.01	0.00	0.18	68368	-0.00	0.00	0.15	-0.01***
Δ Bank Deposit Ratio	2158	0.01	0.01	0.31	68368	-0.01	0.00	0.31	-0.02***
Employees	2158	4.88	3.00	6.15	68368	4.00	2.00	5.83	-0.88***
Centrality	2158	4.19	4.00	2.69	68368	4.11	4.00	2.67	-0.08

Table 4: Baseline Mortgage Extraction and New Equity Injection Likelihood

This table presents the full sample baseline results for mortgage extractions and new equity injections from Norwegian private firms' critical owners. The sample consists of all private firms with no more than three individual owners and non-missing information on key variables. We use a logit model in all regressions to estimate the likelihood of new equity injections from firm owners. The dependent variable is a binary indicator of the owner's personal equity injection, taking the value of one if the owner injects new equity into the firm and zero otherwise. The key independent variable is a binary indicator of the owner's mortgage extraction, with a value of one indicating extraction and zero otherwise. Firms' accounting information and owners' personal characteristics are lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels and are summarized in Appendix Table 12. The multi-level fixed effects and control variables are shown in the lower panel. Robustness standard errors were clustered at the firm level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	$D_{Injection}$					
	Mortgage extraction	Adding time fixed effects	Adding region-time fixed effects	Adding industry-time fixed effects	Adding firm controls	Adding owner controls
	(1)	(2)	(3)	(4)	(5)	(6)
Mortgage Increase	**0.363*** **	**0.368*** **	**0.373*** **	**0.376*** **	**0.359*** **	**0.338*** **
	(13.307)	(13.391)	(13.548)	(13.643)	(12.960)	(12.176)
Change Bank Loan Ratio					0.362***	0.323***
					(3.369)	(3.064)
Change Bank Deposit Ratio					-0.162***	-0.166***
					(-3.553)	(-3.673)
lag Size					-0.073***	-0.062***
					(-6.431)	(-5.240)
lag Leverage					0.178***	0.188***
					(7.460)	(7.762)
lag ROA					-0.258***	-0.263***
					(-10.190)	(-10.398)
lag Tangibility					0.003	-0.023
					(0.055)	(-0.364)
lag Capex					-0.132	-0.195
					(-0.990)	(-1.465)
lag Working Capital					0.024	0.019
					(1.588)	(1.276)
lag Assets Turnover					0.052***	0.046***
					(8.494)	(7.399)
lag Cash Ratio					-0.597***	-0.575***
					(-9.455)	(-9.057)
lag Public Portfolio to Income						0.014***
						(3.529)
lag Private Portfolio to Income						-0.000
						(-0.553)
log Income						-0.009
						(-0.441)
Divorced						0.173***
						(3.994)
Owner Age						-0.020***
						(-13.952)
Gender						0.197***
						(5.095)
Owner controls	No	No	No	No	No	Yes
Firm controls	No	No	No	No	Yes	Yes
Industry FE	No	No	No	Yes	Yes	Yes
Industry-time FE	No	No	No	Yes	Yes	Yes
Region FE	No	No	Yes	Yes	Yes	Yes
Region-time FE	No	No	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	Yes	Yes	Yes
N	315945	315945	315945	315945	315945	315945
pseudo R^2	0.003	0.005	0.007	0.009	0.018	0.023

Table 5: Owner Equity Injection Amount Conditional on Mortgage Extraction

This table presents the relationship between an owner's mortgage extraction value and the new equity injection amount, conditional on the owner's mortgage extraction behavior. The sample consists of all private firms with no more than three individual owners and non-missing information on key variables. We use the Tobit model in all regressions to estimate the relationship between the owners' mortgage extraction amount and the new equity injection amount. The dependent variable is the natural logarithm of the individual owners' equity injected amount. The key independent variable is the natural logarithm of the individual owners' mortgage extraction amount. Firms' accounting information and owners' personal characteristics are lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels and are summarized in Appendix Table 12. The multi-level fixed effects and control variables are shown in the lower panel. Robustness standard errors were clustered at the firm level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	log Injection Amount					
	Mortgage extraction	Adding time fixed effects	Adding region-time fixed effects	Adding industry-time fixed effects	Adding firm controls	Adding owner controls
	(1)	(2)	(3)	(4)	(5)	(6)
log Mortgage Increase	**0.376*** **	**0.389*** **	**0.396*** **	**0.417*** **	**0.429*** **	**0.380*** **
	(7.402)	(7.561)	(7.659)	(8.030)	(8.094)	(6.982)
Change Bank Loan Ratio					1.786**	1.680**
					(2.486)	(2.358)
Change Bank Deposit Ratio					-0.348	-0.369
					(-0.998)	(-1.060)
lag Size					-0.277***	-0.121
					(-3.600)	(-1.405)
lag Leverage					1.082***	1.077***
					(5.363)	(5.240)
lag ROA					-1.240***	-1.350***
					(-5.680)	(-6.085)
lag Tangibility					0.422	0.185
					(0.939)	(0.408)
lag Capex					0.575	0.415
					(0.605)	(0.438)
lag Working Capital					0.190	0.151
					(1.518)	(1.181)
lag Assets Turnover					0.237***	0.197***
					(5.241)	(4.282)
lag Cash Ratio					-2.375***	-2.290***
					(-5.098)	(-4.887)
lag Public Portfolio to Income						0.218*
						(1.880)
lag Private Portfolio to Income						-0.036**
						(-2.313)
log Income						-0.213
						(-1.395)
Divorced						0.757**
						(2.312)
Owner Age						-0.077***
						(-7.155)
Gender						0.172
						(0.596)
Owner controls	No	No	No	No	No	Yes
Firm controls	No	No	No	No	Yes	Yes
Industry FE	No	No	No	Yes	Yes	Yes
Industry-time FE	No	No	No	Yes	Yes	Yes
Region FE	No	No	Yes	Yes	Yes	Yes
Region-time FE	No	No	Yes	Yes	Yes	Yes
Time FE	No	Yes	Yes	Yes	Yes	Yes
N	80789	80789	80789	80789	80789	80789
pseudo R^2	0.002	0.003	0.006	0.010	0.015	0.018

Table 6: Heterogeneous Firm Location and Access to Credit

This table presents the link between an owner's mortgage extraction and the new equity injection into the firm considering the firm's geographical location. The dependent variable is a binary indicator of the owner's personal equity injection, taking a value of one if the owner injects new equity into the firm and zero otherwise. The key independent variable is the interaction term between the owner's mortgage extraction and the geographical location of the firm. The owner's mortgage increase is a binary indicator, taking a value of one if there is mortgage extraction behavior and zero otherwise. Rural is defined as a binary proxy, taking a value of one if the firm has a centrality score above 2, and zero otherwise. Firms' accounting information and owners' personal characteristics are lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels and are summarized in Appendix Table 12. The multi-level fixed effects and control variables are shown in the lower panel. Robustness standard errors were clustered at the firm level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	$D_{Injection}$			
	Rural Area	Adding firm and owner controls	Fixed bank-firm relationship	Access to new loan
	(1)	(2)	(3)	(4)
Mortgage Increase * Rural	**0.121****	**0.113***	**0.114***	0.108
	(2.056)	(1.903)	(1.734)	(0.669)
Mortgage Increase	0.295***	0.262***	0.246***	0.260*
	(6.029)	(5.326)	(4.539)	(1.827)
Rural	-0.049	-0.095**	-0.129***	-0.138
	(-1.107)	(-2.161)	(-2.629)	(-1.247)
Change Bank Loan Ratio		0.324***	0.236*	0.373**
		(3.069)	(1.952)	(2.110)
Owner controls	No	Yes	Yes	Yes
Firm controls	No	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Industry-time FE	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Region-time FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	315945	315945	266796	41037
pseudo R^2	0.009	0.023	0.024	0.040

Table 7: Heterogeneous Firm Size

This table provides the analyses between an owner's mortgage extraction and the new equity injection to the firm, considering the variation in firm size from 2009 to 2015. The first two columns show the results using the logit model, whereas the last two columns show the results using the Tobit model. The dependent variable for the logit model is a binary indicator of the owner's personal equity injection, taking a value of one if the owner injects new equity to the firm and zero otherwise. The dependent variable for Tobit regression is the natural logarithm of the individual owner's injection amount. The key independent variable for the logit model is a binary indicator for an individual owner's mortgage extraction behavior, whereas the key independent variable for the Tobit model is the natural logarithm of the owner's mortgage extraction amount. Firms are sorted into size quartiles based on the previous year's total assets. $Small$ stands for the smallest quartile, whereas $Large$ represents the largest quartile. Firms' accounting information and owners' personal characteristics are lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels and are summarized in Appendix Table 12. The multi-level fixed effects and control variables are shown in the lower panel. Robustness standard errors were clustered at the firm level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	$D_{Injection}$		log Injection Amount	
	Small	Large	Small	Size
	(1)	(2)	(3)	(4)
Mortgage Increase	**0.281*** **	**0.379*** **		
	(5.313)	(6.143)		
log Mortgage Increase			**0.280*** **	**0.321*** **
			(13.577)	(9.885)
Owner controls	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Industry-time FE	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Region-time FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	78905	78841	20624	20337
pseudo R^2	0.024	0.046	0.027	0.047

Table 8: Heterogeneous Owners' House Value

This table demonstrates the link between an owner's mortgage extraction and new equity injection to the firm, considering the relative value of the owner's house. The dependent variable is a binary indicator of the owner's personal equity injection, taking a value of one if the owner injects new equity into the firm in that firm year and zero otherwise. The key independent variable is a binary indicator of the owner's mortgage extraction, taking a value of one if the owner extracts mortgages from home equity and zero otherwise. An owner's house value is considered to be high using two standard: relative to neighbors and relative to firm value. In the first two columns, the measure $High|Neighbor$ is used. $High|Neighbor$ equals one if the tax value of the owner's house belongs to the largest quartile in a municipality-year and zero otherwise. In the latter four columns, the measure $High|Firm$ is used. $High|Firm$ equals one if the tax value of the owner's house to firm value ratio is beyond the 50th percentile of the sample (0.36) and zero otherwise. In the last two columns, firms are sorted into size quartiles based on total assets of the previous year. Firms' accounting information and owners' personal characteristics are lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels and are summarized in Appendix Table 12. The multi-level fixed effects and control variables are shown in the lower panel. Robustness standard errors were clustered at the firm level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	$D_{Injection}$					
	High value house relative to neighbors	Adding firm and owner controls	High value house relative to firm value	Adding firm and owner controls	Firm Size	
					Small	Large
	(1)	(2)	(3)	(4)	(5)	(6)
Mortgage Increase $*$ High|Neighbor	**0.239*** **	**0.172*** **				
	(4.565)	(3.290)				
Mortgage Increase $*$ High|Firm			**0.148*** **	**0.086** **	**0.285*** **	-0.346
			(3.486)	(2.022)	(4.329)	(-1.633)
High|Neighbor	-0.223***	-0.132***				
	(-5.883)	(-3.405)				
High|Firm			-0.003	-0.173***	-0.624***	-0.074
			(-0.092)	(-3.974)	(-6.887)	(-0.503)
Mortgage Increase	0.329***	0.304***	0.324***	0.310***	0.115*	0.401***
	(11.021)	(10.146)	(10.220)	(9.806)	(1.726)	(6.380)
Owner controls	No	Yes	No	Yes	Yes	Yes
Firm controls	No	Yes	No	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
N	315945	315945	315945	315945	78905	78841
pseudo R^2	0.009	0.023	0.009	0.023	0.027	0.046

