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. When an owner's home experiences substantial house price appreciation and when the owner has lower leverage, this relationship becomes more pronounced. We observe significant and enduring operational improvements within firms, along with higher survival rates in the post-extraction period. We also find that home equity extraction motivates experienced owners to replicate their success by establishing new companies in the same industry and contributes to the promotion of regional entrepreneurial activities. 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*

*This paper is dedicated to the memory of Xunhua Su. We thank the Norwegian Tax Authority for providing these data. This study is a part of a research project granted by Finansmarkedsfondet(pnr.32826). All errors are our own.

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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 and 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 a gap in understanding the direct financing mechanism between personal accounts and firm accounts. Specifically, the process of extracting home equity

[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

and injecting it into the firm's funds, either as debt or equity, remains unexplored. Furthermore, it is important to examine whether these findings extend beyond directors to encompass critical owners of the firms more broadly.

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 primary finding reveals a significant and positive relationship between home equity-based borrowing and the propensity of owners to inject new equity into their closely held private firms. Specifically, when an owner extracts a mortgage, there is a 0.7% increase in the probability of a new equity injection, which aligns closely with previous findings in the entrepreneurial literature (e.g. Schmalz, Sraer, and Thesmar, 2017). Conditional on mortgage extraction, the marginal propensity to inject equals 38 øre per extracted krone. This indicates that owners do not inject the entire volume of the extracted mortgage, which echoes previous research in the field of home equity-based borrowing and consumption (Greenspan and Kennedy, 2008). Using house price variations across Norway, we perform a quasi difference-in-difference analysis follow Schmalz, Sraer, and Thesmar (2017) and Chaney, Sraer, and Thesmar (2012). We find the owners are more likely to extract home-equity for firm financing where the house price appreciated more and when their personal debt capacity are high. The evidence is consistent with the collateral explanation of home equity.

[2]See detailed description in data sources section.

Next, we investigate the motivations behind home equity extraction and how the funds are utilized by owners. We find that owners have a stronger inclination to extract home equity when their firms underperform compared to their industry peers. This suggests that the injection of home equity is driven by the owners' desire to secure financing for their struggling firms. Furthermore, we observe that the injected funds are used to improve the operational performance of these firms. This infusion of capital contributes to enhancing the financial performance of the firms, thereby mitigating the risk of bankruptcy in the near future. Additionally, we find that home equity-based borrowing plays a pivotal role in enabling owners to embark on new entrepreneurial ventures within the same industry, leveraging their expertise and capabilities gained from their previous firms. This highlights the importance of home equity as a catalyst for entrepreneurial activities and the continuity of business creation. On an aggregate level, our analysis reveals that home equity extraction fosters regional entrepreneurial activities. It is associated with a significant increase in the number of new firms being established and the creation of new job opportunities within the region.

To address potential sources of endogeneity that could influence our results, we consider several strategies. Firstly, we acknowledge that the decision to own a home is endogenously determined by the owner. However, thanks to the comprehensive nature of the Norwegian data available to us, we are able to observe the residence address of owners at the zipcode level. This allows us to account for the ownership of a home throughout our sample period, effectively holding it constant and reducing the potential endogeneity concern. Secondly, we recognize the possibility of regional economic conditions acting as a confounding factor, as they are often correlated with the housing market (Mian and Sufi, 2011). To address this concern, we include regional-time fixed effects in our analysis. These fixed effects help control for unobserved economic trends at the local level that may impact both housing dynamics and owner behavior. Additionally, we include industry-time fixed effects to account for any industry-specific trends that could influence our results. To further disentangle the effects of local economic shocks, we perform subsample analyses where owners and firms are located in different kommunes. This allows us to separate and assess the impact of local economic conditions on our findings more precisely. To address owner-level heterogeneity, we consider a broad range of owner characteristics, alongside firm characteristics, in our analyses. Lastly, we employ a highly restricted sample where we can clearly observe that the borrowing is specifically from home equity, thereby ensuring the "labeled" nature of the funds. By analyzing this restricted sample, we verify that the

coefficient remains consistent with our main analysis, providing robustness to our findings.

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 observe enhanced firm performance and long-term survival in the period following the equity injection, indicating that it is a beneficial decision for financially constrained firms rather than a misguided one.

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. Their findings reveal that an increase in directors' home value corresponds to an increase in corporate investment. Our study complements their work by providing

direct evidence on the intermediate step, demonstrating how critical owners extract home equity and inject it as new equity into closely held firms. Furthermore, we enhance identification and address endogeneity concerns by incorporating house price dynamics into our analysis.

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

[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

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, 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

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

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 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.*

3 Data, Variables and Statistics

3.1 Data Sources

To analyze the relationship between home equity extraction and private firm equity injections, we construct 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

[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.

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.

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 have 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 are 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

[7] See **?** for detailed description of the database

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 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). When we look at the aggregated annual new equity raise by the sample firms over time, figure 3 also suggests that greater amount is raised by existing firms.

Figure 4 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 to secure "skin in the game".

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 3 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 annual difference varies 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 consider 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 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.

We conduct a concise analysis to examine the direct link between the mortgage extraction and equity injection behaviors among the Norwegian private firm owners. We sort our sample firms into two type, namely firms receiving equity injections (injected firms) and firms receiving no equity injections (control firms), in a five-year window. We define the "event year" as the year that a firm receives new equity injections subsequent to a minimum of two years of no injections at all ("quiet period"). Firms are also roughly matched by size quartiles, industry, region and year. We then compare the mortgage extraction and and new equity injection behaviors and collect the outcomes in figure 5.

Figure 5a illustrates the average frequency of a private firm owner extracts mortgage over time, whereas 5b plots out the mean amount of home equity extracted by the owner (in thousand kroner).

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

[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%.

Compared with the owners of control firms which receive no equity injections at all, the treated firm owners extract mortgage way more frequent than the control firm owners (0.5 vs. 0.3 times) and the average amount of extraction is almost doubled (appr. 400 thousand vs. 200 thousand). When we look at figure 5c, we can see that the average equity injection amount among the treated group owners is almost equivalent to the money they extracted from home equity in figure 5b. The evidence indicate a strong link between mortgage extractions and equity injections among these Norwegian private firm owners.

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 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 $HousePriceChange$ is an indicator of local house price change from 87 area in Norway [11]. The granularity of the house price dynamics is at the city level if available, and otherwise at the province level. This is because the cross-sectional house price change is substaintial across the geographical territory. Cities, such as Oslo, Bergen, Stanvanger and Trondheim, are closely monitored due to the highly competitive nature of the lcoal market. We calculate the cumulative change of the house price from $t-6$ to $t-1$ at each year t for each area, following Schmalz, Sraer, and Thesmar (2017). Then we map the change of house price to our main sample. The average house price growth of our sample is 37%, with a standard deviation of 16%. Figure 6 illustrates the heterogeneity in housing price variations across different area over the sample period. This variation is substantial, from the minimum of 5% to the maximum of 97%.

Panel B 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

[11] Dataset is provided by Eiendomsverdi AS.

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 3.

Panel C 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 4 that the majority of these firms operate in capital-light industries. We use 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 is 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 shows a slightly higher injection probability. However, the conditional probability is 50% higher. This also corresponds to almost double the equity injection amount compared to the non-extraction group. The mean injection amount is relatively small due to the low frequency of injections 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 probability of an owner's mortgage extraction and new equity injection, we use the linear probability model for our baseline analysis for its easiness to interpret:

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

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 Ordinary Least Square (OLS) 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 indus-

try and industry-time fixed effects. The coefficients of probability of equity injection are maintained at a stable level of 0.8% 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 0.7% in the most exhausted model. 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 0.7% 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.

Our main regression results from Table 4 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 probability. 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 Endogeneity Concerns

In this section, we introduce heterogeneity in owner and firm characteristics to tackle the identification concerns observed in our baseline results. Specifically, we utilize the house price dynamics and owner's indebtedness to help identify the source of funds for firm equity injection.

