Capitalist Human Capital*

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VERY PRELIMINARY AND INCOMPLETE.

Abstract

In this paper we ask the question of whether the managerial and organizational inputs of entrepreneurs enhance the efficiency of their businesses. We ask this question empirically using registry data from Norway. To identify the managerial skills of the entrepreneur (human capital) we explore how the productivity of the business changes after the premature death of the entrepreneur. We find that, if the entrepreneur is wealth-rich, the productivity of the business falls substantially (close to 40%) after the entrepreneur's death. This supports the view that entrepreneurs human capital adds value to the business. But why are the entrepreneurial skills only important for wealth-rich entrepreneurs? The empirical analysis reveals other interesting patterns. New firms founded by wealth-rich entrepreneurs are 40% more productive and they have twice higher capital compared to those founded by wealth-poor entrepreneurs. Furthermore, rich entrepreneurs tend to allocate more of their wealth in the business and hold more shares of the business. These findings show that the wealth of the entrepreneur plays an important role also for the financial structure of the business. Motivated by these empirical findings, we construct a quantitative structural model that is capable of capturing these patterns. In the model, risk-averse entrepreneurs can invest in financial assets and choose to run private businesses in an incomplete market environment. They face possible credit constraints and are heterogeneous in managerial human capital. We study how the entrepreneurs' human capital affects entry, exit, portfolio composition and the consequent macroeconomic implications.

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1 Introduction

Income and wealth inequality has been growing in the last three or four decades in many developed countries. It has raised much interests and concerns about the causes and consequences. Among rich households, a significant fraction of them are entrepreneurs (e.g., active owner and manager of private firms). For example, according to SCF data for US from 1989 to 2013, among the top 10% households in wealth, 41% of them are entrepreneurs (this number is 50% for top 5% households in wealth).[1] In Norway from 2002 to 2012, more than 70% entrepreneurs are in the top 20% households in wealth; more than 50% entrepreneurs are in the top 10% households.

However, the understanding of entrepreneurs is still limited. For example, how important are entrepreneurs' human capital (e.g., innovative ideas, skills in starting and managing firms, and so on) in determining their investment behavior? Since entrepreneurs typically have limited wealth when starting their business and cannot fully diversify their investment risk, how does entrepreneurs' human capital interact with their financial assets? It seems these questions are important for a deeper understanding of entrepreneurs, however, due to limitations of typical data in US, the answers are still in its infancy. In this paper, we use rich registry data from Norway to investigate more on these questions, both empirically and quantitatively.

New empirical facts:

Empirically, we link several new, administration data from Statistics Norway for the whole economy: (1) For all private firms in Norway, we use firms' registry data on income and balance sheets, information on firms' managers (positions in the firms and person ID), information on owner ID and owner shares. (2) We also have information on entrepreneurs' personal and family backgrounds: income, wealth, family, demographic variables.

We first document several new facts for entrepreneurs: (1) New firms with wealth-rich founders are associated with 40% higher productivity and 2 times higher capital, comparing to those with wealth-poor founders. This fact is quite robust with several checks. (2) We find that rich entrepreneurs tend to allocate more wealth to private equities and hold more owner shares; the higher firms' productivity, the higher the faction of wealth in private equities.[2] These facts are new in the literature, and they are helpful for us in the quantitative exercise when we try to match the data and quantify the role of the entrepreneurs' human capital.

We then study the role of entrepreneurs' human capital in managing firms. We do this using owners' premature deaths as a exogenous shock to identify the importance of entrepreneurs' human capital to their firms, we find: Productivity falls substantially (close to 40%) after premature owner deaths if the owner is wealth-rich, and this pattern is not so evident for other owners. This finding is robust with alternative measures for firm productivity, across different industries, and across

[1] See more empirical facts documented in Quadrini (1999, 2000), and Cagetti and De Nardi (2006). Two other recent related papers are Smith et al. (2017) and Guvenen and Kaplan (2017).

[2] Heaton and Lucas (2000) use the SCF data and Tax Model data. They look at the household portfolio composition, and find that households with high business income risk hold less wealth in stocks than other similarly wealthy households.

different initial firm characteristics. This finding is similar to the results for the US as in Smith et al. (2017).[3] This supports the idea that entrepreneurs' human capital is important to their firms.