Table 9: Firm Performance Pre vs. Post Injection

This table compares the firm performance before and after the owner's new equity injection. The analysis was performed with a 5-year event window, with 2 years before and 2 years after the event year of injection. The injection event takes any non-zero equity injection from the owners, regardless of which owner injects money. $PostInjection$ is a dummy proxy that indicates the post-injection period. It equals one if it is a firm-year observation after the owner injects new equity and 0 otherwise. Firms' accounting information and owners' personal characteristics are lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels and are summarized in Appendix Table 12. The multi-level fixed effects and control variables are shown in the lower panel. Robustness standard errors were clustered at the firm level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	logAssets (1)	ROA (2)	logSales (3)	New Loan (4)	Employees (5)	CapEx (6)
Post Injection	**0.027****	**0.041*****	**0.044*****	-0.007	-0.034	0.001
	(2.298)	(4.858)	(2.923)	(-1.621)	(-0.507)	(0.404)
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
N	20091	20091	19581	20091	20091	20091
adj. R^2	0.114	0.113	0.097	0.129	0.163	0.352

Table 10: Exit Analysis

This table demonstrates the exit sample analyses. We examine firms' bankruptcy decisions and perform logit regression across different samples. Bankrupt is a binary indicator that equals one if the firm files for bankruptcy in that year, and zero otherwise. The analyses in columns 1 to 4 specify the number of years between the owner's mortgage extraction and the firm files bankruptcy. Firms' accounting information and owners' personal characteristics are lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels and are summarized in Appendix Table 12. The multi-level fixed effects and control variables are shown in the lower panel. Robustness standard errors were clustered at the firm level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	Bankrupt in			
	Current year	One year	Two years	Three years
	(1)	(2)	(3)	(4)
Mortgage Increase	-0.033**	-0.024**	-0.031***	-0.040***
	(-2.353)	(-2.329)	(-2.969)	(-3.340)
Owner controls	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Industry-time FE	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes
Region-time FE	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
N	315676	315879	248549	177656
pseudo R^2	0.070	0.071	0.081	0.089

Table 11: Entry Analysis

This table presents the results of the entry analysis on whether the owner established a new firm in an industry with prior experience. The first column shows the general new firm result, the second column presents the result for new industry entry, and the third column shows the result for experienced industry entry. Experience is defined as whether the owner holds a firm in the same industry before the establishment of this new entity. The dependent variable is a dummy variable that takes a value of one if this is a new firm created in the year of analysis and zero otherwise. The owner's mortgage increase is a binary indicator, taking a value of one if there is mortgage extraction behavior and zero otherwise. The models are estimated using probit regression. The multi-level fixed effects are shown in the lower panel. Robustness standard errors were clustered at the firm level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	D_{Entry}		
	General	New Sector	Experienced Sector
	(1)	(2)	(3)
Mortgage Increase	0.101***	-0.039***	0.102***
	(24.573)	(-3.410)	(13.410)
Industry FE	Yes	Yes	Yes
Industry-time FE	Yes	Yes	Yes
Region FE	Yes	Yes	Yes
Region-time FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes
N	951561	86545	878089
pseudo R^2	0.012	0.027	0.017

Appendix

Table 12: Variable Definitions

This table provides the definitions of the variables used in the analyses of the sample of Norwegian private firms from 2009 to 2015. We retain firms with no more than three individual owners and non-missing information on key variables. Values on financial statements, both firms and owners, are expressed in thousands NOK and inflation-adjusted (we use 2015 as base year). Firms' accounting information are lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels, respectively. Panel A defines firm-level features. Panel B. defines owner-level characteristics.

Panel A. Firm Characteristics	
Variable	Definition
Total Assets	Total assets of a firm.
Size	Natural logarithm of the total assets of a firm.
Leverage	The ratio of total debt over total assets of a firm.
ROA	The ratio of ebitda over total assets of a firm.
Tangibility	The ratio of property, plant and equipment(PPE) to total assets of a firm.
Working Capital	The ratio of current assets minus short-term liabilities to total assets.
Capex	The ratio of total capital expenditure to total assets.
Assets Turnover	The ratio of total sales revenue to total assets.
Cash Ratio	The ratio of cash over total assets.
Firm Age	The age of the firm, using the current year minus the founding year.
Δ ***Bank Loan Ratio***	The incremental change in total bank loans of the firm compared with last year over the firm's total assets.
Δ ***Bank Deposits Ratio***	The incremental change in total bank deposits of the firm compared with last year over the firm's total assets.
Employees	The number of employees of the firm.
Firm Age	The age of the firm, in years.
Centrality	The Centrality score of an Norwegian municipality, scaling from 1 (the most central municipality) to 10 (the most remote municipality), from Statistics Norway.
Rural	A dummy indicator based on centrality score as a proxy for distance to urban settlement. It takes a value of one if the centrality score is greater than two and zero otherwise.
D_{Entry}	A dummy indicator takes a value of one if a firm is newly founded in a calendar year and zero otherwise.
Bankrupt	A dummy indicator takes a value of one if a firm files a bankruptcy calendar year and zero otherwise.

Table 12: Variable Definitions Continued

Panel B. Owner Characteristics	
Variable	Definition
Only Firm	A binary variable indicating whether it is the only firm of an individual owner.
Ind_Age	The age of an individual owner.
Male	The binary gender indicator that takes a value of one for men and zero for women.
$D_{Injection}$	A binary proxy for new equity injection, excluding founding equity capital. One indicates injection and zero indicates no injection.
Equity Injection	Annual new equity (founding equity capital excluded) injection per firm at the individual level, in thousand NOK, CPI adjusted.
log Injection Amount	Natural logarithm of annual new equity (excluding founding equity capital) injection per firm at the individual level.
House value	An individual's tax value of the house, from a person's annual tax report, in thousand NOK, CPI adjusted.
Debt Value	The individual total debt outstanding, from a person's annual tax report under the code 21077, in thousand NOK, CPI adjusted.
Mortgage Increase	A binary proxy of increase in mortgage, one stands for increased mortgage, and zero stands for not increasing mortgage. Four criteria were applied to define mortgage increase: 1) tax value of the house is non-zero; 2) the overall loan portfolio increases; 3) the overall interest rate decreases; 4) the marginal change in the interest rate is less than 5%.
Δ***Mortgage***	A proxy to measure the change in individual mortgage amount compared with last year, in thousand NOK, CPI adjusted.
log Mortgage Increase	Natural logarithm of the change in individual mortgage amount compared with the previous year.
Income	Natural logarithm of the individual's annual income from related firms in thousand NOK, CPI adjusted.
Public to Income ratio	A wealth proxy to measure an individual's total public equity holdings scaled by their annual income from firms.
Private to Income ratio	A wealth proxy to measure an individual's total private equity holdings, scaled by their annual income from firms.
Divorce	The binary marital indicator that takes a value of one as divorced and a value of zero as non-divorced.

Table 13: Robustness Different Thresholds for Mortgage Extraction

This table presents the robustness analyses using different thresholds of incremental interest rate changes to define the owner's mortgage extraction behavior. The sample consists of all private firms with no more than three individual owners and non-missing information on key variables over the sample period from 2009 to 2015. The first three columns show the logit regression results, whereas the latter three columns show the Tobit regression results. The dependent variable in first three models is the binary indicator of the owner's personal equity injection. The dependent variable in the latter three models is the natural logarithm of the individual owners' equity injected amount. The thresholds for incremental interest rate changes are specified at the level 0.02, 0.03, and 0.04, to define the owner's mortgage extraction. The key independent variable for the first three columns is a binary indicator of the owner's mortgage extraction according to the corresponding thresholds, with a value of one indicating extraction and zero otherwise. The key independent variable for the last three columns is the natural logarithm of the owner's mortgage extraction amount using the corresponding interest rate thresholds. Firms' accounting information and owners' personal characteristics are lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels and are summarized in Appendix table 12. The multi-level fixed effects and control variables are shown in the lower panel. Robustness standard errors were clustered at the firm level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	$D_{Injection}$			log Injection Amount		
	0.02	0.03	0.04	0.02	0.03	0.04
	(1)	(2)	(3)	(4)	(5)	(6)
Mortgage Increase 0.02	0.283***					
	(9.458)					
Mortgage Increase 0.03		0.325***				
		(11.417)				
Mortgage Increase 0.04			0.335***			
			(11.995)			
log Mortgage Change 0.02				0.222***		
				(10.361)		
log Mortgage Change 0.03					0.244***	
					(12.156)	
log Mortgage Change 0.04						0.249***
						(12.740)
Owner controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Region-time FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
N	315945	315945	315945	315945	315945	315945
pseudo R^2	0.022	0.022	0.023	0.015	0.016	0.016

Table 14: Robustness Heterogeneous Ownership

This table presents the robustness analyses using heterogeneous ownership stakes that influence the owner's mortgage extraction and equity injection relationship. The sample consists of all private firms with no more than three individual owners and non-missing information on key variables over the sample period from 2009 to 2015. The dependent variable is a binary indicator of an owner's personal equity injection. We vary the ownership stake from below 20% to full ownership of the firm. The key independent variable is a binary indicator of the owner's mortgage extraction with a value of one indicating extraction and zero otherwise. Firms' accounting information and owners' personal characteristics are lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels and are summarized in Appendix table 12. The multi-level fixed effects and control variables are shown in the lower panel. Robustness standard errors were clustered at the firm level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	Ownership				
	Below 0.2	0.2-0.4	0.4-0.6	0.6-0.8	Above 0.8
	(1)	(2)	(3)	(4)	(5)
Mortgage Increase	0.297**	0.342***	0.323***	0.394***	0.334***
	(2.044)	(3.815)	(5.862)	(3.873)	(8.740)
Owner controls	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Industry-time FE	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes
Region-time FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
N	17126	40903	91582	16336	147171
pseudo R^2	0.042	0.041	0.026	0.058	0.034

Table 15: Robustness Heterogeneous Firm Leverage

This table presents the robustness analyses considering the influence of different firm leverages on owners' mortgage extraction and equity injection behaviors. The sample consists of all private firms with no more than three individual owners and non-missing information on key variables over the sample period from 2009 to 2015. We apply the baseline logit regression model across different firm subsamples sorted by lagged year of firm leverage. The key dependent variable is a dummy variable with a value of one, indicating the owner's personal equity injection, and zero otherwise. The key independent variable is a binary proxy with a value of one, indicating owner's mortgage extraction, and zero otherwise. Firms' accounting information and owners' personal characteristics are lagged by one year. All variables are winsorized by year and industry at the 1% and 99% levels and are summarized in Appendix table 12. The multi-level fixed effects and control variables are shown in the lower panel. Robustness standard errors were clustered at the firm level. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	Leverage				
	Zero leverage	Below 0.2	0.2-0.4	0.4-0.6	Above 0.6
	(1)	(2)	(3)	(4)	(5)
Mortgage Increase	0.282***	0.334***	0.487***	0.241***	0.408***
	(6.587)	(4.541)	(6.088)	(2.766)	(6.621)
Owner controls	Yes	Yes	Yes	Yes	Yes
Firm controls	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes
Industry-time FE	Yes	Yes	Yes	Yes	Yes
Region FE	Yes	Yes	Yes	Yes	Yes
Region-time FE	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes	Yes
N	157102	49043	37663	27351	42727
pseudo R^2	0.024	0.037	0.047	0.048	0.033

The costs and benefits of cornerstone investors: Evidence from the Nordic IPO market

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Abstract

Cornerstone investors have become a regular feature of European IPOs. These investors pre-commit to purchasing shares during the IPO. Using Scandinavian data, we explore the implications of cornerstone investors. We show that on one hand they decrease price efficiency but on the other hand they increase demand during book-building. We address the endogeneity of the cornerstone inclusion decision by showing that higher expected underpricing negatively affects the decision to involve cornerstone investors.

Keywords: IPO process, cornerstone investors, fixed-price offerings, book-building

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1 Introduction

The IPO process in the Nordics[1] has developed in a fundamentally different way from the process most researchers are familiar with. The difference is a recent one and arises in the way IPO marketing is carried out. Starting in 2014, in the Nordics, potential (institutional) investors are approached long before the IPO is announced through so-called pilot-fishing[2]. Often a pilot-fish results in what is a so-called cornerstone investor, where an unrelated investor[3] pre-commits to buying a certain amount of shares at the IPO price.