4.2.1 House Price Dynamics

First, we consider the source of variations from the housing market and investigate how house price dynamics would affect this relationship. we perform a quasi difference-in-difference (DiD) analysis that is similar to Schmalz, Sraer, and Thesmar (2017) and Chaney, Sraer, and Thesmar (2012). The model specification is:

$$\begin{aligned} Injection_{i,j,t} =& \beta_1 Mortgage\ Increase_{i,t} \times House\ Price\ Change_i^{t-6\to t-1} + \beta_2 Mortgage\ Increase_{i,t} \\ &+ \beta_3 House\ Price\ Change_i^{t-6\to t-1} + \beta Firm\ Controls_{j,t-1} + \beta Owner\ Controls_{i,t-1} \\ &+ \beta Firm\ Controls_{j,t-1} \times House\ Price\ Change_i^{t-6\to t-1} \\ &+ \beta Owner\ Controls_{i,t-1} \times House\ Price\ Change_i^{t-6\to t-1} \\ &+ \alpha_{i,j} + \mu_{j,t} + \eta_{j,t} + \varepsilon_{i,j,t} \end{aligned} \tag{3}$$

While all other specifications are the same as in our baseline analysis, we introduce the house price dynamic proxy $HousePriceChange_i^{t-6\to t-1}$ and interact it with our key independent variable $MortgageIncrease_{i,t}$ as well as all the other firm and owner level control variables. The $House\ Price\ Change_i^{t-6\to t-1}$ stands for the cumulative house price growth in the area where owner i lives and it can be different from where the firm j is based. Given the different granularity levels, the regional fixed effect does not fully absorb the house price change information. The extensive inclusion of interaction terms encompassing house price growth and the control variables at both the owner and firm levels significantly mitigates concerns regarding omitted variables, particularly addressing the confounding issue related to local economic conditions.

This setting is similar to a difference-in-difference identification. The "treatment" is the cumulative five-year house price growth of the area. The "treated group" are the owners with mortgage extraction whereas the "control group" are the owners without mortgage extraction. The coefficient of interest in equation 3 is therefore β_1 for the interaction term. It relies on two sources of variation: the decision on home equity withdrawal and the growth of house price. A positive β_1 indicates that an

owner is more likely to injection new equity to her firm when she withdraws home equity and when the house price appreciates more. In the scenario where the extraction behavior is unrelated to the collateral value of the home, we would expect an outcome of zero β_1.

The results of this analysis are collected in Table 5. The columns are arranged in the same order as in baseline analysis with detailed regression specifications indicated in the lower panel. Although the coefficient of interest (β_1)is positive but insignificant in column 1, it becomes significant when we include multi-level fixed effects from column 2 to column 4. When we add firm controls (column 5) and owner controls (column 6), the coefficients of interest remain significant with a magnitude of 1%. It suggests when a sample owner withdraw home equity and when the house price appreciates from its minimum to its maximum (a difference of 92%), the probability of equity injection increases by 0.9%. This result is also consistent with the findings of Schmalz, Sraer, and Thesmar (2017).

While the findings affirm the significant impact of the housing market on equity injections for private firms, it is important to acknowledge that we are unable to disentangle the collateral effect from the wealth effect. An increase in home value can simultaneously enhance an owner's debt capacity and their ability and/or willingness to take on risk.

4.2.2 Owners' Indebtedness

In this section, we provide additional evidence that reinforces the rationale behind the collateral channel explanation. Owners exhibit variations in their debt capacities. Even with the same level of house price appreciation, an owner with a high initial leverage ratio may lack the ability or willingness to borrow as much as their counterparts with lower leverage ratios. Consequently, we anticipate that lower leveraged owners will exhibit a more pronounced response compared to their highly leveraged counterparts, despite both groups experiencing an equal level of exposure to the wealth effect.

To categorize the sample owners, we divide them into two groups based on the median leverage of owners in the previous year. The leverage of owners is determined by estimating the ratio of total outstanding debt to the tax value of their respective houses. Then we perform test in equation 3 in both subsamples and collect the regression results in Table 6. The regression specifications are described in the lower panel.

Column 1 reports the result from the lower leveraged owners and column 2 displays the result

including additional owner and firm controls. Following the same approach, columns 3 and 4 collect the results from the high leveraged owners. We can see significant and positive coefficients of the interaction term from columns 1 and 2 contrasting to the negative and insignificant coefficients for it from columns 3 and 4. The results indicate that an increase in home value results in a higher likelihood of home equity-based injections among low leveraged owners, while high leveraged owners do not exhibit the same response. When all control variables are included, the coefficient for lower leverage owners exhibits a magnitude of 2.6% increase in probability of new equity injection among the lower leveraged owners to their closely held private firms. This is more than doubled in terms of magnitude from the full sample analysis in Table 5.

The outcomes of this section consequently support the notion that our findings align more closely with the collateral channel explanation rather than the wealth effect of home equity.

4.3 The Impact of Home Equity-related Injection

In this section, we delve into the implications of home equity extractions, specifically focusing on how owners utilize the extracted funds. We conduct five sets of analyses to explore this further. Firstly, we examine the volume of equity injection conditional on mortgage extraction. Secondly, we investigate firms' performance following equity injections. Thirdly, we assess whether equity injections serve as a preventive measure against bankruptcy for these firms. Next, we explore whether owners show intentions to pursue external investment opportunities. Finally, we study the aggregate impact at the regional level.

4.3.1 Injected Amount

We first 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 is the log transformed mortgage extraction amount from the owner. When there is no injection, the dependent variable is replaced with 0. The model is censored at 0 to account for the zero-injection cases. The rest of the model specifications are similar to those of the baseline analysis.

Table 7 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.

4.3.2 Performance Analyses

Next, our objective is to understand the changes brought about by the injected funds to the firms. However, before delving into that analysis, we first seek to comprehend the rationale behind the injections. To achieve this, we compare the performance of two groups of firms previously mentioned in Figure 5 around the event year. Specifically, we examine indicators such as the natural logarithm of firm assets, operational profitability, the natural logarithm of firm sales, leverage, fixed asset investment, and cash ratios. All the firm proxies are lagged by one year. We collect these proxies from the two groups of firms accordingly and present them in Figure 7. The blue lines represent the mean values of firms with new equity injections, while the red lines depict the mean values of firms without home equity-related injections.

Figure 7a illustrates that "treated firms" witness a decline in lagged year log Assets compared to their peer firms in the year preceding the injection. However, in the event year when the owners inject money, the lagged year log Assets of the "treated firms" catch up to those of their peers. Similarly, in Figure 7b, we observe a significant drop in lagged operating profitability (OROA) among the "treated firms" during the year of injection, indicating poorer profitability compared to their peers. However, there is a subsequent recovery right after the injection. Prior to the equity injection, the "treated group" experiences an increase in leverage from the previous year, as shown in Figure 7d. While there are no significant changes observed for other proxies such as log Sales (Figure 7c), fixed assets investment (Figure 7e), and cash ratios (Figure 7f), these findings collectively suggest a decline in firm performance prior to the equity injection, providing insights into the motivation behind owners'

decisions to inject money. It appears that they are witnessing deteriorating business conditions and are striving to salvage their firms.

Now we move on to the post-injection performance. The analyses are perform at the individual 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:

$$Performance_{j,t} = \beta_1 Post\ Injection_{j,t} + \beta Firm\ Controls_{j,t-1} + \alpha_{i,j} + \mu_{j,t} + \eta_{j,t} + \varepsilon_{j,t} \quad (4)$$

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 dependent 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 examine firm size ($logAssets$), profitability (ROA), sales ($logSales$), bank financing ($NewLoan$), job creation ($Employees$), and fixed asset investment ($CapEx$). We control for the lagged year firm characteristics in each model. We include $\alpha_{i,j}$, $\mu_{j,t}$ and $\eta_{j,t}$ as fixed effects to account for the firm, industry-time and regional-time levels of unobservables.