Quantitative Structural Model:

Motivated by the previous empirical facts on entrepreneurs' human capital and entrepreneurs' portfolio choices in the presence of private equities, in this section, we ask how important are entrepreneurs' human capital in determining the investment in their private businesses, and consequently the macroeconomic implications on output (in the sense of Hsieh and Klenow (2009) and Midrigan and Xu (2014)) and cross-sectional wealth inequality. We do this through the lens of a structural model. In particular, traditional literature focuses and highlights the importance of entrepreneurs' *financial capital* in determining the entry and production for entrepreneurial firms. In this paper, we focus on the special characteristics of entrepreneurs' *human capital*: it is embodied in and inalienable from entrepreneurs. Consequently, entrepreneurs' investment is endogenously illiquid since they may face price discount due to human capital specificity. In addition, entrepreneurs face incomplete markets for their investment risk since there is no insurance against entrepreneurs' future human capital risk.

In the dynamic model, we assume each agent lives infinitely and agents are heterogenous in initial financial assets and the ability of managing firms - entrepreneurial ability. At the beginning, each faces an one-time investment opportunity to start up a new firm. If the agent chooses not to invest, he simply consumes and saves in risk-free financial assets. If instead he chooses to start a new business, he considers the initial size of the firm, the capital structure of the firm, in addition to his consumption and savings in financial assets. We assume he faces a some credit market limits. Importantly, we assume the overall production efficiency is affected both by entrepreneurs' human capital and firm-specific productivity. Going into the next period, he may face risks in his entrepreneurial human capital of managing firms and the firm-specific productivity shocks.[4] For entrepreneurs who run private firms, they can choose to continue their business, or to sell their firms to the market. The market is endogenously illiquid for entrepreneurs since they may face price discount in their business due to the human capital specificity.

Using rich administration data from Norway, we are able to bring the model to data and study the importance of entrepreneurs' human capital empirically and quantitatively. Preliminary numerical results show that, entrepreneurs' human capital is more important in determining the extensive margin of investment - the choices to invest or not - and not so much in the firms' leverage choices. We hope to conduct more exercises on the estimations, counterfactuals, and welfare and

[3]They use US administration data on households' income. They find that private business income accounts for most of the rise of top incomes since 2000 and the majority of top earners receive private business income. Since they do not have information on entrepreneurs' firms/production, they use sales per worker to gauge the importance of entrepreneurs' human capital in their private firms.

[4]We choose to model entrepreneurs' human capital simply following an exogenous stochastic process, and not to model the endogenous accumulation of entrepreneurs' human capital (e.g., see human capital literature: (Becker (1962),Ben-Porath (1967),Becker and Tomes (1986), Restuccia and Urrutia (2004), Aiyagari et al. (2002), Manuelli and Seshadri (2014) Erosa et al. (2010)). It would be interesting to extend and further explore the avenue that entrepreneurs can endogenously accumulate human capital through experience and investing.

policy implications.

Related Literature (Preliminary) :

Literature - Macroeconomics: To be added soon.

Literature - Finance:

Comparing to much of the economics literature, the finance literature mostly focuses on entrepreneurial risk and its impact on the entry, exit and portfolio compositions for entrepreneurs. In contrast to the shareholders of public corporations, entrepreneurs typically hold large and undiversified equity stakes in their own businesses.[5] In addition, entrepreneurs typically face borrowing constraint. In the presence of these two frictions (non-diversified risk and borrowing constraint), private business owners typically make more conservative decisions (comparing to the first best), such as lower firm investment, less consumption/higher saving, more safe assets in individual portfolios.

The most related paper is Wang et al. (2012). Wang et al. (2012) develop a qualitative, unified model of entrepreneurship dynamics with borrowing constraint and physical capital illiquidity. They study the entry and exit decisions of the entrepreneurs. They show that the option to liquidate the firm (exit) is critical for the entrepreneur to manage business downside risk.[6] Wang et al. (2012) also show that the option value of waiting to become an entrepreneur (entry timing) is valuable. They show that the cutoff wealth level - beyond which entrepreneurs enter - depends on the initial project size, fixed start-up cost, risk aversion, and other fundamental parameters. We also observe these findings in our context. Differently, our paper focuses more on entrepreneurs' human capital and how it affects the entrepreneurs' decisions on entry, exit and portfolio choices. With new empirical facts from administration data, we are able to study the structural model quantitatively - which also distinguishes our paper from the literature.