By pre-committing to buy a certain fraction of the shares being offered during the IPO cornerstone investors may increase the likelihood of IPO success. Pre-commitment may signal early demand and hence convince others to invest (Welch (1992)). On the other hand, such a pre-commitment likely comes at a cost, namely lower price efficiency. The purpose of our paper is to investigate this trade-off. Understanding such new arrangements is important, as our view of the IPO process is shaped by the large U.S. market. Yet it is not clear that the institutional arrangements there are necessarily optimal for other countries.

Why can pre-commitment be an optimal choice for the issuer and underwriter? As Jenkinson et al. (2018) for example show, IPOs can have seemingly sub-optimal outcomes for issuers in the form of underpricing and possibly quid-pro-quo allocations. Yet what most firms going public will be concerned with is something subtly different, namely the expected benefit from going public. The benefit depends upon both the share price S and the likelihood of deal success p:

$$E(IPO) = p(S) \cdot S \tag{1}$$

and not only the share price S. Essentially, we want to analyze the IPO process from an ex-ante perspective about a firm's expected benefits from the IPO, rather than focusing on the ex-post efficiency of the outcomes.

[1] The Nordic countries in our sample are Denmark, Finland, Norway and Sweden.
[2] In the U.S., price discussions with potential investors are not allowed.
[3] We define such investors as unrelated if they have not invested in the firm through a pre-IPO funding round.

The question of whether the ex-post efficiency of the IPO process is sub-optimal or not is not an easy one to answer. The fact that firms leave money on the table is well established - Jay Ritter[4] documents that underpricing is a phenomenon that is constant across many countries. Whether this is a rational explanation for underpricing as a reward for information revelation, as first proposed by Benveniste and Spindt (1989), or some form of quid-pro-quo by investment banks is still an open question.

Yet underpricing also reduces the risk of firms not completing their IPO. Hence, there exists a trade-off: a lower share price S will increase the likelihood of deal success $p(S)$ but will also increase underpricing. In addition, the latter issue could raise the question of a quid-pro-quo between the underwriter and the institutional investors with whom the underwriter may have a long-term relationship. Not completing the IPO is a major risk for companies, as witnessed by WeWork's failed IPO in 2019 that led to major restructurings at the company[5]. As can be glanced from Table 1, about ten percent of all IPOs in the U.S. fail during our sample period, whereas in the Nordics, 3 out or 124 or about 2.5% failed. Dunbar and Foerster (2008) point out that from 1985 to 2000 about 20% of all IPOs in the United States were withdrawn, with rates reaching lows of 10% and highs of 55%. The low withdrawal rate in the Nordics is even more interesting as most IPOs in this region are small and medium-sized companies, at least relative to the U.S. Nor is it easy to attempt a second listing. As reported by Dunbar and Foerster (2008), firms rarely try to go make a second attempt, with only about 10% of all withdrawn IPOs returning[6,7].

Cornerstone investors can be seen as a mechanism to increase the likelihood of the IPO succeeding: they signal the demand for the issuer's shares to other potential investors. We would expect cornerstone investors to be compensated for this service - they are essentially shouldering some of the risks of the IPO, in particular, if demand for the IPO is weak.

[4] https://site.warrington.ufl.edu/ritter/ipo-data/.

[5] https://www.businessinsider.com/wework-ipo-fiasco-adam-neumann-explained-events-timeline-2019-9?r=US&IR=T#september-22-and-23-52.

[6] Not completing the IPO may have severe consequences. Basuba et al. (2001) point out that the threat of withdrawing an IPO can discipline investors by forcing them to not low-ball their offers during the book-building process.

[7] Incidentally, WeWork is now optioning for a SPAC deal and not a full IPO. See https://therealdeal.com/2021/09/20/two-years-after-its-ipo-fail-wework-will-go-public/.

To sum up the previous discussion, our paper investigates two issues: First, whether the involvement of cornerstone investors in the IPO process negatively affects price-setting efficiency. Second, we investigate whether the involvement of cornerstone investors in the IPO process increases the probability of IPO success.

From an econometric point of view, the problem of measuring changes to the likelihood of IPO success correctly is a difficult one. In our paper, we propose several measures: first, the speed at which the book fills, second, overall demand relative to shares offered. Finally, we compare absolute failure rates in the Nordics to failure rates in the U.S., which has a system that is more focused on ex-post efficiency than the Nordic system that we describe in this paper.

One complication to our research comes from the fact that we find that cornerstone investments and fixed-price offerings are highly correlated. Fixed-price offerings are a form of IPOs that have almost disappeared from U.S. markets[8]. From a practical perspective, fixed-price offerings raise the same question of price efficiency as cornerstones investors, however[9].

Indeed, we find that both cornerstone investments and fixed-price offerings are correlated with higher underpricing (or first-day returns), suggesting that cornerstone investors lead to less efficient prices during the IPO[10]. We then use the Lee (1978) sample selection model to correct for the possible endogeneity of the decision to include cornerstone investors, and we find that the expected increase in underpricing negatively and significantly affects the decision to involve cornerstone investors.

Second, looking at the speed at which the books of firms fill, we find that both cornerstone investors and fixed-price offerings lead to considerably higher demand for shares during book-building. Hence our results suggest two different channels at which cornerstone investors affect the likelihood of IPO success: prior to the IPO process, as the firm receives signals much earlier than in a U.S.-style IPO process, reducing the likelihood of a withdrawn IPO dramatically, and

[8]Welch (1992) shows that fixed-price offerings can be as efficient in the IPO process as book-building if they are combined with a positive cascade. Such processes can often be found in fund-raising, for example in crowdfunding. Private equity with its multiple closings is another example of such a mechanism.

[9]One could think of the combination of fixed-price offerings and cornerstone investments as being an even stronger commitment device.

[10]Pezier (2021) finds similar results for cornerstone investments in Europe.

during the IPO process, as the speed at which the book fills is significantly higher.

How do the cornerstone investors profit from this arrangement? Our results indicate that they are compensated in two different ways: first, underpricing is higher for firms with cornerstone investors. Second, we find that cornerstone investors almost always receive a full allocation of shares, whereas normal investors are usually rationed to receive only ten percent of the shares they demand (as measured by their demand during the last day of book-building).

Whether cornerstone investors receive this compensation because they reveal information about the issue to the underwriter or because they are compensated for their risk-taking is a difficult question to answer. One could interpret the fact that cornerstone investors always receive a full allocation as a form of commitment from the underwriter - no rationing for good offerings may compensate for losses on bad offerings.

Our findings also raise the question of whether only cornerstone investors are rewarded with higher allocations or whether this extends to all early-look and pilot-fish investors. We find that indeed not only cornerstone investors are rewarded but also early-look and pilot-fish investors get a higher allocation than normal investors, conditional on their participation during book-building. However, only about 50% seem to actually submit bids. Our results generally suggest that investors are rewarded for information revelation during the IPO process[11].

The remainder of the paper is organized as follows. Section 2 presents the institutional details relevant for the IPO process in the Nordics and highlights the differences from the IPO process in the U.S. Section 3 presents the sample and the corresponding summary statistics. Section 4 focuses on the empirical analysis and the results, and Section 5 concludes.

2 Institutional background

The IPO process in Europe, and in particular in the Nordic countries, differs significantly from the process known in the U.S. The main difference lies in the communication with potential

[11] See Benveniste and Spindt (1989) for a formal model and Cornelli and Goldreich (2001) and Jenkinson et al. (2018) for empirical evidence.

investors before the official announcement of the IPO. In the following section, we outline the main characteristics of the pre-IPO marketing process in the U.S. and Europe[12].

2.1 Pre-IPO marketing process in the U.S.

Section 5(c) of the Securities Act does not permit U.S. firms intending to go public to communicate with or to collect pricing-related information from potential investors before the firms file for the IPO[13]. The introduction of the JOBS Act in 2012[14] relaxed the requirements for emerging growth companies, allowing them to engage in so-called "test-the-waters" meetings with qualified institutional buyers and institutional accredited investors. Such meetings may include indications of investor interest. In September 2019, the SEC issued the Securities Act Rule 163B[15] in which it allowed the "test-the-waters" meetings for all firms. Still, the "test-the-water" meetings exclude binding investor commitments or share orders.

2.2 Pre-IPO marketing process in Europe

In contrast to the U.S., the pre-IPO marketing process in Europe, and in particular in the Nordics, relies heavily on meetings with selected potential investors[16] prior to the formal announcement of the IPO decision and before the prospectus is issued. These meetings are split up into two parts: initial meetings are called "early-look" and a second round of later meetings which incorporate the feedback from investors met during the early-look meetings are called "pilot-fish"[17]. The idea behind these meetings is to gauge demand for the offering and to learn the investors' views about firm pricing[18].

Early contact with potential investors has two advantages for firms. First, these early meetings

[12]For further details on the IPO process in Europe, we refer to McNaughton et al. (2015).
[13]For the Securities Act of 1933, see `https://www.fdic.gov/regulations/laws/rules/8000-6200.html`.
[14]Jumpstart Our Business Startups Act, see `https://www.sec.gov/spotlight/jobs-act.shtml`.
[15]For the SEC announcement, see `https://www.sec.gov/news/press-release/2019-188`.
[16]Usually, the underwriter is responsible for selecting investors that attend these meetings.
[17]The whole process is often referred to as "pilot-fishing".
[18]As Table 17 shows, on average there are 25-43 meetings with potential investors prior to the IPO announcement. Our data do not suggest a large overlap of investor contact during the two phases.

allow the firms to base their decision to go through with the formal IPO announcement on the feedback of potential investors very early on. According to the underwriter that we received our data from, in the Nordics, firms learn very early whether they are suitable for an IPO or not. Second, those meetings help establish bonds with potential investors, for instance by explaining and promoting the business model (Borsche (2006)). On the other hand, such meetings may increase the influence of investors on the form and pricing of the IPO.

2.3 Cornerstone investors

The early meetings often result in (so-called) cornerstone investments. In the Nordics, cornerstone investors have been increasingly common since 2014. Cornerstone investors pre-commit to buying a certain amount of shares at the IPO price. The pre-commitments happen before the draft prospectus is distributed and before the IPO is officially announced. Usually, these pre-commitments involve a lock-up period to prevent price pressure arising if cornerstone investors sell their shares shortly after the IPO.

Cornerstone involvement brings certain advantages for both the investor and the firm going public. On one hand, cornerstone investors benefit from the preferred or guaranteed allocation of shares. On the other hand, cornerstone investments by prominent institutions may encourage other investors to consider investments and thus increase the probability of IPO success.

2.4 Other forms of pre-IPO investment

Other forms of pre-IPO investment exist. First, anchor investors may indicate strong interest to buy shares in the IPO similar to cornerstone investors. However, in contrast to cornerstone investors, anchor investors are not guaranteed the share allocation during the book-building process. Additionally, they are not subject to lock-up agreements. Second, strategic pre-IPO investors may invest in the firm that intends to go public shortly before the IPO. However, their investment may become illiquid since it is independent of the firms' decision to go public (McNaughton et al. (2015)).

2.5 IPO announcement and the book-building period

European IPOs are officially announced through the (so-called) intention to float (ITF) announcement. The issuer may distribute the preliminary prospectus, and further meetings with potential investors may take place until the final publication of the prospectus. The prospectus contains information on the preliminary price of the IPO, which can be a fixed price, a fixed price range, or an indicative price range without fixed limits.

During the following book-building period, the underwriter collects share demand from potential investors. The underwriter may adjust the offering price while building the book. Alternatively, the underwriter may collect share demand for multiple suggested prices. The investors may also adjust their demand during the process or withdraw from the process. When the book-building period is completed, the underwriter decides on the share allocation to each investor.