Table 8 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 are 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.

4.3.3 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 probability in year t is estimated using the following probit model:

$$\begin{aligned} Bankrupt\,N\,Years_{i,j,t} =& \beta_1 Mortgage\,Increase_{i,t} + \beta Bank\,Finance_{j,t} + \beta Firm\,Controls_{j,t-1} \\ &+ \beta Owner\,Controls_{i,t-1} + \alpha_{i,j} + \mu_{j,t} + \eta_{j,t} + \varepsilon_{i,j,t} \end{aligned} \tag{5}$$

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 are identical to those in the baseline model.

Table 9 collects the results of the bankruptcy analyses. Column 1 presents the baseline result as a benchmark. Subsequently, we examine a subset of firms whose equity dipped below zero in the previous year. The coefficient for home equity-related injections improves to 9%, suggesting that owners of these firms exhibit a greater willingness to safeguard their companies and prevent bankruptcy. Moving on to columns 3 to 5, we assess the probability of bankruptcy within one to three years following the extraction. Notably, mortgage extraction by owners significantly reduces the likelihood of firm bankruptcy across all models. As evident from previous analyses, the injection of new equity serves to enhance the firm's operations and profitability, ultimately acting as a preventive measure against bankruptcy.

4.3.4 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:

$$Entry_{i,j,t} = \beta_1 Mortgage\,Increase_{i,t} + \mu_{j,t} + \eta_{j,t} + \varepsilon_{i,t} \tag{6}$$

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 10 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.

4.3.5 Aggregate Impact

In this section, we study the home equity impact at the regional level. Figure 8 shows the over time aggregate home equity extraction from the Norwegian private 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 9 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.

Next, we proceed to estimate the impact at the kommune (municipality) level. Specifically, we aggregate our mortgage extraction and equity injection data at the kommune level for each year. Additionally, we investigate the regional influence of these activities on other entrepreneurial endeavors, such as the number of new firms established and the number of new jobs generated, following Schmalz, Sraer, and Thesmar (2017). We perform the OLS estimation and collect the results in Table

11. We also control the regional, year, and region-year fixed effects in the exhausted models, and specified them in the lower panel.

The results obtained from columns 1 and 2 indicate a correlation between mortgage extraction and 7% of new equity injection behaviors among private owners in Norwegian kommunes. When considering the aggregated volume analyses presented in columns 3 and 4, the coefficients for mortgage extraction exhibit a similar magnitude to the previous baseline results. Additionally, we observe positive and significant coefficients associated with entrepreneurial activities. Specifically, the number of newly established firms displays a 75% increase (as indicated in columns 5 and 6), while the number of new jobs created shows an approximate 1% increase for every percentage point increase in the extracted amount. These findings align with numerous previous studies highlighting how home equity facilitates regional entrepreneurial activities (e.g. Adelino, Schoar, and Severino, 2015; Schmalz, Sraer, and Thesmar, 2017; Bracke, Hilber, and Silva, 2018).

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 robustness tests for our main results. We first consider additional sources that can cause endogeneity concerns, we then examine alternative thresholds for our mortgage extraction measure. Finally, we investigate how different levels of firm financial constraints can influence our main findings.

5.1 Other endogeneity concerns

Table 13 presents the additional check aiming to address other concerns on endogeneity. Column 1 repeats the baseline analysis. Columns 2 to 4 examine whether the potential endogeneity issues that drives our results. In particular, columns 2 and 3 exploit the spatial variations between owners and firms by separating the sample based on whether the owners and the firms locate in the same municipality (Kommune). If the injection behavior related to home equity is influenced by local economic condition, we would anticipate a less pronounced response from the sample where owners reside far away from their firms and where there are different house price dynamics. Nevertheless, in column 3, where the owner and firm are located in different regions, the coefficient is actually

larger compared to the same location subsample in column 2 (0.8% vs. 6%). This finding aligns with our main hypothesis and suggests that regional economic conditions alone cannot fully explain our results.

The final column presents the regression results obtained from a more restricted subsample, where lenders' information is clearly observable. This enables us to ascertain whether the owner borrowed from housing credit by searching for specific terms such as "bolig" (meaning "building") and "eiendom" (meaning "real estate"). We construct a new mortgage extraction proxy accordingly to incorporate information about the source of finance. Consequently, the money can be regarded as almost labeled. Our baseline analysis is conducted within this restricted sample, and the results are summarized in the last column. Table 13 demonstrates that the coefficient of the new proxy, Mortgage Increase Labeled, is identical to that obtained from the baseline analysis, indicating the robustness of our key proxy.

5.2 Alternative thresholds

Our dataset allows us to directly observe the owner's balance sheet with details of personal debts at portfolio level.[12] Our mortgage proxy in the main analyses 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 14. Columns 1 to 3 display the analysis with dummy indicators of mortgage extraction at different cut-off rates using ols 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

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

coefficients. The coefficients of the probability slightly increase from columns 1 to 3, from 0.6% to 0.7%, 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 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.

5.3 Firm Financial constraints

Finally, we examine the financial constraints at the firm level. Previous findings from sections (section 4.3.2 and section 4.3.3) highlight that firm-level distress can serve as a significant motivation for owners to withdraw home equity for their closely-held private firms. In this part, we investigate how different levels of financial constraints impact this relationship.

To assess the level of financial constraints, we adopt the methodology outlined by Hetland and Mjøs (2012). Specifically, we categorize firms into two groups based on four indicators: firm size, firm age, dividend payments, and the number of bank-firm relationships.

Firstly, firm size plays a crucial role in determining the capital requirements of firms (Bahaj, Foulis, and Pinter, 2020). We anticipate that larger firms have a greater need for additional capital to support their growth. Consequently, we divide the sample into large and small firms using the median level of lagged year total assets as a criterion. Next, young firms in their early stages often encounter difficulties in securing external financing for their development (e.g., Berger and Udell, 1998; Petersen and Rajan, 1995). To account for this, we use the median age as a benchmark to distinguish between young and mature firms. Moreover, the payment of dividends by a firm typically signals that it is not financially constrained (DeAngelo and DeAngelo, 1990). Therefore, we consider whether a firm pays dividends as an indicator of its financial flexibility. Lastly, the number of bank-firm relationships provides insights into the range of funding sources available to a firm (Hetland and Mjøs, 2012). A firm with multiple bank relationships is likely to have a more diverse set of financing options.

By employing these four indicators, we aim to capture the varying degrees of financial constraints across different firms in our analysis. We then repeat our baseline approach across these subsamples and present the results in Table 15. Columns 1 and 2 display the results from the size subsamples. As expected, we observe that owners of larger firms exhibit a higher probability of extracting mortgage and injecting the funds into their firms. This finding aligns with our prediction that larger firms have a greater need for additional capital. Similarly, columns 3 and 4 present the results for firms in their early stages. In line with our hypothesis, we find that owners of young firms are more likely to utilize home equity as a source of equity financing for their firms. However, we do not find consistent evidence in support of our prediction regarding dividends payment, as shown in columns 5 and 6. Previous studies such as Skinner and Soltes (2011) and Li and Zhao (2008) suggest that financially constrained firms may still choose to pay dividends in order to establish a good reputation and lower future financing costs. Finally, in line with our prediction, we find that firms with multiple bank-firm relationships rely less on home-equity withdrawal for equity financing. This suggests that having a wider range of funding sources reduces the need to extract home equity.

Overall, these results provide insights into the relationship between financial constraints and home equity extraction for equity financing. In line with our previous findings, firm's financial constraint gives an owner stronger incentives to bring their business back to normal operations.

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 krone extracted from the home equity. Given its magnitude, home equity provides great potential for SME financing.