There are also papers studying how private entrepreneurs diversify risks. Heaton and Lucas (2004) argue that entrepreneurs can use risky (defaultable) debt to reduce personal exposure to the firm's idiosyncratic risk. In their model, entrepreneurs use risky debt to finance firm projects and retain personal wealth outside the firm as well. The use of debt creates a direct connection between the firm's capital structure and the entrepreneur's portfolio composition. Chen et al. (2010) extend the static model of Heaton and Lucas (2004) to a dynamic model. When the firm revenue becomes sufficiently low, the entrepreneur defaults on the debt and exit; if the firm does sufficiently well, he might choose to incur the transaction and other costs (such as taxes), repay the debt in full, and realize the capital gains by selling the firm. Cash-out and/or default allow the entrepreneur to enjoy the diversification benefits. In contrast, in our model, we assume there is some external finance costs in a relatively parsimonious way, and do not introduce defaults on firm debt or other

[5]There are many reasons why private firms have difficulties to sell shares to the investors: asymmetric information, moral hazard, and so on. Jensen and Meckling (1976) were among the first offer an explanation for the phenomena of concentrated equity holdings by managers. Brealey et al. (1977) were the first to emphasize that asymmetric information could cause a risk-averse entrepreneur to hold a large undiversified stake in his own business.

[6]In their model, entrepreneurs hold 100% inside equity. The only way for the entrepreneur to diversify business risk is to completely liquidate the firm.

micro behaviors which could be underlying the external finance costs. Second, comparing to those papers, since human capital is embodied in and inalienable from entrepreneurs, a novel feature in our model is that entrepreneurs will face endogenous price discount or illiquidity in selling firms - this may affect diversification benefits and ex-ante investment.

2 Empirical Analysis

2.1 Data

In the empirical analysis, our main goal is to study the role of entrepreneurs' ability in managing firms, or the entrepreneurs' human capital. To do so, we combine entrepreneurs' firm side and household side information. We merge several administration data sets from Statistics Norway. In particular, (1) Firm Registry Data (1995 -2015) provides annual information for all firms in Norway on firm ID, registered starting dates, organization types, operating industries and locations, etc. (2) Firm accounting Data (1995 -2015) provides annual information on firms' income statement and balance sheet variables, including total revenue, intermediate goods inputs, wage bills, total assets and so on. This accounting data is only available for limited liability firms, and thus we focus on these firms. (3) Firm Registry Data on owners (2002 -2012) provides annual information for each firm's owner ID, owner shares, manager ID and positions. (4) For the household side, by using unique person ID, we can have annual information on each individual's demographics, family information, income and its decompositions, wealth and its components, and so on. Figure 1 shows our data structure intuitively. For more details on each data set and the procedures of merging data sets, please see the appendix.

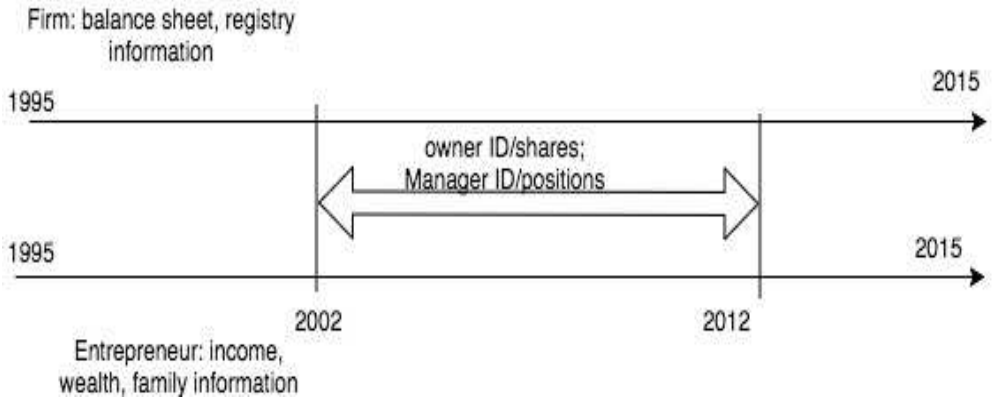


Figure 1: Data structure

We first exclude firms with missing information on total assets or value added. In addition, we impose sample restrictions so that firms should have positive value added, positive number of employees and wage bills.