3 Data

3.1 Sample construction

Our main sample includes all SDC firms that conduct an IPO at the main market on one of the primary stock exchanges in Northern Europe, including Nasdaq Stockholm, Nasdaq Copenhagen, Nasdaq Helsinki and Oslo Boers. We focus on the period 2014-2018 which are the initial years of cornerstone involvement in Nordic IPOs. SDC provides IPO deal information such as transaction size and percentage of shares sold. We hand collect additional information on cornerstone involvement, offering method choice, the final offer price and free float from the respective pre-IPO marketing material including prospectuses, term sheets and news announcements. We complement this information with accounting and share-related data from Compustat Global. Missing accounting and share price data are added from various sources including Proff, Euronext and Thomson Reuters Eikon. The final sample contains 118 IPOs.

3.2 Summary statistics

Table 2 presents an overview of the sample firms per year and per industry. All IPOs in the Nordics are "best-effort" issues in the U.S. sense[19]. Panel A shows that 44% of IPOs indicate the presence of cornerstone investors in their IPO marketing material (term sheet or prospectus). Furthermore, 25% of IPOs are fixed-price offerings. The correlation between cornerstone involvement and fixed-price offerings in the main sample is 41%.

Panel B of Table 2 presents the distribution of the main sample IPOs based on the 2-digit SIC industry. The majority of the considered firms operate in manufacturing and services, followed by finance. We see that nearly 50% of the manufacturing and services firms involve cornerstone investors whereas the ratio is with 26% lower in finance firms. On the other hand, we observe that 50% of the manufacturing and services firms also have fixed-price offerings whereas this ratio is lower in other industries. Therefore, we note that the correlation between cornerstone involvement and fixed-price offerings is mostly driven by those two industries.

Table 3 presents the summary statistics for the main variables used in our empirical analysis as of the IPO year[20]. Columns (1) to (4) refer to our main sample. The average underpricing, which is defined as the first-day stock return after the IPO relative to the final offer price, is 7.8% in the mean, whereas it is 4% in the median. We note that the average firm risk of the IPO firms is considerable. In particular, the average leverage ratio is 25% and the average Altman (1968) Z-score is with 1.45 below the "distressed" zone of 1.81 (Altman (1968)). EBITDA margin has a negative mean but a positive median, suggesting a high variation in the sample. Additionally, 13.6% of the firms in our sample operate in R&D-intense high-tech industries.

[19] We do not have exact information about issuance costs but from the conversation with practitioners we understand that the average costs of going public are around 4%.

[20] All variables used in this study are defined in Table A1.

4 Empirical analysis

In this section, we perform the empirical analysis. First, we build a relation between the involvement of cornerstone investors and the offering method choice and analyze the determinants of both decisions. Then, we investigate whether cornerstone investors come with a cost, namely less pricing efficiency. Second, we discuss the benefits of cornerstone investors by analyzing whether they affect investor demand and book filling speed during the book-building process. We also compare share allocations to investors participating in book-building and analyze whether cornerstone investors relate to investor meetings during the pre-IPO period.

4.1 Cornerstone involvement and the offering method choice

We begin the empirical analysis by investigating the characteristics of firms going public in the Nordic market based on their choice to involve cornerstone investors and their offering method choice. Columns (2) and (3) of Table 2 present the number of IPOs with and without cornerstone involvement during our sample period and reveal that in 2014, only one IPO involved cornerstone investors, however in the period 2015-2018, cornerstone investors were involved in over 50% of IPOs, suggesting that the involvement of cornerstone investors in the Nordic IPO market is a relatively recent phenomenon. In Table 4, we examine how the presence of cornerstone investors relates to the characteristics of the IPO. We find that underpricing is with 11% higher in IPOs with cornerstone involvement than in IPOs without cornerstone involvement (4.9%), and this difference is significant at the 1% level. Second, we find that cornerstone involvement is significantly associated with fixed-price offerings. About 44% of IPOs with cornerstone involvement were fixed-price offerings while this is true for only 10% of IPOs without cornerstone involvement.

Columns (4) and (5) of Table 2 display the number of IPOs per year and industry based on the offering method choice. As indicated above, the large majority of IPOs (75%) are floating-price offerings, that is they provide an indicative or a fixed price range in their prospectuses, while 30 IPOs in our sample are fixed-price offerings. However, the number of floating-price offerings

has declined during the observed period. Table 5 presents the summary statistics for IPOs with fixed-price and floating-price offerings. Interestingly, we find that underpricing is higher in IPOs with fixed-price offerings, and this result is significant at the 5% level. On the other hand, we find that IPOs with fixed-price offerings have a significantly higher probability to involve cornerstone investors. 77% of IPOs with fixed-price offerings also include a cornerstone investor, whereas this is the case for only 33% of the floating-price offerings.

4.1.1 Determinants of cornerstone involvement and the offering method choice

We want to further investigate the determinants of the issuers' decision to involve cornerstone investors and their offering method choice. In particular, we examine the role of free float, defined as the ratio of shares offered to the public to the total shares outstanding after the IPO, as indicated in the IPO prospectuses. Most stock exchanges, including those in the Nordics, expose free float requirements on issuers, making free float a variable that is not necessarily determined by the issuer or underwriter. We assume that higher free float increases the loss from eventual underpricing, and thus, higher free float will be associated with more efficient pricing. Since we hypothesize that issuers involve cornerstone investors (and make fixed-price offerings) to increase the probability of IPO success, we predict that IPOs with a higher free float are associated with less involvement of cornerstone investors and are less likely to be fixed-price offerings. Similarly, we predict that a hot IPO market, proxied by a higher number of successful IPOs in the last 3 months, is decreasing the probability that cornerstone investors are involved or that the IPOs include fixed-price offerings. We investigate this empirically by running regressions of the following type:

$$Y_{i,t} = \alpha \ + \beta_1 Free\_float_{i,t} + \beta_2 IPO\_last3months_{i,t} + \gamma X_{i,t} + \delta_t + \epsilon_{i,t} \tag{2}$$

where $Y_{i,t}$ is an indicator for involvement of cornerstone investors ($Cornerstone$) or an indicator for fixed-price offerings ($Fixed$). $X_{i,t}$ is a vector of control variables including $Firm\_size$, $Revenue$, BtM, $EBITDA\_margin$ and $High\_tech$ and should capture firm risk, following Loughran and Ritter (2004). Furthermore, we include IPO-year fixed effects, denoted by δ_t.

We run both OLS and probit regressions. Table 6 presents the regression results where Columns (1), (3) and (5) present the determinants of cornerstone involvement, and Columns (2), (4) and (6) refer to the offering method choice. Columns (1) to (4) present coefficients, while in Columns (5) and (6) we present average marginal effects of the probit regression. In accordance with our predictions, we see that the higher the expected free float (and hence the higher the loss from underpricing), the less likely issuers involve cornerstone investors or consider fixed-price offerings. In addition, we see that fixed-price offerings become less likely the more IPOs succeeded in the three months prior to the IPO. These findings support our hypothesis that cornerstone investors are more likely to be involved in IPOs with lower success probability.

4.1.2 Cornerstone involvement, offering method choice and underpricing

Next, we investigate whether there is an empirical relation between the issuers' choice to involve cornerstone investors and to make a fixed-price offering, and pricing efficiency. Consistent with our hypothesis, we predict that cornerstone investors (and fixed-price offerings) negatively affect pricing efficiency. We begin by running OLS regressions of the following type:

$$Underpricing_{i,t} = \alpha + \beta Choice_{i,t} + \gamma X_{i,t} + \delta_t + \epsilon_{i,t} \tag{3}$$

where $Underpricing_{i,t}$ is our measure of pricing (in)efficiency and is defined as the first-day stock return after the IPO relative to the final offer price. $Choice_{i,t}$ refers to the issuers' choice and is either an indicator for cornerstone involvement or an indicator for fixed-price offerings. $X_{i,t}$ denotes the vector of control variables as above. In some specifications, we additionally control for accruals, IPO proceeds, leverage, and indicators of market hotness. Furthermore, we include IPO-year fixed effects, denoted by δ_t.

Table 7 presents the regression results. Columns (1) and (2) focus on the choice to involve cornerstone investors and reveal that cornerstone investors are positively related to underpricing and thus are negatively associated with pricing efficiency, consistent with our predictions. Similarly,

Columns (3) and (4) reveal a positive association between fixed-price offerings and underpricing.

While these results are statistically significant, we cannot make causal inferences at this stage due to endogeneity concerns. If cornerstone investors cause more underpricing, then we would expect that extra underpricing to affect the choice to involve cornerstone investors. Thus, in the next sub-section, we focus on addressing these endogeneity concerns.

4.1.3 Addressing endogeneity concerns - Lee (1978) model

We implement the Lee (1978) sample selection model to address our concerns that underpricing affects the choice to involve cornerstone investors[21]. The Lee (1978) procedure has been used recently to address such concerns in the bond literature[22]. It is a variation of the Heckman (1976) sample selection model. In the Heckman (1976) model applied to labor market participation, one outcome, the wage of staying at home, is unobservable. This sample selection model is not appropriate in our case, however, as we can observe underpricing both with and without cornerstone involvement. Our problem is that we cannot observe the counterfactual underpricing for each firm in our sample - i.e., while we can observe firm A's actual underpricing, say while using cornerstone investors, we cannot observe how much underpricing firm A would experience if it had chosen not to use cornerstone investors.

Lee (1978) proposed a procedure to compute these counterfactuals. The first step of his procedure is to model the decision to involve cornerstone investors (or have a fixed-price offering) as a latent variable model[23]:

$$C_i^* = \alpha - \beta X_i + \epsilon_{c,i} + \delta(U_i^c - U_i^{nc}) - \epsilon_{nc,i}. \tag{4}$$

where $C = 1$ if the firm involves cornerstone investors and $C = 0$, if it does not, and X_i represents firm characteristics. The idea here is that cornerstone investors are used if they maximize the overall surplus and vice versa while taking into account the level of underpricing caused by this

[21]The exposition in this paragraph follows Bienz et al. (2021) closely.
[22]See for instance Bradley and Roberts (2015), Goyal (2005) and Bienz et al. (2021).
[23]See Bradley and Roberts (2015) for a derivation of this equation.

decision. U_i^c and U_i^{nc} are the extent of underpricing for firms with cornerstones (fixed pricing) and no cornerstones, and $\epsilon_i \sim N(0, \sigma^2)$ is the error term. We estimate the amount of underpricing, U_i^ω for $\omega = (c, nc)$ as:

$$U_i^\omega = \alpha_\omega - \beta_\omega X_i + \epsilon_{\omega,i} \tag{5}$$

We cannot directly estimate U_i^{nc} or U_i^c as we only observe U_i^c if $C_i^* > 0$ and U_i^{nc} if $C_i^* \leq 0$. Standard OLS would be inconsistent in this case as $E(U_i^c) = \beta X + E(\epsilon|\epsilon > -\beta X)$. The term $E(\epsilon|\epsilon > -\beta X)$ is called the inverse Mills ratio (Greene (2008)). Lee (1978) shows that by augmenting equation (5) with the inverse Mills ratio we receive consistent estimates of equation (5):

$$U_i^\omega = \alpha_\omega - \beta_\omega X_\omega + \epsilon_{\omega,i} + \sigma\phi\left(\frac{\beta X}{\sigma}\right) / \left(1 - \Phi\left(\frac{\beta X}{\sigma}\right)\right) + \eta_{d,i} \tag{6}$$

First, we estimate the reduced form of equation (4). To get the reduced form equation, we substitute equation (5) into equation (4). Second, we compute the inverse Mills ratio from this regression and include it into the cornerstone equation to get a consistent estimate for the decision to include cornerstone investors or not. While technically it is possible to gain identification simply through the inverse Mills ratio we use expected free float as an instrument. We do not expect free float to be directly linked to underpricing, yet it will affect the cornerstone decision as the higher underpricing associated with cornerstone investors will make higher free float more costly to the issuers. Note that we run two separate regressions, one for IPOs which involve cornerstone investors and the second one for all IPOs that eschew this option. Table 8 contains our results. Columns (1) and (2) show results of the OLS regression employed in the second stage of the Lee (1978) procedure. We then use the point estimates to compute two (model-based) estimates of underpricing in our sample. We estimate underpricing for all firms if they were to include cornerstone investors and also estimate underpricing if the firms were to exclude cornerstone investors. These two estimated levels of underpricing allow us to estimate counterfactual levels of underpricing and the spread in underpricing for each firm. Finally, we use a t-Test to see if the yield difference is also statistically significant. We find a 39 percent reduction in the underpricing

for firms that do not involve cornerstone investors (see Panel B of Table 8). In fact, our regression predicts almost no underpricing for IPOs that do not include cornerstone investors but very high underpricing for firms that use cornerstones. This reduction in underpricing is in line with our idea that cornerstone investors reduce the underwriters' ability to avoid underpricing.