We also document that owners exhibit a higher tendency to inject home equity into firms when the local housing market is booming and when themselves have higher debt capacity. The findings align more with the collateral channel explanation. Furthermore, our analysis reveals that the injected

capital is utilized to enhance firm operations, mitigate the risk of bankruptcy, and enable owners to explore new business opportunities by establishing additional ventures within the same industry. This injection of home equity also contributes to regional entrepreneurial activities.

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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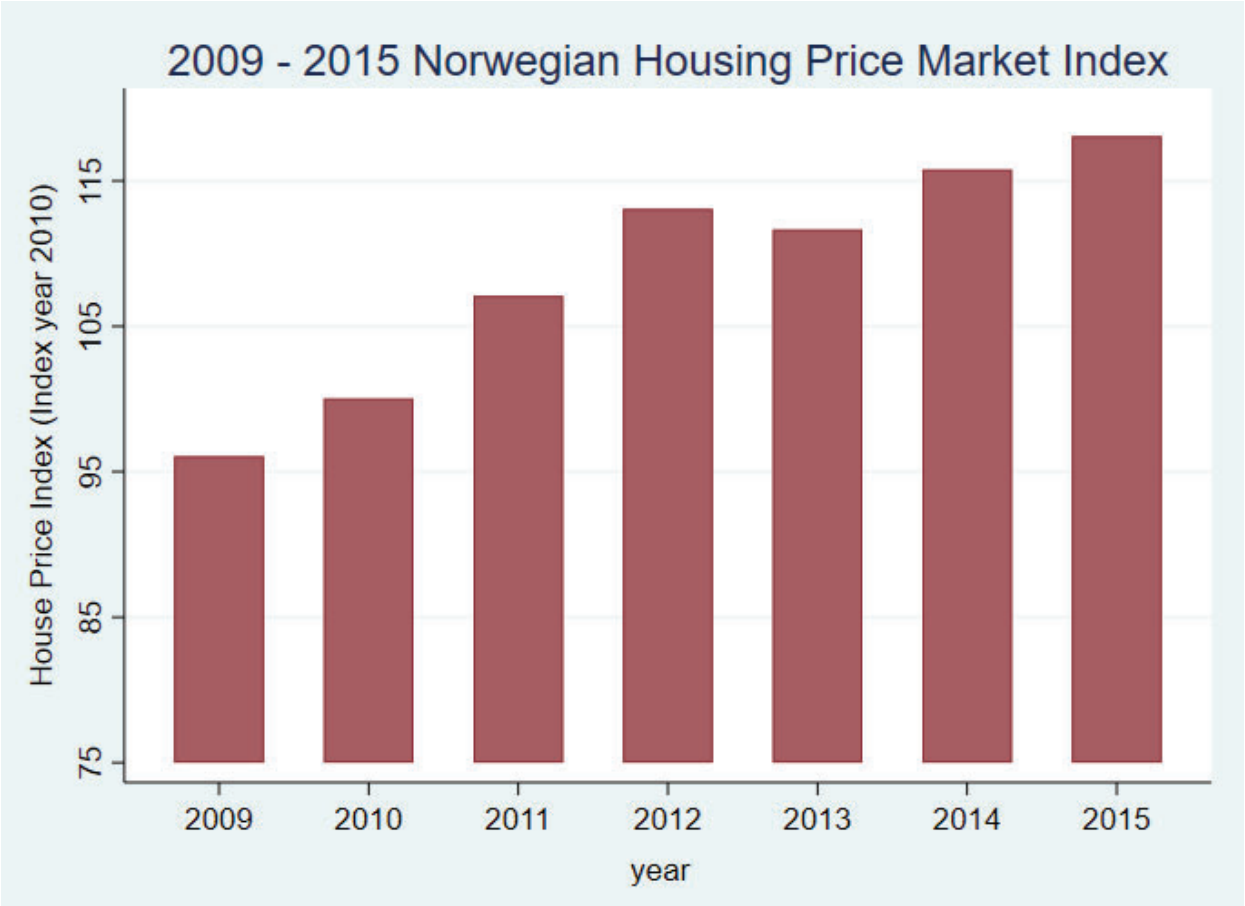


Figure 1: Norwegian Housing Market Index 2009-2015

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).

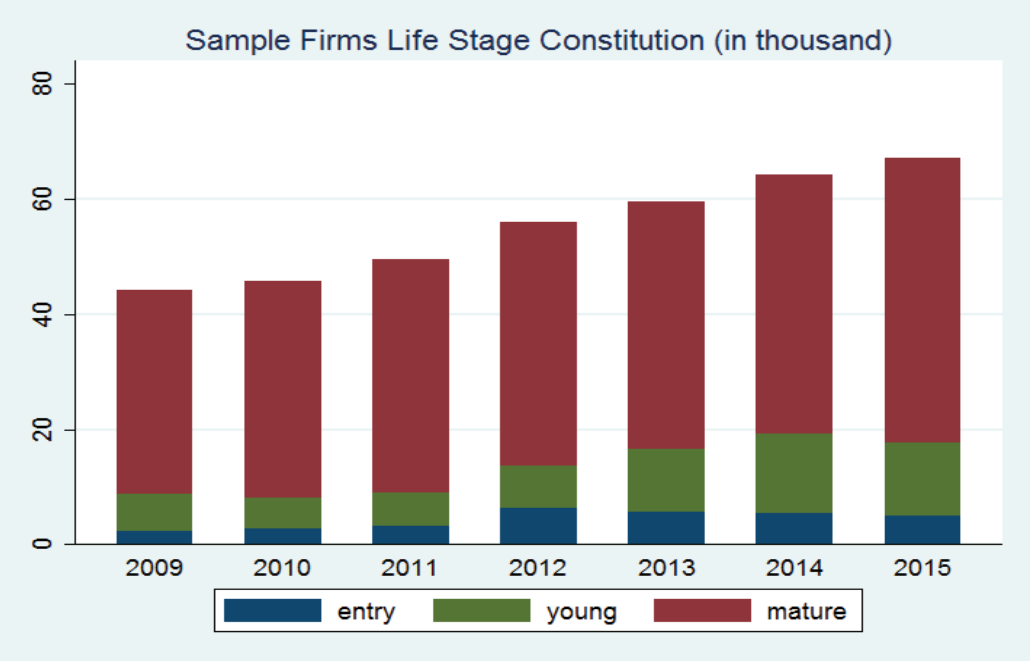


Figure 2: Sample Firms Constitution by Firm Life Stages 2009-2015

This figure compares the number of newly established firms with the number of existing private 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.

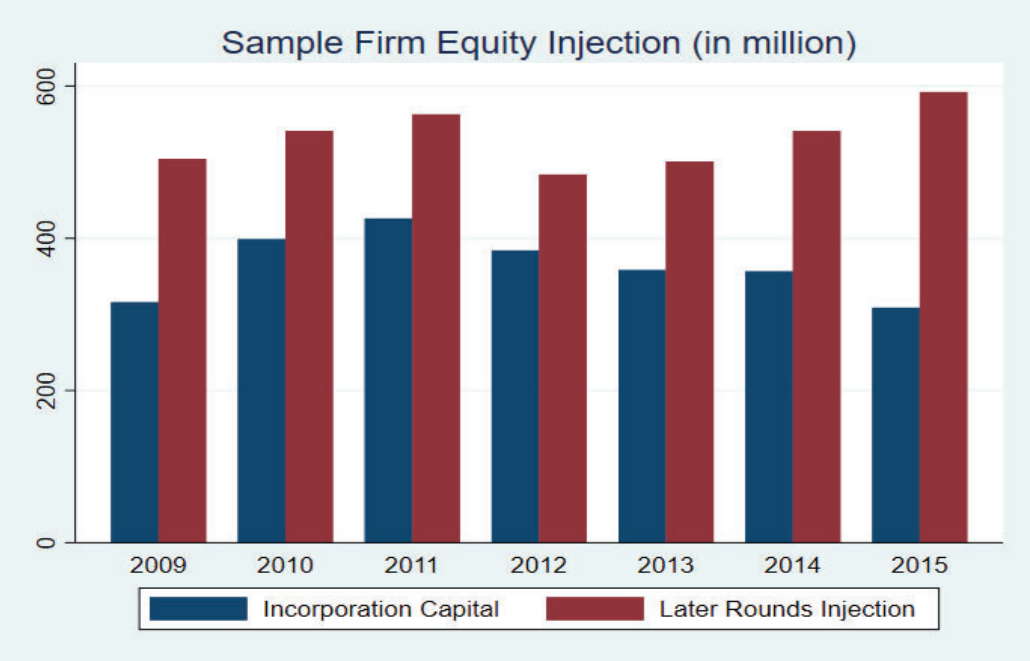


Figure 3: Sample Firms Aggregate Injection Amount 2009-2015

This figure compares newly established firms with existing firms in terms of market level 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.