Defining entrepreneurs. Following most of the literature (such as Quadrini (2000), Cagetti and De Nardi (2006) and Hurst and Lusardi (2004)), we define entrepreneurs as those firm owners actively manage their firms. By using this definition, we can capture the essential economic fact that entrepreneurs should input both of their financial and human capital into their firms. In the Norwegian data, we require entrepreneurs should hold at least 33% shares of the firm and should serve in at least one of the managing positions (see Table 4 for the details of different manager

positions).[7] In the case when a firm has no active entrepreneurs, we define any owners with more than 33% shares as entrepreneurs. Our results are also robust to alternative definitions of entrepreneurs as detailed below.

Measuring Entrepreneurs' Productivity Following the literature (such as Lucas Jr (1978), Bloom et al. (2013) and Bhattacharya et al. (2013)), the importance of entrepreneurs' human capital in managing firms is largely reflected in firm productivity. In particular, inspired by the seminar work in Hsieh and Klenow (2009) and Bloom et al. (2013), we define entrepreneurs' productivity A_{it} as

$$A_{it} = \frac{Y_{it}}{K_{it}^{1-\alpha} L_{it}^{\alpha}}, \tag{1}$$

where Y_{it} is firm i's output, K_{it} is the book value of fixed assets (the average of the values at the beginning and at the end of this period) and L_{it} is labor input. Since we only observe nominal value added not real ones at firm level, following Hsieh and Klenow (2009), we assume there is a downward-sloping demand curve for firms' products and services, and assume the elasticity of substitution between different products within 3-digit industries is 3. Thus, we replace the real output Y_{it} by $(P_{it}Y_{it})^{\frac{\sigma}{\sigma-1}}$ and $P_{it}Y_{it}$ is the observed nominal value added. Essentially, this is the concept of "TFPQ" used in Hsieh and Klenow (2009) and Bloom et al. (2013).[8] We also use total wage bill to control for labor quality. For labor share, we use the median value about 0.78. As can be seen from Table 5, this number is fairly stable across different sectors. After measuring A_{it} at firm level, we then net of any industry and year fixed effects in A_{it}, and exclude any observations with missing values or with extreme values (in the top and bottom 1% of A_{it} across all years).

For our purpose, we did not choose to focus on other measures, such as marginal revenue product of capital, or marginal revenue product of labor, or "TFPR", the total factor productivity revenue productivity. This is because even if A_{it} are different across firms, in theory those mentioned measures will tend to converge under the assumptions of frictionless factor markets. This point has been made clear in Restuccia and Rogerson (2008), Hsieh and Klenow (2009) and Restuccia and Rogerson (2013). Thus these measures are not ideal for our purpose. On the other hand, measuring A_{it} only relies on quite standard assumptions about technology, demand and profit maximization, and it can also allow us to take out the contributions from capital and labor and only use residual variations in real output. Consequently, we think A_{it} can best help us capture the entrepreneurs'productivity, which is closely related to his/her human capital in managing firms.

Sample description To have a sense about the data, Table 2 provides basic summary information for our data. First, we can view the data from entrepreneurs' perspective (as long as an entrepreneur can be linked to some firm in some period between 1995 and 2015). In total we have about 4.6 million observations for entrepreneurs. 80% of these entrepreneurs are male and 70% of

[7] If an owner has shares too small, then we think he/she is more likely an investor (e.g., investing through equity holdings) and not an active owner. We exclude these owners in our definitions of entrepreneurs.

[8] As pointed out in Hsieh and Klenow (2009), doing this only requires very standard assumptions about technology, demand and profit maximization; we need not assume anything about how inputs are determined.

them are married. The average and median values of their ages are quite close to 44. The average wealth of these entrepreneurs is about 9.7 million Norwegian Kroners in 2005 (roughly about 1.5 million US dollars).

We can also view the data from firms' perspective. In total we have about 1.7 million observations for firms (as long as a firm can be linked to some entrepreneurs in some period between 1995 and 2015). In general, our sample consists of relative young firms, with average firm ages around 9 years and average number of full-time equivalent employees around 11. It should be noted that there is about 30% of our firms have negative value added. We do not use these observations to calculate firm TFPR or TFPQ. Finally, for the sample sizes used, Table 3 provides information on the number of sample sizes with different requirements.