Note that one of the coefficients for the inverse Mills ratio is significant. Wooldridge (2002) notes that the t-statistic of the inverse Mills ratio provides a test for endogeneity in the case of the Heckman (1976) two-stage procedure (page 564). Hence, one can interpret the statistical significance of the inverse Mills ratio as evidence for selection bias, or the lack of statistical significance as evidence against selection bias. Our evidence suggests that we should treat results that do not account for this endogeneity problem with caution.

Finally, we plug the underpricing differential back into the equation (4) and re-estimate it to get a consistent estimation of the impact of cornerstone inclusion. This method is similar to the Heckman (1976) two-step sample selection procedure and can be interpreted as a form of instrumental variable estimation (Bradley and Roberts (2015)). Table 9 contains our results. The table allows us to see if the yield differential of the cornerstone inclusion affects the inclusion decision itself, and we see clearly that the size of the implied underpricing differential negatively affects the underwriter's choice of using a cornerstone investor.

How can we interpret our results? Clearly, observed underpricing is less than 39bp - and it is important to understand the meaning of this number. It is the amount of underpricing each firm would have experienced if it would have used cornerstone investors relative to not using them. The fact that the underpricing differential from Table 9 is negative and significant tells us that firms anticipate this outcome and internalize it by not opting for cornerstone investors.

4.2 Investor demand and book filling speed

The previous sub-section suggests that the involvement of cornerstone investors decreases pricing efficiency in form of higher underpricing. In this sub-section, we analyze whether and to what extent issuers benefit from involving cornerstone investors. In particular, we examine how pre-

IPO marketing differs based on cornerstone involvement and offering method choice. An important feature of our study is that for a sub-sample of 55 IPOs (referred to as the *Underwriter-sample*), we additionally benefit from unique data on the underwriter books as well as information on pre-IPO marketing activities from a renowned Nordic underwriter. In the *Underwriter-sample* we have access to information about pre-IPO marketing and the number of investor meetings, in particular, those meetings classified as early-look and pilot-fish, and information from the book-building process including the price at demand, share order on the final day and the final share allocations.

Columns (5) to (8) of Table 3 refer to the *Underwriter-sample*, and we additionally test for differences in characteristics of firms in the *Underwriter-sample* and our main sample. Overall, we note that the firms in the *Underwriter-sample* do not seem to differ significantly from the firms in our main sample, except for cornerstone investors, which seem to be over-represented in the smaller sample. The average underpricing is with 9.8% slightly higher in the *Underwriter-sample*. Additionally, the smaller sample indicates higher average proceeds from the IPO.

Furthermore, for 42 IPOs, the data is sufficiently detailed to include the share orders on each day during the book-building period. We refer to this sub-sample as *Extended underwriter-sample*. Table 10 shows that firms in this sub-sample are not significantly different from firms in the *Underwriter-sample*, again except for a higher representation of IPOs with cornerstone involvement.

We begin by investigating the filling speed of IPO books by analyzing the daily share demand during the book-building period. Figure 1 shows the ratio of the share demand to the final share allocation for each day during the book-building period, averaged across the sample and split into book-building with cornerstones (in green) and without cornerstone investors (in blue). It is interesting to see how speeds differ. The graph reveals that offers with cornerstone investors reach full subscriptions earlier and benefit from a significantly higher share demand than those without cornerstone involvement. Figure 2 shows the same result split by the offering method choice. IPOs with fixed-price offerings, represented by the green bar, show for almost all days a

significantly higher share demand than those with floating-price offerings.

We proceed by testing for the difference in the filling speed using the Welch Two Sample t-Test. Panel A of Table 11 reveals that cornerstone involvement significantly increases book filling speed, confirming the visible findings above. Panel B of Table 11 also reveals the difference between the filling speed based on the offering method choice, even though the statistical significance of this difference is low. Ultimately, we see from these results that the overall demand is higher for IPOs with cornerstone investors than for those without.

In the next step, we analyze the sources of this growth. In particular, do we see that investors demand more shares overall, or do we see an increase in the number of investors overall? Table 12 analyzes this question. We normalize demand by the total amount of shares outstanding and the total amount of shares offered and run a simple OLS regression to control for other factors. Normalized demand is on the left-hand side of the equation, whereas the dummy for cornerstone inclusion is on the right-hand side. We see that cornerstone involvement is positively correlated with normalized share demand. This finding suggests that investors understand that cornerstone investors come along with lower pricing efficiency in terms of higher underpricing and that they rationally increase demand in order to profit from the higher underpricing. The benefit for the issuer is the overall increase in demand for its shares, which increases the likelihood of success during the book-building phase. Do we also observe that more investors ask for share allocations? Table 13 analyzes this question. We run a simple OLS regression where the number of (institutional) investors is on the left-hand side and the cornerstone dummy on the right-hand side[24]. We see only a very small effect of the cornerstone dummy and cannot conclude that there is an increase in the number of investors. Hence our results suggest that while cornerstone investors increase the demand for shares they do not increase the number of (institutional) investors.

Taken together our results indicate that cornerstone investors do not only lead to lower pricing efficiency in terms of higher underpricing but that the other side of the bargain, namely a reduction in risk of the IPO failing, also exists.

[24]We do not have information on private investors in our books.

4.3 Allocations

How are shares allocated in the book-building process? Benveniste and Spindt (1989) posit that investors that provide underwriters with information require compensation. Cornelli and Goldreich (2001) show that investors that place more informative orders get rewarded by underwriters in the form of higher allocations. Does the same hold for investors that participate in early-look and pilot-fish meetings? Implicitly we posit that participation in these meetings transfers information from investors to the underwriters. Unlike Cornelli and Goldreich (2001) we do not have more information about the type of interaction, but we can compare allocations to institutional investors that did not participate in the meetings[25].

Panel A of Table 14 presents the results on the underwriter's final allocations. First, we analyze the size of each investor's demand relative to total demand and find that an individual institutional investor accounts for 0.51% of all demand. These investors are then allocated 0.52% of all shares. This leads to a demand to allocation ratio of about 14%, an indication that these investors are heavily rationed in the final allocation.

Cornerstone investors' demand is much higher in comparison and stands at 1.75% of the final demand. They are allocated about 10% of all shares and face almost no rationing, receiving 96% of their desired allocation on average.

Early-look and pilot-fish investors form a middle category of investors - they ask for 1.16% of all shares and receive about 3% of all shares. They face rationing and receive about 50% of their demand as final allocation.

Panels B and C repeat the above analysis for the sub-sample of IPOs that involve cornerstone investors and those that do not. We do not observe major differences across the two sub-samples but find a somewhat lower demand for early-look and pilot-fish investors (but higher allocations) in the case of cornerstone involvement. This is puzzling as we would have expected the opposite to happen. However, given the results of Table 12 we might simply observe that higher overall

[25]We do not know if these investors were not selected by the underwriter or declined to participate in the first place though.

demand drives down the relative demand from these investors.

Overall these results are in line with the Benveniste and Spindt (1989) argument that investors are rewarded for disclosing information, though in our case this information is disclosed prior to book-building.

Given that early-look and pilot-fish investors receive higher allocations, do all of them always bid? Table 15 analyzes how frequently early-look and pilot-fish investors actually submit bids. The first column is for early-look investors, pilot-fish investors come second, whereas the third column combines the first two[26]. We see that on average about 50% of all investors submit bids. Interestingly we can see fewer investors submitting bids when there is no cornerstone involvement (instead of 54% of all investors submitting bids only 44% submit a bid).

Apart from a small number of books we do not know whether orders are limit orders or market orders, hence we cannot directly replicate the results from Cornelli and Goldreich (2001) or Jenkinson et al. (2018). In addition, we have many fixed-price offers in our sample where this distinction is moot. However, we can follow Jenkinson et al. (2018) and test whether investors that ask for more shares get higher allocations. The idea behind this test is that a larger order is a signal of higher demand for the shares. Table 16 shows that this is indeed the case. The larger the relative order, the higher the final allocation. Again, this validates the fact that more informative bidders are rewarded.

4.4 Pre-IPO investor meetings

Lastly, we investigate whether there is a relationship between the number of meetings with investors and cornerstone involvement. In particular, we focus on those investors that are classified as early-look, pilot-fish, or both. Table 17 presents the average number of investor meetings per IPO. Notably, we see a significant increase in the total number of meetings in the years 2017 and 2018.

We then test for the difference in the number of meetings based on the offering method choice

[26]Some but not all investors take part in early-look and pilot-fish meetings.

and cornerstone involvement. Panel A of Table 18 shows that the number of meetings is lower if cornerstone investors are involved in the IPO, however, the difference is not statistically significant. Similarly, Panel B of Table 18 shows that the number of meetings is lower for fixed-price offerings.

Overall we cannot conclude that the number of meetings itself influences the choice between cornerstone involvement or affects the choice for fixed-price offerings.

5 Conclusion

Our paper investigates the use of cornerstone investors in Nordic IPOs. We find a trade-off between higher underpricing and a higher demand for shares of firms that use cornerstone investors. We also show that cornerstone investors are rewarded for their commitment to the firm through an almost full allocation of shares. We address the endogeneity of the cornerstone inclusion decision by employing the Lee (1978) sample selection model. Our results suggest that the higher underpricing associated with cornerstone investors negatively affects the decision to include cornerstone investors in the IPO.

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6 Figures & Tables

6.1 Figures

Figure 1: **Book filling speed and cornerstone involvement**

This figure presents the average ratio of the daily share demand to the final share allocation for each day during the book-building period. The sample consists of 42 firms going public (IPOs) in the Nordic stock market in the period 2014-2018, for which we received information on the pre-IPO marketing activities and extended books with daily share demand during the book-building process from a Nordic underwriter. The green bars represent IPOs with cornerstone involvement, while the blue bars represent IPOs without cornerstone involvement.