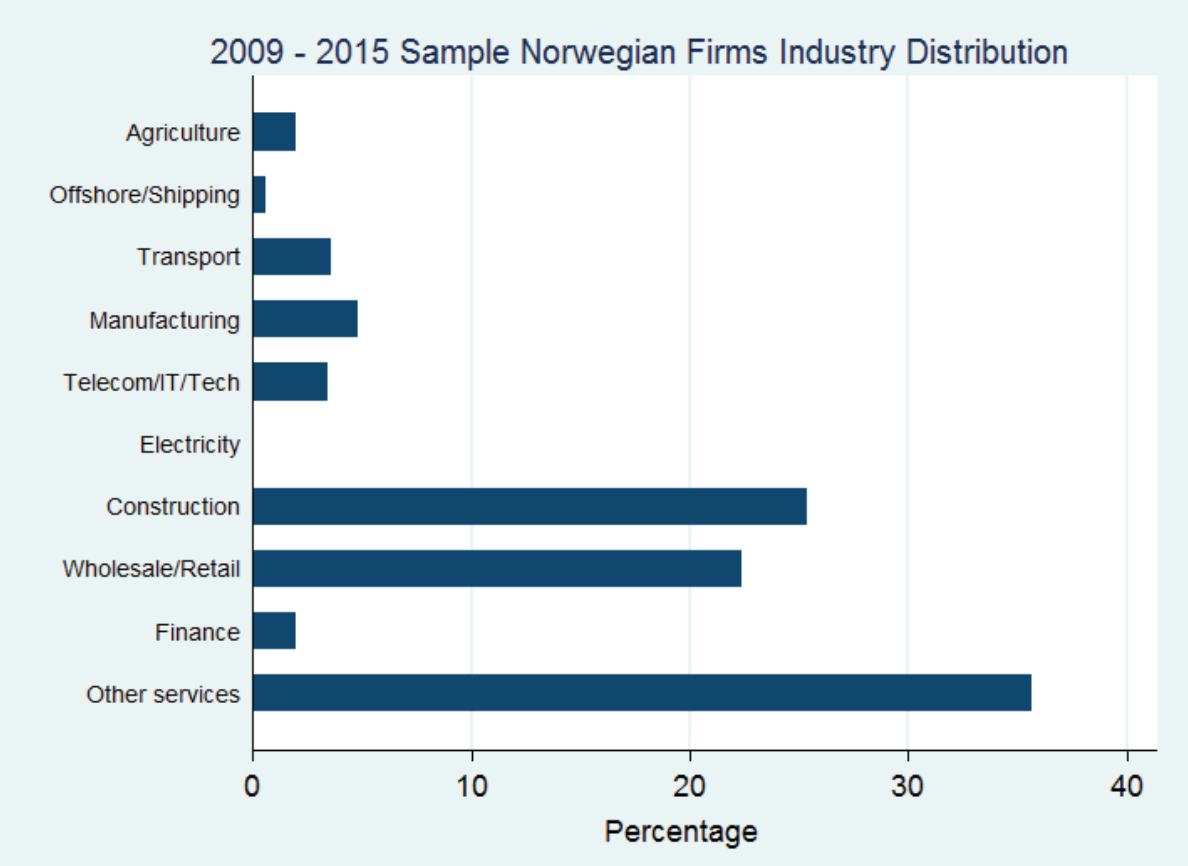
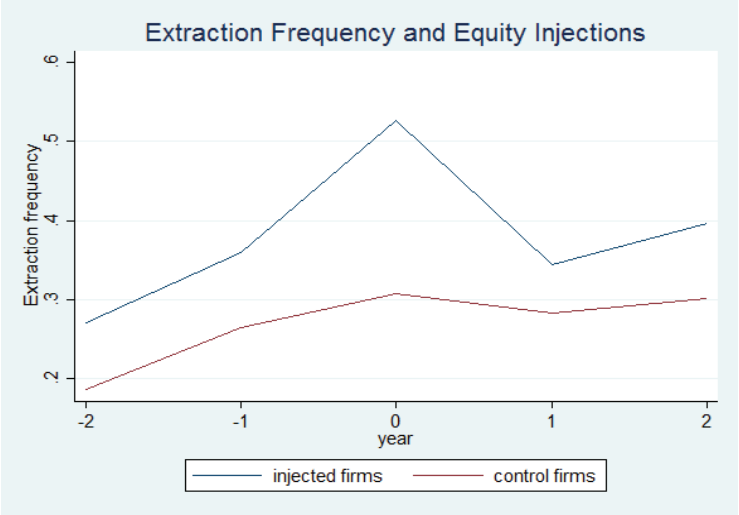
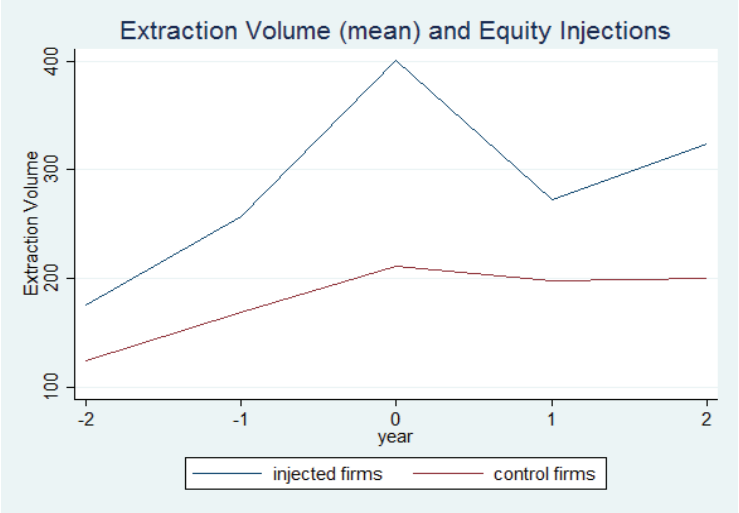


Figure 4: Sample Firms Industry Distribution 2009-2015

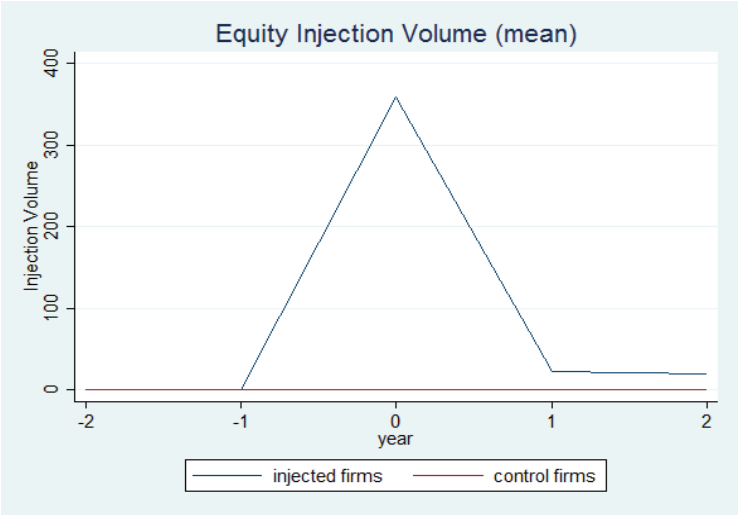
This figure shows the industry distribution of Norwegian private firms as percentages. We retain private firms with no more than three individual owners. Industry group is based on the variable "bransjegr_07" in the Norwegian Corporate Accounts database.