Distribution of entrepreneurs and their owner shares Entrepreneurs may own multiple firms and may have different owner shares. To have a sense, Figure 11 shows the distribution for the number of any owners and owner shares within a firm. We can see that more than 40% firms just have one owner and the owner shares could vary from a very small number close to 2% to 100%. Turning to active owners - our definition of "entrepreneurs", Figure 12 shows that now more than 70% firms have just one entrepreneur, and a firm rarely has more than 3 entrepreneurs. The entrepreneurs' owner shares vary between 33% and 100%, with some spikes around 33%, 50% and 100%. Figure 13 shows the distribution of entrepreneurs across different sectors. Manufacturing, Construction, Wholesale and retail trade, and Professional services sectors typically have more entrepreneurs than other sectors. Finally, Figure 14 shows the distribution of entrepreneurs across wealth percentiles. Consistent with conventional wisdom, more than 50% entrepreneurs are in the top 10 percentile of the wealth distribution, and this patten is true across different sectors.

2.2 Entrepreneurs' productivity and Initial Wealth

In this section, we show a new fact relating entrepreneurs' productivity (ability) to their initial wealth before founding new firms. Specifically, we track new firms and examine the differences of entrepreneur firms' productivity between wealth-rich and wealth-poor founders. We focus on new firms instead of mature firms largely because presumably, entrepreneurs play an essential role in founding new firms and managing them. By comparing entrepreneurs' ability between different wealth groups, we can say more for the "capitalists" on their human capital component.

To begin with, our regression equation is as follows:

$$\begin{aligned} Y_{f(i),i,t} &= \sum_{k\geq 1} \beta_k \times D^k_{f(i),i,t=t_0+k}(Firm\ Age) \times \mathbf{I}\{W_{i,t_0-1} > \bar{W}_{t_0-1}\} \\ &\quad + \sum_{k\geq 1} \delta_k D^k_{f(i),i,t=t_0+k}(Firm\ Age) \\ &\quad + \delta_Y\, Year_{f(i),i,t} + \delta_I\, Industry_{f(i),i,t} + \epsilon_{f(i),i,t}, \end{aligned} \tag{2}$$

where $Y_{f(i),t=t_0+k}$ is the outcome variable of interests for entrepreneur i's new firm $f(i)$ after k years

since founded in year t_0. We use W_{i,t_0-1} to denote the household-level wealth before the new firm started, and the dummy variable $\mathbf{I}\{W_{i,t_0-1} > \bar{W}_{t_0-1}\}$ indicates the founder is wealth rich or not (richer than 90% of the population in year t_0). We also include year and industry dummies as controls and a constant intercept (omitted above). We cluster the errors within each firm and use firms' value added times owner shares as weights for the regression. In what follows, we also provide several robustness check for this benchmark regression.

We are mostly interested in β_k, which reflects the differences in entrepreneurial ability between wealth-rich and wealth-poor founders. It is clear that we are only using the variation within the same year, the same 3-digit industry and the same class of firm ages.

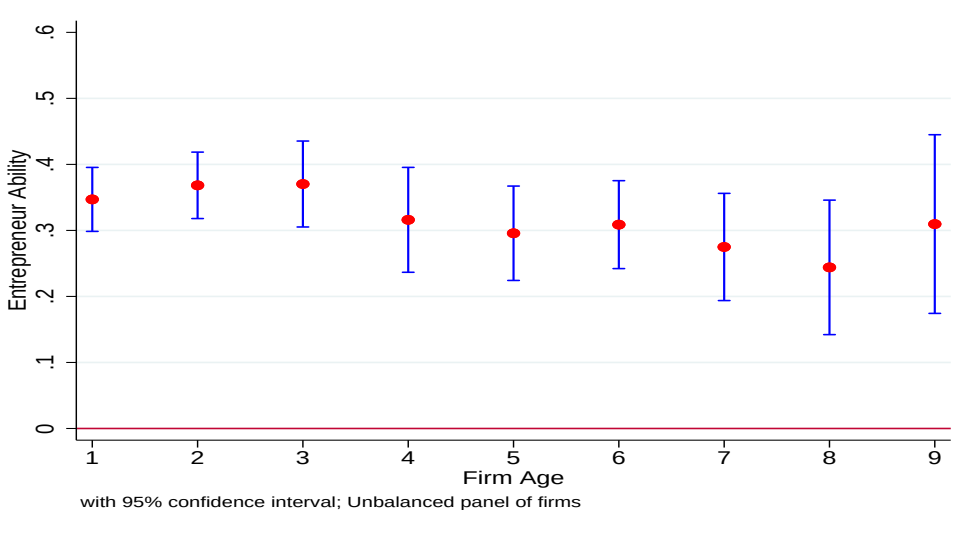


Figure 2: Differences in Entrepreneurs' ability between wealth-rich and wealth-poor founders: Tracking New firms