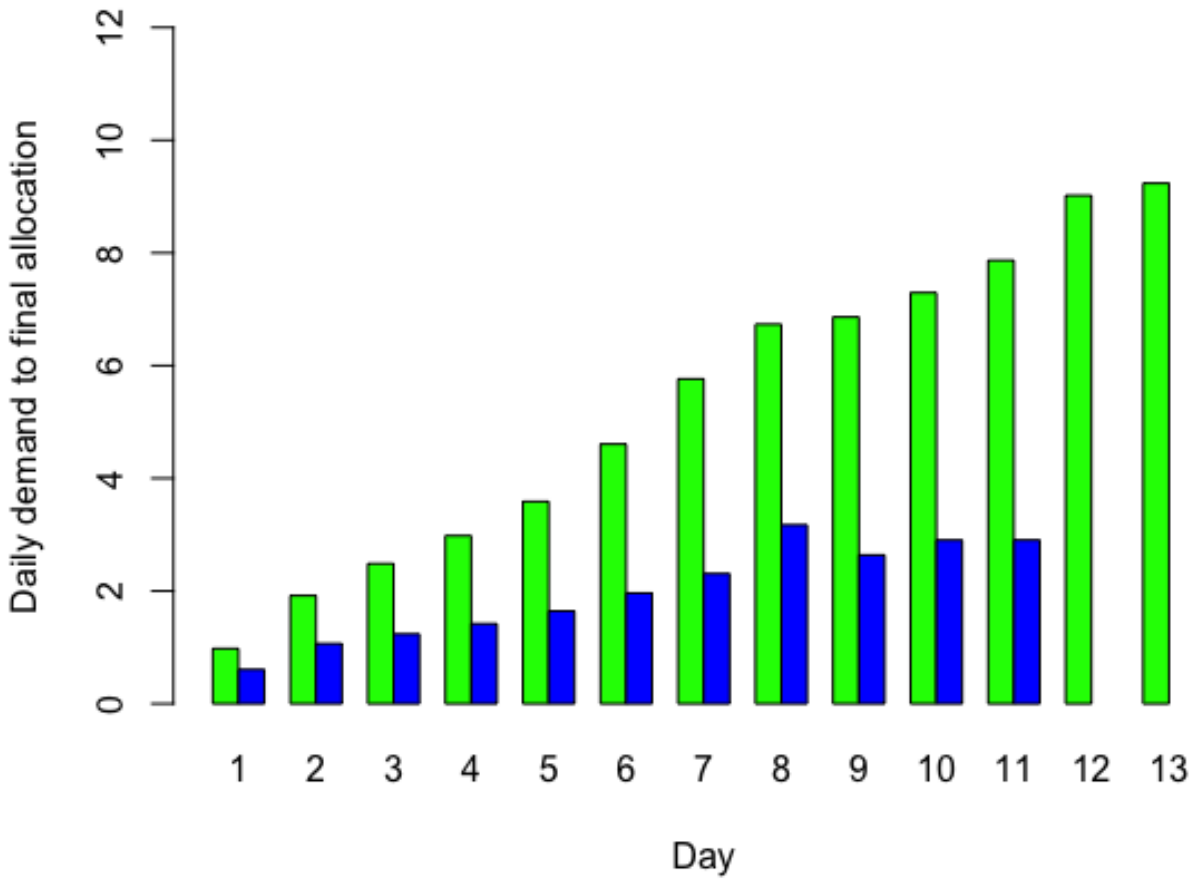
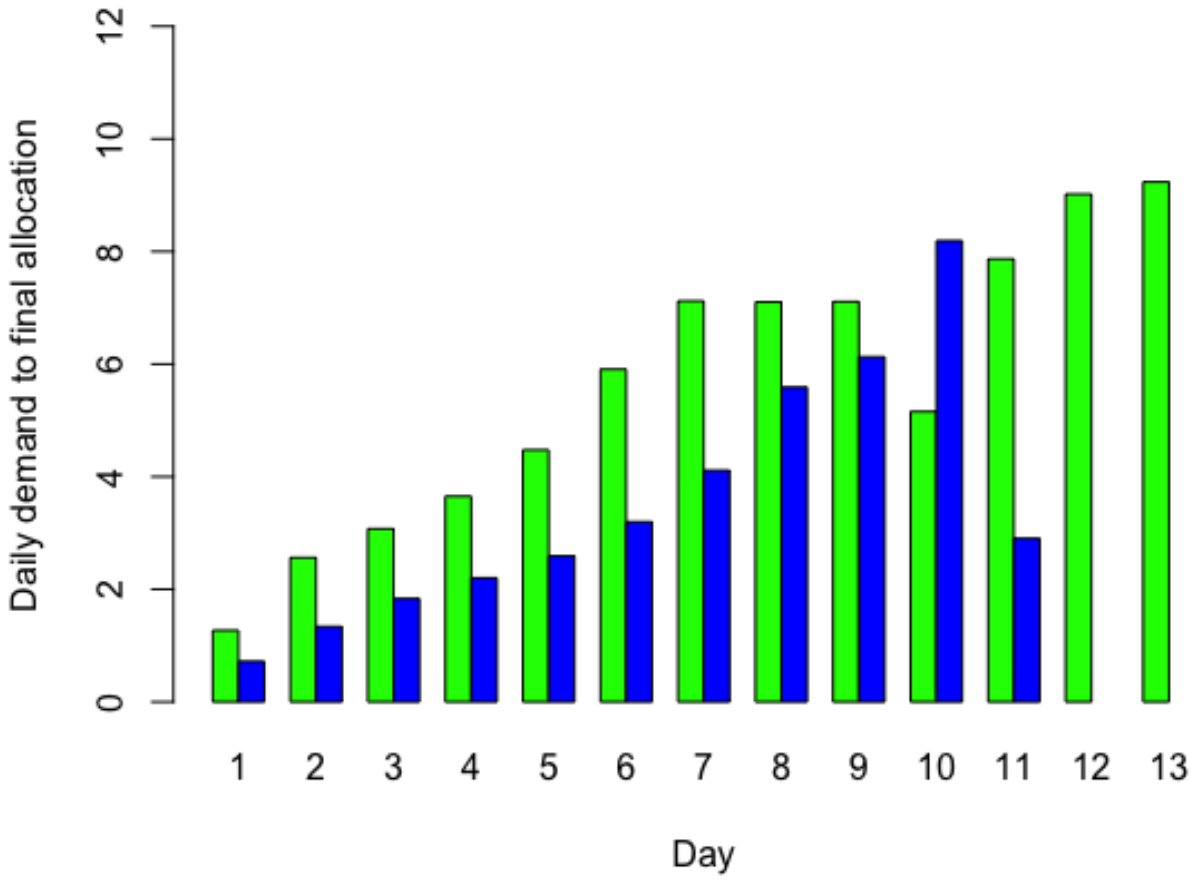


Figure 2: **Book filling speed and offering method choice**

This figure presents the average ratio of the daily share demand to the final share allocation for each day during the book-building period. The sample consists of 42 firms going public (IPOs) in the Nordic stock market in the period 2014-2018, for which we received information on the pre-IPO marketing activities and extended books with daily share demand during the book-building process from a Nordic underwriter. The green bars represent IPOs with fixed-price offerings, while the blue bars represent IPOs with floating-price offerings.



6.2 Tables

Table 1: **IPO activity in the Nordic countries and the United States**

This table presents the number of successful and withdrawn IPOs for all considered main markets in the period 2014-2018, for all considered IPOs (Columns (1) and (2)) as well as for IPOs that involve cornerstone investors (Columns (3) and (4)).

Nation	IPO	Withdrawn	IPO w. cornerstone	Withdrawn w. cornerstone
	(1)	(2)	(3)	(4)
Denmark	9	0	2	0
Finland	18	2	7	1
Norway	34	1	1	0
Sweden	63	0	45	0
United States	931	94	0	0

Table 2: **Overview of sample IPOs**

This table presents an overview of the 118 sample firms going public (IPOs) in the Nordic stock market in the period 2014-2018. Panel A presents the overview per year of issuance, while Panel B splits the sample per 2-digit SIC industry. Column (2) shows the number of IPOs involving cornerstone investors, while Column (3) shows the number of IPOs without cornerstone involvement. Column (4) shows the number of IPOs with fixed-price offerings, while Column (5) shows the number of IPOs with floating-price offerings. Column (6) refers to the sub-sample of 55 firms for which we received pre-IPO marketing information from a Nordic underwriter. Column (7) refers to the sub-sample of 42 firms for which we received extended books with daily share demand during the book-building process.

	N	Cornerstone involvement	No cornerstone involvement	Fixed	Floating	Underwriter sample	Extended und. sample
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: IPOs per year							
2014	23	1	22	3	20	9	0
2015	28	16	12	4	24	14	12
2016	20	12	8	6	14	13	12
2017	29	17	12	12	17	16	16
2018	18	6	12	5	13	3	2
Total	118	52	66	30	88	55	42
Panel B: IPOs per industry							
Construction	7	5	2	1	6	2	2
Finance	19	5	14	4	15	5	4
Manufacturing	37	18	19	13	24	24	15
Mining	3	0	3	0	3	0	0
Retail_trade	8	3	5	0	8	3	2
Services	31	17	14	10	21	14	14
Transportation	9	1	8	1	8	4	2
Wholesale_trade	4	3	1	1	3	3	3
Total	118	52	66	30	88	55	42

Table 3: **Summary statistics at IPO year - Full sample and Underwriter-sample**

This table presents the summary statistics of the most important variables used in this study. Columns (1) to (4) refer to the sample of 118 firms going public (IPOs) in the Nordic stock market in the period 2014-2018. Columns (5) to (8) refer to the sub-sample of 55 firms for which we received pre-IPO marketing information from a Nordic underwriter. All variables are defined in Table A1. Column (9) presents the t-statistic from the Welch Two Sample t-Test of differences in variable means between the two samples. Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

	Full sample				Underwriter-sample				t-Test
Variable	N	Mean	Median	St. Dev.	N	Mean	Median	St. Dev.	t-Statistic
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Accruals	102	-0.026	-0.025	0.064	51	-0.032	-0.031	0.065	0.567
BtM	116	-14.609	-14.515	1.030	55	-14.530	-14.482	1.075	-0.459
Capex	101	0.031	0.015	0.052	51	0.026	0.016	0.032	0.769
CF	113	0.042	0.056	0.098	50	0.049	0.057	0.071	-0.499
Cornerstone	118	0.441	0.000	0.499	55	0.655	1.000	0.480	-2.696**
EBITDA_margin	110	-5.346	0.120	41.689	51	-8.050	0.106	58.368	0.298
Firm_size	118	5.837	5.696	1.575	55	5.905	6.121	1.445	-0.278
Fixed	118	0.254	0.000	0.437	55	0.273	0.000	0.449	-0.254
High_tech	118	0.136	0.000	0.344	55	0.145	0.000	0.356	-0.172
Leverage	115	0.247	0.256	0.169	54	0.255	0.243	0.173	-0.281
Proceeds_MVE	116	0.801	0.413	3.073	55	1.262	0.507	4.433	-0.697
Revenue	112	5.175	5.463	1.955	52	5.421	5.859	1.856	-0.778
Tangibility	114	0.110	0.035	0.178	55	0.126	0.079	0.184	-0.528
Underpricing	118	0.078	0.040	0.122	55	0.091	0.065	0.130	-0.644
Z	96	1.453	1.428	1.086	45	1.482	1.478	0.915	-0.165

Table 4: **Summary statistics at IPO year - Cornerstone involvement**

This table presents the summary statistics of the most important variables used in this study. Columns (1) to (4) refer to the sample of firms going public (IPOs) in the Nordic stock market in the period 2014-2018 with cornerstone involvement. Columns (5) to (8) refer to those IPOs without cornerstone involvement. All variables are defined in Table A1. Column (9) presents the t-statistic from the Welch Two Sample t-Test of differences in variable means between the two samples. Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

	Cornerstone involvement				No cornerstone involvement				t-Test
Variable	N	Mean	Median	St. Dev.	N	Mean	Median	St. Dev.	t-Statistic
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Accruals	48	-0.016	-0.015	0.076	54	-0.034	-0.030	0.051	1.357
BtM	52	-14.698	-14.819	1.184	64	-14.537	-14.458	0.890	-0.812
Capex	47	0.021	0.012	0.023	54	0.040	0.020	0.067	-1.978+
CF	47	0.052	0.060	0.085	66	0.036	0.052	0.106	0.903
EBITDA_margin	46	-2.443	0.103	17.178	64	-7.432	0.142	52.779	0.706
Firm_size	52	5.438	5.053	1.387	66	6.151	6.212	1.652	-2.547*
Fixed	52	0.442	0.000	0.502	66	0.106	0.000	0.310	4.238**
High_tech	52	0.135	0.000	0.345	66	0.136	0.000	0.346	-0.027
Leverage	50	0.209	0.242	0.149	65	0.276	0.262	0.179	-2.198*
Proceeds_MVE	52	1.198	0.447	4.560	64	0.477	0.402	0.416	1.136
Revenue	48	5.080	5.270	1.744	64	5.246	5.692	2.110	-0.457
Tangibility	52	0.075	0.032	0.139	62	0.139	0.049	0.202	-1.994*
Underpricing	52	0.113	0.081	0.138	66	0.049	0.029	0.099	2.811**
Z	42	1.656	1.536	1.229	54	1.296	1.314	0.943	1.569