(a) Owners Home Equity Extractions Frequency



(b) Owners Home Equity Extractions Volume



(c) Owners New Equity Injection Volume

Figure 5: Home Equity Extraction and Equity Injection Five-Year Window

These figures show the Norwegian private firm owners' home equity extraction and new equity injection behaviors over the period of 2009 to 2015. We use a $[-2, +2]$ window and define the "event year", year 0, as the year that a firm receives new equity injections subsequent to a minimum of two years of a "quiet period" (no injections at all). Firms are split based on whether they receive new equity injections from the owners and are matched on size quartile, industry, region and year. Blue line represents the mean of firms receiving at least one injection (treated group) whereas red line stands for mean of firms with no injection at all (control group). Figure (a) demonstrates the owners' home-equity extraction frequency. Figure (b) displays the owners' home equity extraction volume. Figure (c) shows the owners' equity injection volume.

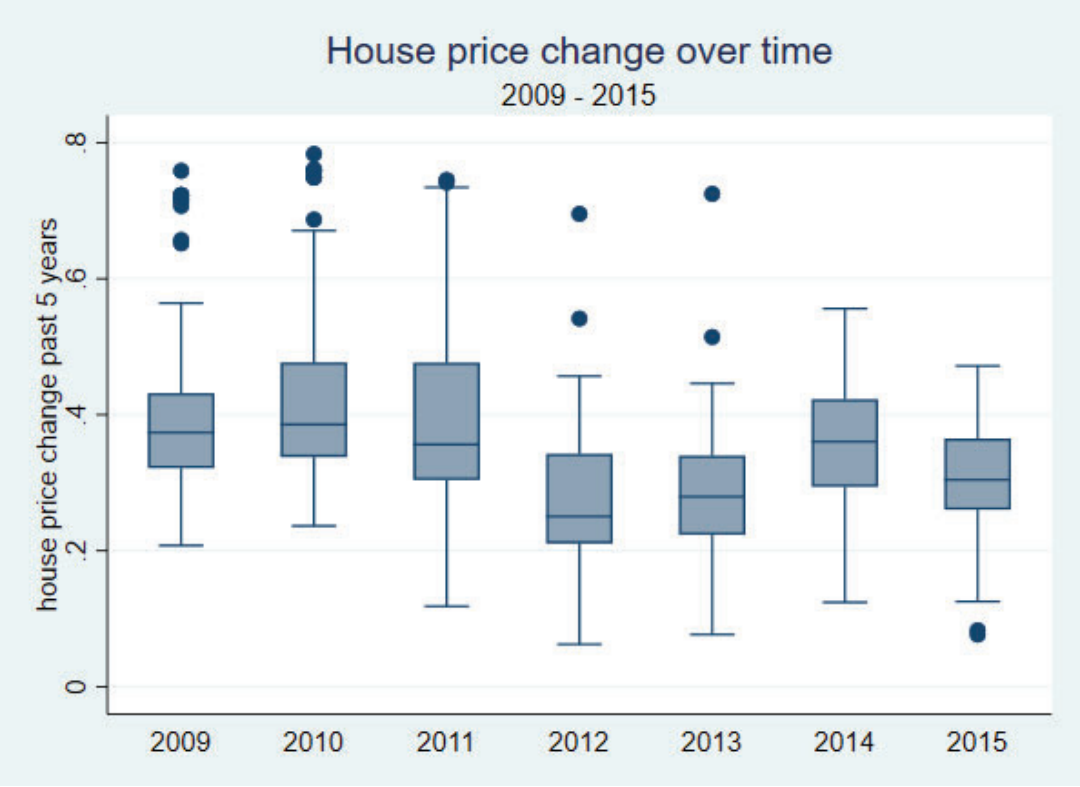
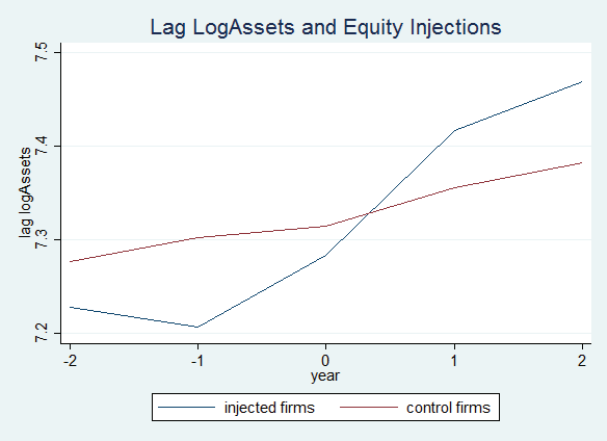
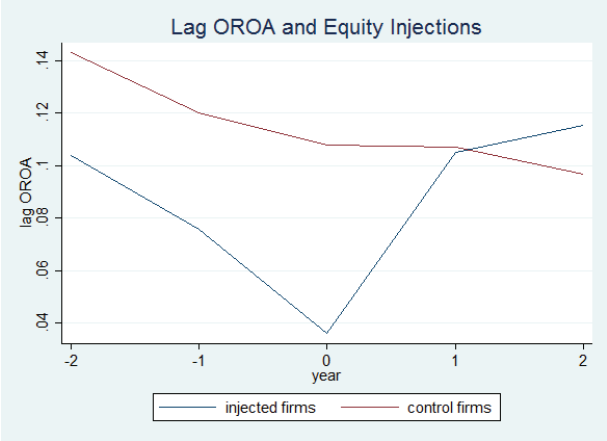


Figure 6: Norwegian Housing Market Index 2009-2015

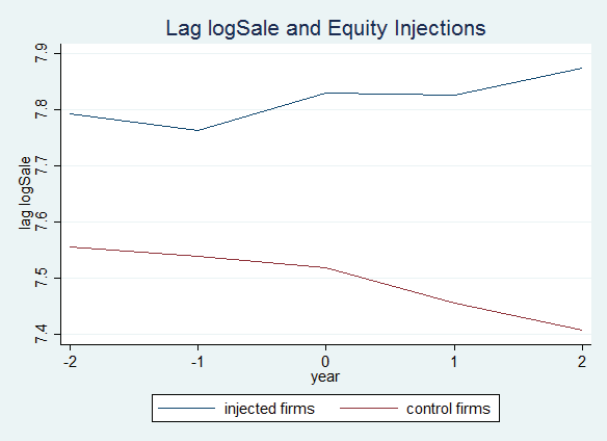
This figure illustrates the price dynamics of the Norwegian housing market from 2009 to 2015. The box plot shows the 5-year housing price variations across 87 different regions in Norway over time. Source: Eiendomsverdi AS.



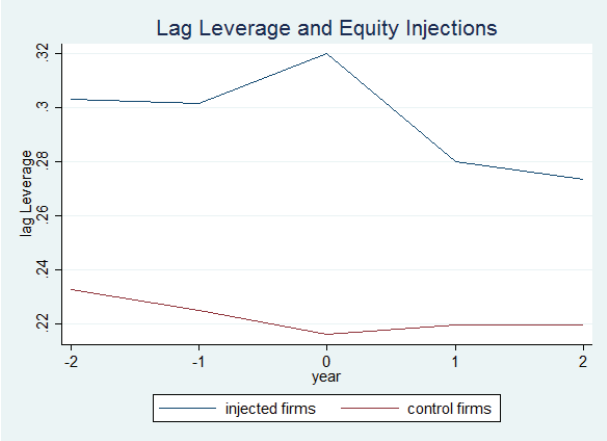
(a) Lag Assets and Injection



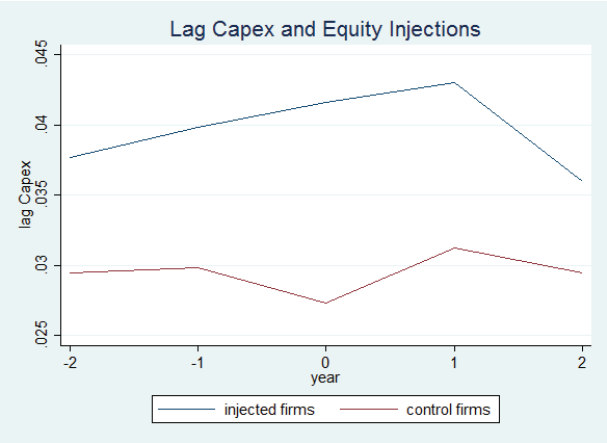
(b) Lag OROA and Injection



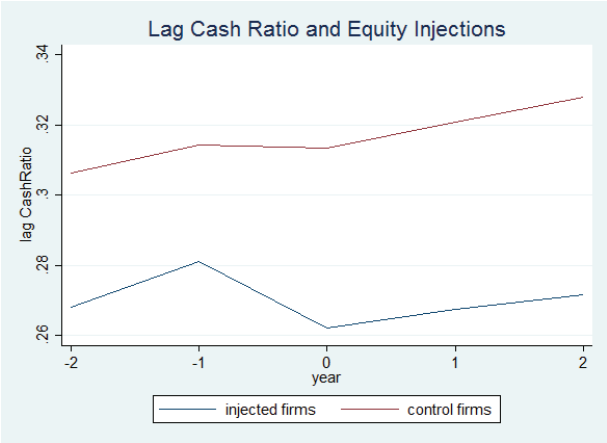
(c) Lag Sales and Injection



(d) Lag Leverage and Injection



(e) Lag Capex and Injection



(f) Lag Cash Ratio and Injection

Figure 7: Owner Equity Injection and Firm Performance

These figures illustrate the relationship between firm performance and the owners' new equity injection behaviors. The sample consists of Norwegian private limited-liability firms with no more than three individual owners. We use a five-year window and define the "event year" as the year that a firm receives new equity injections subsequent to a minimum of two years of a "quiet period" (no injections at all). Firms are split based on whether they receive new equity injections from the owners and are matched on size quartile, industry, region and year. Blue line represents the mean of firms receiving at least one injection (treated group) whereas red line stands for mean of firms with no injection at all (control group). Firm performance proxies are lagged by one year. Variable definition follows table 12.

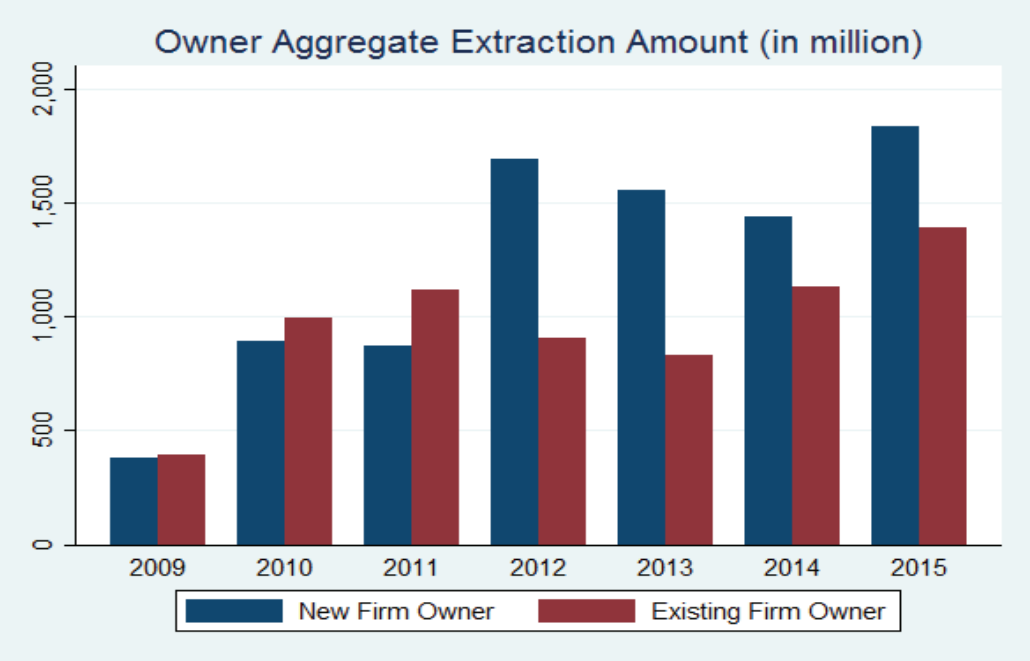


Figure 8: Sample Owners Home Equity Extraction 2009-2015

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.

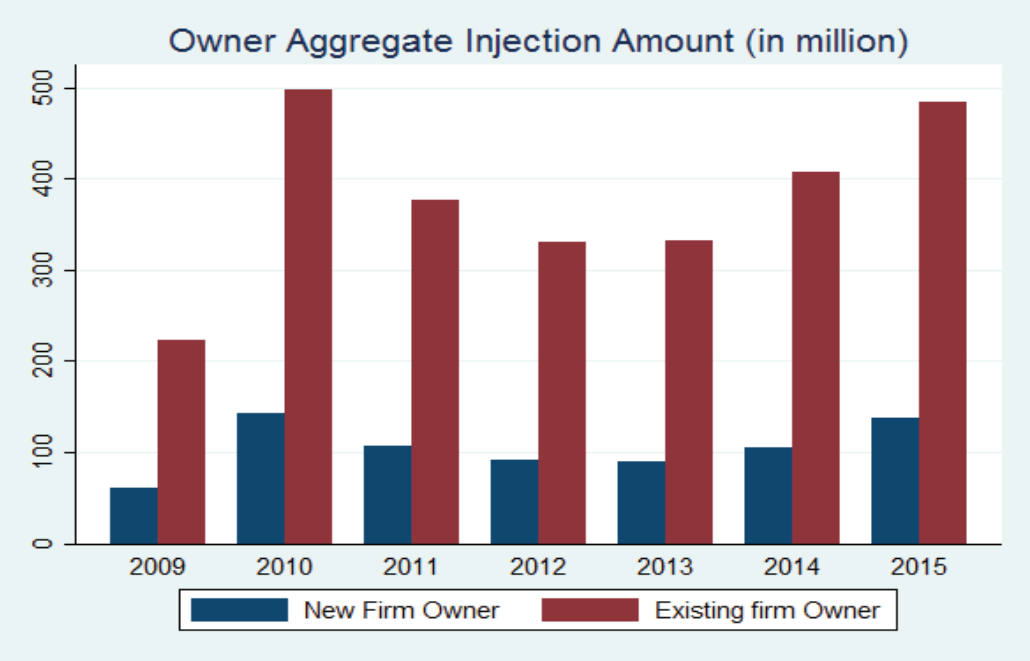


Figure 9: Sample Owners New Equity Injection Conditional On Extraction 2009-2015

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 house price dynamics, Panel B shows the characteristics of the owners, and Panel C 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. House Price Dynamics							
	N	Mean	SD	Min.	P25	P50	P75	Max.
House Price Change	693	.37	.16	.05	.27	.34	.43	.97
	Panel B. Owner Characteristics							
	N	Mean	SD	Min.	P25	P50	P75	Max.
Owner Age	315945	48.64	10.4	27	41	48	56	71
Gender	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 C. 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***
Gender	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