Table 5: **Summary statistics at IPO year - Offering method choice**

This table presents the summary statistics of the most important variables used in this study. Columns (1) to (4) refer to the sample of firms going public (IPOs) in the Nordic stock market in the period 2014-2018 with fixed-price offerings. Columns (5) to (8) refer to those IPOs with floating-price offerings. All variables are defined in Table A1. Column (9) presents the t-statistic from the Welch Two Sample t-Test of differences in variable means between the two samples. Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

	Fixed-price offerings				Floating-price offerings				t-Test
Variable	N (1)	Mean (2)	Median (3)	St. Dev. (4)	N (5)	Mean (6)	Median (7)	St. Dev. (8)	t-Statistic (9)
Accruals	26	-0.004	-0.006	0.058	76	-0.033	-0.030	0.065	2.135*
BtM	30	-14.441	-14.652	1.274	86	-14.668	-14.512	0.933	0.898
Capex	25	0.021	0.014	0.020	76	0.034	0.016	0.059	-1.733+
CF	28	0.025	0.054	0.143	85	0.048	0.056	0.078	-0.824
Cornerstone	30	0.767	1.000	0.430	88	0.330	0.000	0.473	4.684**
EBITDA_margin	26	-2.688	0.109	14.408	84	-6.168	0.122	47.085	0.594
Firm_size	30	5.319	4.929	1.410	88	6.014	5.979	1.597	-2.25*
High_tech	30	0.100	0.000	0.305	88	0.148	0.000	0.357	-0.708
Leverage	28	0.204	0.223	0.167	87	0.261	0.256	0.168	-1.565
Proceeds_MVE	30	1.699	0.323	5.994	86	0.487	0.438	0.370	1.107
Revenue	27	4.766	4.924	2.048	85	5.305	5.636	1.919	-1.208
Tangibility	29	0.064	0.036	0.070	85	0.126	0.035	0.200	-2.453*
Underpricing	30	0.134	0.102	0.151	88	0.058	0.031	0.104	2.555*
Z	24	1.353	1.388	1.084	72	1.487	1.428	1.093	-0.524

Table 6: **Determinants of cornerstone involvement and the offering method choice**

This table presents the results of the OLS (Columns (1) and (2)) and the probit (Columns (3) - (6)) regressions of the determinants of cornerstone involvement and the offering method choice. The regressions consider the full sample of 118 firms going public (IPOs) in the Nordic stock market in the period 2014-2018. The dependent variable in Columns (1), (3) and (5) is *Cornerstone*, which is an indicator equal to 1 if cornerstone investors have been involved, 0 otherwise. The dependent variable in Columns (2), (4) and (6) is *Fixed*, which is an indicator equal to 1 if the IPO was a fixed-price offering, 0 otherwise. All other variables are defined in Table A1. The regressions include IPO-year fixed effects. Columns (1) - (4) present coefficients, while Columns (5) and (6) present average marginal effects. Standard errors are robust to heteroskedasticity and reported in brackets. Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

	Coefficients				Marginal effects	
	OLS Cornerstone (1)	*OLS* Fixed (2)	*Probit* Cornerstone (3)	*Probit* Fixed (4)	*Probit* Cornerstone (5)	*Probit* Fixed (6)
Free_float	−0.720*	−1.000**	−2.500*	−5.300**	−0.760*	−1.200**
	(0.330)	(0.270)	(1.200)	(1.500)	(0.310)	(0.280)
IPO_last3months	−0.012	−0.037*	−0.027	−0.150*	−0.008	−0.035**
	(0.019)	(0.015)	(0.057)	(0.061)	(0.016)	(0.013)
Firm_size	−0.120**	−0.098*	−0.400*	−0.460*	−0.120**	−0.110*
	(0.044)	(0.041)	(0.160)	(0.220)	(0.041)	(0.044)
Revenue	0.040	0.006	0.150	0.110	0.044	0.025
	(0.042)	(0.036)	(0.150)	(0.150)	(0.041)	(0.032)
BtM	0.020	0.120**	0.055	0.440*	0.016	0.100*
	(0.047)	(0.044)	(0.150)	(0.210)	(0.041)	(0.040)
EBITDA_margin	0.001	0.001	0.002	0.002	0.0005	0.0005
	(0.001)	(0.001)	(0.003)	(0.003)	(0.001)	(0.001)
High_tech	−0.052	−0.070	−0.210	−0.170	−0.064	−0.039
	(0.120)	(0.110)	(0.390)	(0.440)	(0.110)	(0.090)
Constant	1.200	3.100**	2.000	11.000**		
	(0.850)	(0.800)	(2.700)	(4.000)		
Observations	105	105	105	105	105	105
R^2	0.260	0.260				
Adjusted R^2	0.170	0.170				
Log Likelihood			−56.000	−43.000	−56.000	−43.000
Akaike Inf. Crit.			135.000	110.000	135.000	110.000
Residual Std. Error (df = 93)	0.450	0.400				
F Statistic (df = 11; 93)	3.000**	2.900**				

Table 7: **Cornerstone involvement, offering method choice and underpricing - Baseline regression**

This table presents the results of the OLS regressions of underpricing on its determinants. The regressions consider the full sample of 118 firms going public (IPOs) in the Nordic stock market in the period 2014-2018. The dependent variable is *Underpricing*, which is the ratio of the unadjusted closing price on the first trading day following the IPO to the final offering price. *Fixed* is an indicator equal to 1 if the IPO was a fixed-price offering, 0 otherwise. *Cornerstone* is an indicator equal to 1 if cornerstone investors have been involved, 0 otherwise. All variables are defined in Table A1. The regressions include IPO-year fixed effects. Standard errors are robust to heteroskedasticity and reported in brackets. Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

	Underpricing			
	(1)	(2)	(3)	(4)
Cornerstone	0.059*	0.075*		
	(0.027)	(0.032)		
Fixed			0.100**	0.110*
			(0.033)	(0.042)
Firm_size	−0.016	−0.026	−0.014	−0.020
	(0.010)	(0.019)	(0.009)	(0.020)
Revenue	0.013	0.025*	0.016+	0.022+
	(0.009)	(0.013)	(0.009)	(0.013)
BtM	−0.015	−0.026	−0.024+	−0.033
	(0.013)	(0.022)	(0.013)	(0.023)
EBITDA_margin	−0.0002	−0.0004	−0.0003	−0.0003
	(0.0002)	(0.0003)	(0.0002)	(0.0003)
High_tech	0.019	0.004	0.026	0.014
	(0.042)	(0.044)	(0.042)	(0.045)
Accruals		0.083		0.086
		(0.180)		(0.170)
Proceeds_MVE		0.002		0.002
		(0.004)		(0.004)
Leverage		−0.076		−0.098
		(0.097)		(0.098)
MktRet_above_last3months		−0.013		−0.012
		(0.031)		(0.029)
Av_underpricing_last3months		−0.420*		−0.410*
		(0.180)		(0.190)
IPO_last3months		−0.004		0.001
		(0.005)		(0.005)
Constant	−0.150	−0.270	−0.310	−0.420
	(0.200)	(0.370)	(0.210)	(0.390)
Observations	108	90	108	90
R^2	0.170	0.270	0.240	0.300
Adjusted R^2	0.089	0.110	0.160	0.140
Residual Std. Error	0.120 (df = 97)	0.120 (df = 73)	0.110 (df = 97)	0.120 (df = 73)
F Statistic	2.000* (df = 10; 97)	1.700+ (df = 16; 73)	3.100** (df = 10; 97)	1.900* (df = 16; 73)

Table 8: **Cornerstone involvement and underpricing - Lee (1978)**

This table presents the second stage of the Lee (1978) model where we examine the relation between underpricing and cornerstone involvement. In Panel A, we run separate OLS regressions for IPOs without and with cornerstone involvement. The dependent variable *Underpricing* is the stock return on the IPO day. The main independent variable IMR is the inverse Mills ratio from the first stage. All variables are defined in Table A1. The regressions include IPO-year fixed effects. t-Statistics are robust to heteroskedasticity and reported in brackets. In Panel B, we present the predicted level of underpricing for IPOs without and with cornerstone involvement and the implied difference (incl. statistical significance from a t-Test). Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

	Underpricing	
	No cornerstone	Cornerstone
	(1)	(2)
Panel A: Second stage		
IMR_nc	0.078	
	(1.54)	
IMR_c		0.268*
		(2.60)
Firm_size	-0.064*	0.015
	(2.06)	(0.24)
Revenue	0.061*	0.017
	(2.31)	(0.45)
BtM	-0.054+	-0.049
	(1.94)	(0.97)
EBITDA_margin	-0.001*	-0.002
	(2.52)	(1.02)
High_tech	0.007	0.075
	(0.15)	(0.76)
Accruals	0.049	-0.293
	(0.16)	(0.87)
Proceeds_MVE	0.017	0.002
	(0.80)	(0.21)
Leverage	0.078	-0.093
	(0.67)	(0.29)
MktRet_above_last3months	-0.066+	-0.102+
	(1.77)	(1.74)
Av_underpricing_last3months	-0.620+	-0.114
	(2.04)	(0.30)
IPO_last3months	-0.003	-0.008
	(0.44)	(0.64)
Constant	-0.702	0.055
	(1.57)	(0.06)
Observations	47	43
R^2	0.40	0.47
Panel B: Predicted spread		
Predicted underpricing	0.002	0.392
Predicted difference	-0.390**	
Observations	90	

Table 9: **Cornerstone involvement and underpricing - Lee (1978): Augmented probit**

This table presents the third stage of the Lee (1978) model where we examine the relation between underpricing and cornerstone involvement. The third stage consists of an augmented probit model where the dependent variable *Cornerstone* is an indicator for involvement of cornerstone investors. The independent variable Δ *Underpricing* is the implied underpricing differential from the second stage. $Free\_float$ is the percentage of shares available to the public after the IPO. All variables are defined in Table A1. The regression includes IPO-year fixed effects. t-Statistics are robust to heteroskedasticity and reported in brackets. Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

	Cornerstone (1)
Δ Underpricing	-0.648* (2.32)
Firm_size	-0.008 (0.12)
Revenue	-0.056 (1.00)
BtM	0.093+ (1.65)
EBITDA_margin	0.001 (1.08)
High_tech	0.018 (0.14)
Accruals	0.216 (0.32)
Proceeds_MVE	-0.012 (0.91)
Leverage	0.382 (1.19)
MktRet_above_last3months	0.204* (2.16)
Av_underpricing_last3months	-0.341 (0.51)
IPO_last3months	0.009 (0.50)
Free_float	-1.166** (3.56)
Observations	90

Table 10: **Summary statistics at IPO year - Underwriter-sample with extended books**

This table presents the summary statistics of the most important variables used in this study. Columns (1) to (4) refer to the sample of 55 firms going public (IPOs) in the Nordic stock market in the period 2014-2018 for which we received pre-IPO marketing information from a Nordic underwriter. Columns (5) to (8) refer to a further sub-sample of 42 firms for which we received extended books with daily share demand during the book-building process. All variables are defined in Table A1. Column (9) presents the t-statistic from the Welch Two Sample t-Test of differences in variable means between the two samples. Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