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 linear probability model in all regressions to estimate the probability 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 (1)	Adding time fixed effects (2)	Adding region-time fixed effects (3)	Adding industry-time fixed effects (4)	Adding firm controls (5)	Adding owner controls (6)
Mortgage Increase	0.008***	0.008***	0.008***	0.008***	0.007***	0.007***
	(12.282)	(12.366)	(12.497)	(12.572)	(11.947)	(11.280)
Change Bank Loan Ratio					0.009***	0.008***
					(3.580)	(3.282)
Change Bank Deposit Ratio					-0.003***	-0.003***
					(-3.011)	(-3.086)
lag Size					-0.001***	-0.001***
					(-5.778)	(-4.598)
lag Leverage					0.006***	0.006***
					(6.898)	(6.960)
lag ROA					-0.008***	-0.009***
					(-9.359)	(-9.675)
lag Tangibility					-0.001	-0.001
					(-0.834)	(-1.034)
lag Capex					-0.003	-0.004
					(-0.964)	(-1.482)
lag Working Capital					-0.000	-0.000
					(-0.016)	(-0.075)
lag Assets Turnover					0.001***	0.001***
					(7.829)	(6.928)
lag Cash Ratio					-0.009***	-0.008***
					(-7.821)	(-7.277)
lag Public Portfolio to Income						0.001**
						(2.141)
lag Private Portfolio to Income						-0.000
						(-0.691)
log Income						-0.000
						(-0.504)
Divorced						0.003***
						(3.631)
Owner Age						-0.000***
						(-13.571)
Gender						0.004***
						(5.661)
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
adj. R^2	0.001	0.001	0.001	0.001	0.004	0.004

Table 5: Mortgage Extraction, New Equity Injection and House Price Change

This table displays the results of linear probability model regression of the new equity injection decisions on the mortgage extraction behavior interaction with the local house price change over the five-year period preceding the decision (House Price Change). The sample consists of all private firms with no more than three individual owners and non-missing information on key variables. 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. House Price Change is the cumulative house price change across Norwegian cities over five years. Firms' accounting information and owners' personal characteristics are lagged by one year. The columns are arranged following the baseline analysis in table 4. 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 x House Price Change	0.009	0.009*	0.011*	0.011*	0.010*	0.010*
	(1.630)	(1.645)	(1.949)	(1.953)	(1.802)	(1.804)
Mortgage Increase	0.004**	0.005**	0.004**	0.004**	0.004**	0.004*
	(2.240)	(2.277)	(2.011)	(2.035)	(1.978)	(1.758)
House Price Change	0.005*	-0.004	-0.001	-0.001	0.028*	0.026
	(1.811)	(-1.439)	(-0.338)	(-0.359)	(1.805)	(1.345)
Owner controls	No	No	No	No	No	Yes
Owner controls × House Price Change	No	No	No	No	No	Yes
Firm controls	No	No	No	No	Yes	Yes
Firm controls × House Price Change	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	315734	315734	315734	315734	315734	315734
adj. R^2	0.001	0.001	0.001	0.001	0.004	0.005

Table 6: Heterogeneous Individuals Debt Capacity

This table presents the regression results of equity injection behavior among Norwegian private firm owners on the interaction between mortgage extraction behavior and local house price change over a five-year period prior to the injection. The sample consists of all private firms with no more than three individual owners and non-missing information on key variables. We split the sample based on the medium level of owners' leverage, which is the total personal debt outstanding over the tax value of the house prior to the year of equity injection. Columns 1 and 2 displays the subsample results among low leveraged owners, whereas columns 3 and 4 shows the subsample results among high leveraged 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. House Price Change is the cumulative house price change across Norwegian cities over five years. 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.

	$D_{Injection}$			
	Low Leverage		High Leverage	
	(1)	(2)	(3)	(4)
Mortgage Increase x House Price Change	0.027***	0.026***	-0.003	-0.004
	(3.449)	(3.403)	(-0.367)	(-0.459)
Mortgage Increase	-0.002	-0.003	0.009***	0.009***
	(-0.706)	(-0.932)	(3.170)	(2.996)
House Price Change	-0.003	0.036	0.001	0.018
	(-0.643)	(1.302)	(0.135)	(0.658)
Owner controls	No	Yes	No	Yes
Owner controls × House Price Change	No	Yes	No	Yes
Firm controls	No	Yes	No	Yes
Firm controls × House Price Change	No	Yes	No	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	150877	150877	164857	164857
adj. R^2	0.001	0.004	0.002	0.005

Table 7: Intensive Margin 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 (1)	Adding time fixed effects (2)	Adding region-time fixed effects (3)	Adding industry-time fixed effects (4)	Adding firm controls (5)	Adding owner controls (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 8: Intensive Margin 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	ROA	logSales	New Loan	Employees	CapEx
	(1)	(2)	(3)	(4)	(5)	(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 9: Exit Analysis

This table demonstrates the link between owners' home equity extraction behaviors and firms' bankruptcy probability over the period of 2009 to 2015. In the first two columns, we perform the linear probability regression and the dependent variable is the new equity injection dummy. In the later three columns we run the probit model and the dependent variable is a bankruptcy dummy. Columns 1 reports the baseline result whereas column 2 shows the results from a subsample where a firm's equity capital from previous year falls below zero. Columns 3 to 5 display the probability of firms to go bankruptcy after owners' home equity extraction in 1, 2, and 3 years, respectively. 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.

	$D_{Injection}$		Bankrupt in		
	Baseline	Negative Equity	One year	Two years	Three years
	(1)	(2)	(3)	(4)	(5)
Mortgage Increase	0.007***	0.009***	-0.014**	-0.018***	-0.024***
	(11.280)	(6.475)	(-2.431)	(-2.989)	(-3.300)
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	315945	88301	315879	248549	177656
adj. R^2	0.004	0.005			
pseudo R^2			0.072	0.080	0.087

Table 10: 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***	-0.041***	0.103***
	(24.574)	(-3.513)	(13.470)
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	878057
pseudo R^2	0.012	0.027	0.017

Table 11: Regional Analysis

This table demonstrates the link between aggregate mortgage extractions and firm activities at the regional level. We perform linear regression model across all analyses. The dependent variables are the regional new equity injection frequency (columns 1 and 2), the natural logarithm of regional new equity injection volume (columns 3 and 4), the total number of new firms at the regional level (columns 5 and 6), and change of employee numbers at the regional level (columns 7 and 8). The key independent variables are the regional mortgage extraction frequency and natural logarithm of the extraction volume. We impose regional, time, and regional times time fixed effects in each regression. All variables are defined in Table 12. t-values are presented in parentheses. *, **, and *** indicate that the coefficient is statistically significant at the 10%, 5%, and 1% levels, respectively.

	Injection Freq.		Injection Vol		New Firms		Change Employee	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mortgage Increase Freq.	0.072***	0.073***			0.746***	0.752***		
	(134.762)	(136.948)			(192.488)	(206.342)		
log Mortgage Increase			0.395***	0.397***			0.012**	0.009*
			(53.554)	(53.381)			(2.333)	(1.796)
Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Region FE	No	Yes	No	Yes	No	Yes	No	Yes
Year - Region FE	No	Yes	No	Yes	No	Yes	No	Yes
N	5500	5500	5495	5495	5500	5500	3421	3421
adj. R^2	0.768	0.775	0.343	0.344	0.871	0.888	0.001	0.045

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 in a calendar year and zero otherwise.

Table 14: Variable Definitions Continued

Panel B. Owner Characteristics	
Variable	Definition
Housing Price Change	The regional change of housing price from t-6 to t-1 prior to the mortgage extraction decision.
Only Firm	A binary variable indicating whether it is the only firm of an individual owner.
Owner Age	The age of an individual owner.
Gender	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%.
Mortgage Increase Labeled	A binary proxy based on Mortgage Increase dummy, with explicit lender information containing "Bolig", "bolig", "Eiendom" and "eiendom".
$\triangle$***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.