	Underwriter-sample				Underwriter-sample with extended books				t-Test
Variable	N (1)	Mean (2)	Median (3)	St. Dev. (4)	N (5)	Mean (6)	Median (7)	St. Dev. (8)	t-Statistic (9)
Accruals	51	-0.032	-0.031	0.065	38	-0.033	-0.033	0.072	0.089
BtM	55	-14.530	-14.482	1.075	42	-14.595	-14.515	1.203	0.278
Capex	51	0.026	0.016	0.032	38	0.022	0.013	0.024	0.651
CF	50	0.049	0.057	0.071	37	0.052	0.055	0.064	-0.213
Cornerstone	55	0.655	1.000	0.480	42	0.833	1.000	0.377	-2.054*
EBITDA_margin	51	-8.050	0.106	58.368	39	0.099	0.103	0.237	-0.997
Firm_size	55	5.905	6.121	1.445	42	5.684	5.738	1.487	0.733
Fixed	55	0.273	0.000	0.449	42	0.357	0.000	0.485	-0.877
High_tech	55	0.145	0.000	0.356	42	0.167	0.000	0.377	-0.281
Leverage	54	0.255	0.243	0.173	41	0.221	0.236	0.158	0.993
Proceeds_MVE	55	1.262	0.507	4.433	42	1.488	0.507	5.065	-0.229
Revenue	52	5.421	5.859	1.856	39	5.422	5.859	1.542	-0.003
Tangibility	55	0.126	0.079	0.184	42	0.080	0.033	0.123	1.46
Underpricing	55	0.091	0.065	0.130	42	0.107	0.094	0.141	-0.588
Z	45	1.482	1.478	0.915	33	1.574	1.478	0.943	-0.429

Table 11: **Book filling speed**

This table presents the results of the Welch Two Sample t-Tests performed on a sample of 42 firms going public (IPOs) in the Nordic stock market in the period 2014-2018 for which we received additional information on the pre-IPO marketing activities and extended books with daily share demand during the book-building process from a Nordic underwriter. The variable of interest is daily book filling speed, which is defined as the ratio of the daily share order to total shares allocated during the book-building period. The t-Tests are performed for sub-samples of IPOs with and without involvement of cornerstone investors (Panel A) and for sub-samples of IPOs with fixed-price offerings and with floating-price offerings (Panel B). Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

Panel A: Cornerstone involvement

	Cornerstone involvement (1)	No cornerstone involvement (2)	Difference (3)	t-Statistic (4)
Day 1	0.98	0.61	0.37	2.235*
Day 2	1.92	1.07	0.85	2.639*
Day 3	2.49	1.24	1.25	3.335**
Day 4	2.98	1.42	1.56	3.455**
Day 5	3.59	1.64	1.94	3.673**
Day 6	4.61	1.96	2.64	3.936**
Day 7	5.76	2.31	3.46	4.164**
Day 8	6.73	3.17	3.56	3.219**
Day 9	6.86	2.64	4.22	4.676**

Panel B: Offering method choice

	Fixed-price offerings	Floating-price offerings	Difference	t-Statistic
Day 1	1.27	0.72	0.55	1.772+
Day 2	2.56	1.34	1.22	2.144*
Day 3	3.07	1.83	1.24	1.881+
Day 4	3.65	2.20	1.45	1.81+
Day 5	4.48	2.59	1.89	1.996+
Day 6	5.91	3.20	2.71	2.222*
Day 7	7.12	4.11	3.01	2.108*
Day 8	7.10	5.59	1.51	0.911
Day 9	7.11	6.13	0.98	0.541
Day 10	5.16	8.19	-3.04	-1.218

Table 12: **Cornerstone involvement and share demand**

This table focuses on the relationship between the involvement of cornerstone investors and share demand during the book-building period. The focus lies on 55 firms going public (IPOs) in the Nordic stock market in the period 2014-2018 for which we received additional information on the pre-IPO marketing activities from a Nordic underwriter. The dependent variable in Column (1) is *Demand_Shares_outstanding*, which is the ratio of the total share demand on the final day of the book-building period to total shares outstanding after the IPO as suggested in the respective IPO prospectuses. The dependent variable in Column (2) is *Demand_Shares_offered* and considers total shares offered in the IPO (excluding optional shares and over-allotment options) as the denominator. The main independent variable is *Cornerstone*, which is an indicator equal to 1 if cornerstone investors have been involved, 0 otherwise. All variables are defined in Table A1. The regressions include IPO-year fixed effects. Standard errors are robust to heteroskedasticity and reported in brackets. Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

	Demand_Shares_outstanding (1)	Demand_Shares_offered (2)
Cornerstone	1.800**	6.100**
	(0.480)	(1.500)
Firm_size	−0.480*	−0.810
	(0.240)	(0.550)
Revenue	0.600**	1.200+
	(0.230)	(0.650)
BtM	−0.062	−0.240
	(0.200)	(0.560)
EBITDA_margin	−0.011**	−0.032*
	(0.004)	(0.013)
High_tech	−0.460	−0.460
	(0.600)	(2.200)
Constant	1.800	0.740
	(2.800)	(9.300)
Observations	51	51
R^2	0.340	0.380
Adjusted R^2	0.170	0.220
Residual Std. Error (df = 40)	1.500	4.300
F Statistic (df = 10; 40)	2.000+	2.400*

Table 13: **Cornerstone involvement and the number of investors**

This table focuses on the relationship between the involvement of cornerstone investors and the number of investors during the book-building period. The focus lies on 55 firms going public (IPOs) in the Nordic stock market in the period 2014-2018 for which we received additional information on the pre-IPO marketing activities from a Nordic underwriter. The dependent variable in Column (1) is *Investors*, which is the number of investors submitting a bid during the book-building process. The dependent variable in Column (2) is *Investors_Firm_size* and considers the ratio of the number of investors submitting a bid during the book-building process to IPO firm size. The main independent variable is *Cornerstone*, which is an indicator equal to 1 if cornerstone investors have been involved, 0 otherwise. All variables are defined in Table A1. The regressions include IPO-year fixed effects. Standard errors are robust to heteroskedasticity and reported in brackets. Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

	Investors (1)	Investors_Firm_size (2)
Cornerstone	59.000^{+}	8.100^{+}
	(31.000)	(4.800)
Firm_size	18.000	−2.100
	(16.000)	(2.200)
Revenue	27.000*	4.100*
	(13.000)	(1.900)
BtM	−13.000	−3.000^{+}
	(11.000)	(1.700)
EBITDA_margin	−0.690**	−0.110**
	(0.210)	(0.035)
High_tech	−23.000	−3.400
	(33.000)	(5.900)
Constant	−235.000	−20.000
	(195.000)	(29.000)
Observations	51	51
R^2	0.410	0.280
Adjusted R^2	0.270	0.099
Residual Std. Error (df = 40)	80.000	13.000
F Statistic (df = 10; 40)	2.800**	1.500

Table 14: **Share demand and allocation**

This table presents the share demand and allocation during the book-building period for 55 IPOs for which we received additional information on the pre-IPO marketing activities from a Nordic underwriter. Investor demand is the ratio of the share demand of each investor on the final day to the total share demand of all investors. Investor allocation is the ratio of the share allocation to each investor to the total share allocation to all investors. Investor demand to allocation is the ratio of the share demand of each investor on the final day to the share allocation to each investor. The results are presented for all investors, all investors excluding cornerstone investors, cornerstone investors, investors classified as early-look, pilot-fish, or both early-look and pilot-fish. The results are averages across all books and presented in percentages. Panel A presents the results for all IPOs, Panel B presents the results for IPOs with cornerstone involvement, and Panel C presents the results for IPOs without cornerstone involvement.

	Investor demand to total demand (%) (1)	Investor allocation to total allocation (%) (2)	Investor demand to allocation (%) (3)
Panel A: All IPOs			
All investors	0.51	0.52	13.99
Investors w/o cornerstone	0.50	0.40	12.84
Cornerstone investors	1.75	9.60	96.29
Early-look	1.16	2.99	42.10
Pilot-fish	1.16	2.91	41.27
Early-look and pilot-fish	1.40	4.29	52.45
Panel B: IPOs with cornerstone involvement			
All investors	0.52	0.52	11.20
Investors w/o cornerstone	0.49	0.33	9.39
Cornerstone investors	1.75	9.60	96.29
Early-look	1.09	3.15	40.20
Pilot-fish	1.05	3.19	39.53
Early-look and pilot-fish	1.13	4.43	51.66
Panel C: IPOs without cornerstone involvement			
All investors	0.50	0.54	19.53
Early-look	1.34	2.58	47.14
Pilot-fish	1.36	2.42	44.53
Early-look and pilot-fish	2.02	3.99	54.45

Table 15: **Investor type and bid submission**

This table focuses on investors classified as early-look (including those that are also classified as pilot-fish), pilot-fish (including those that are also classified as early-look), and those classified as both early-look and pilot-fish. The results are presented for 55 firms going public (IPOs) in the Nordic stock market in the period 2014-2018. *Investor type* is the total number of investors (for all considered IPOs), *Bid submission* is the number of investors that have submitted share demands during the book-building period, and *Submission ratio* is the ratio of *Bid submission* to *Investor type*. Panel A presents the results for all IPOs, Panel B presents the results for IPOs with cornerstone involvement, and Panel C presents the results for IPOs without cornerstone involvement.

	Early-look (1)	Pilot-fish (2)	Early-look and pilot-fish (3)
Panel A: All IPOs			
Investor type	1029	864	300
Bid submission	521	488	192
Submission ratio	0.51	0.56	0.64
Panel B: IPOs with cornerstone involvement			
Investor type	689	520	193
Bid submission	370	311	134
Submission ratio	0.54	0.60	0.69
Panel C: IPOs without cornerstone involvement			
Investor type	340	344	107
Bid submission	151	177	58
Submission ratio	0.44	0.51	0.54

Table 16: **Share demand and allocation - Terciles**

This table presents the average share demand on the final day of the book-building process, share allocation and the ratio of share demand to allocation of investors split based on share demand terciles for each respective book. The sample consists of 55 firms going public (IPOs) in the Nordic stock market in the period 2014-2018 for which we received information on the pre-IPO marketing activities from a Nordic underwriter.

	Share demand (1)	Share allocation (2)	Demand to allocation (3)
Demand lowest tercile	107,328	9,976	0.11
Demand mid tercile	543,860	58,912	0.12
Demand highest tercile	3,103,717	583,178	0.19

Table 17: **Overview of meetings with investors**

This table presents the overview of investor meetings for a sample of 55 firms going public (IPOs) in the Nordic stock market in the period 2014-2018 for which we received additional information on the pre-IPO marketing activities from a Nordic underwriter. The variable of interest is the average number of meetings with potential investors classified as early-look (including those that are also classified as pilot-fish), pilot-fish (including those that are also classified as early-look) and those classified as both early-look and pilot-fish, relative to the number of IPOs. *Meetings total* refers to the sum of meetings with all potential investors, relative to the number of IPOs.

Year	Number of IPOs (1)	Early-look (2)	Pilot-fish (3)	Early-look and pilot-fish (4)	Meetings total (5)
2014	9	14	14	4	25
2015	14	16	12	4	24
2016	13	18	13	5	25
2017	16	24	20	8	36
2018	3	25	23	5	43

Table 18: **Investor meetings**

This table presents the results of the Welch Two Sample t-Tests performed on a sample of 55 firms going public (IPOs) in the Nordic stock market in the period 2014-2018 for which we received additional information on the pre-IPO marketing activities from a Nordic underwriter. The variable of interest is the average number of meetings with potential investors classified as early-look (including those that are also classified as pilot-fish), pilot-fish (including those that are also classified as early-look), and those classified as both early-look and pilot-fish, and total meetings with all potential investors. The t-Tests are preformed for sub-samples of IPOs with and without involvement of cornerstone investors (Panel A) and for sub-samples of IPOs with fixed-price offerings and with floating-price offerings (Panel B). Superscripts **, * or + indicate significance at the 1%, 5% or 10% levels, respectively.

Panel A: Cornerstone involvement

	Cornerstone involvement (1)	No cornerstone involvement (2)	Difference (3)	t-Statistic (4)
Early-look	19.11	18.32	0.80	0.303
Pilot-fish	14.44	17.42	-2.98	-1.091
Early-look and pilot-fish	5.36	5.32	0.05	0.036
Meetings total	28.19	30.42	-2.23	-0.59

Panel B: Offering method choice

	Fixed-price offerings	Floating-price offerings	Difference	t-Statistic
Early-look	18.40	19.00	-0.60	-0.2
Pilot-fish	15.27	15.55	-0.28	-0.079
Early-look and pilot-fish	6.13	5.05	1.08	0.574
Meetings total	27.53	29.50	-1.97	-0.482