Figure 2 shows the estimates for β_k for different firm ages, $k = 1, ..., 9$. Note that the regression sample used is an unbalanced panel for firms, with about 28,448 observations for firm age 1 but about a half of that after 5 years. We can observe that wealth-rich founders always have significantly higher productivity than wealth-poor founders, by about 30%. This pattern holds across different firm ages. In addition, we can see a few points: (1) Overtime, it seems there is a slow, mean reversion pattern between the two groups. (2) The estimates are more precise when firms are younger since we can have more observations in our sample and not so precise when the new firm's age is large.

Robustness and Heterogeneity We provide several robustness check for the fact that wealth-rich founders are associated with higher productivity and hence higher human capital in managing firms, and we delegate them to the appendix. Specifically, in Figure 17, we show three robustness check. First, we look at new firms that survive at least 5 years, and compare the entrepreneurial productivity. Surely this will change the sample composition and it allows us to focus on firms with relatively good performance. It is reassuring to see that our previous result is almost not affected

by this new sample selection.

One may concern that wealth-rich founders may choose to have riskier projects and consequently we only observe those survived firms with good luck. To deal with this concern, we tried a few different ways. (1) We smooth the measurement for entrepreneurial productivity by using 2-period moving-averages. The middle panel of Figure 17 shows that our result is still true and is more precisely estimated. (2) We also compute a firm's standard deviation of its TFPQ time series, and uses it to scale the firm's TFPQ; after that, we take logs and net of any fixed effects. The results are in the lower panel of Figure 17.[9] Note that since this measure is scaled by standard deviations, the magnitude now changes. Nevertheless, we still see our results hold. (3) Finally, we directly provide evidence that in fact, wealth-rich founders are associated with higher firm survival probability. We call a firm survived in a year if it has non-missing registry data, not being associated with any bankruptcy, insolvency, liquidation, and other merger and acquisition activities. Figure 18 reports the results. As can be seen, on average, wealth-rich founders are associated with higher (unconditional) firm survival probability by about 3% in the beginning years; overtime, it seems there is a slow convergence between groups when firm age is larger than 7.

Across different industries, the importance of entrepreneurs' ability to the new firms may vary. Figure 19 documents the heterogeneity for the differences in sectors of Manufacturing, Wholesale and Retail trade, and Professional Services. In general, we find the pattern that wealth-rich founders have significantly higher productivity is quite robust across different sectors. Also, it seems that in Manufacturing, the initial differences in entrepreneurs' ability is quite persistent over firm ages; however, this pattern is not so evident in the sector for Professional Service.

Lastly, we report the results when we use different regression weights in Table 7. So far we only use the variations within 3-digit industries and use the entrepreneur's value added according to his/her shares of the firm as weight. We check our results with alternative weighting: (1) in the case of "Basic", we use pooling OLS for all entrepreneurs' firms and do not use any weighting; (2) in the case of "Longest Founder", we require that the new firm is the firm that the founder stays longest among all the firms he founds and owns; (3) in the case of "Only Founder/Owner", we further restrict the sample so that the entrepreneur is also the only founder and owner of the firm; (4) Finally, in the case of "Weighted by Firm Assets" we use the entrepreneur's firm assets according to his/her shares of the firm as weight for the OLS. Moreover, we report the heterogeneous results across different sectors using different weighting schedules in Table 8. We find our results are still robust and significant.

Characteristics on Firm assets and Firm leverages Since we compare entrepreneurs' ability between different wealth groups, it is natural to ask whether these two groups of entrepreneurs are different on other dimensions. Traditional literature has been focusing on the role of financial capital in starting firms (such as Evans and Jovanovic (1989), Quadrini (2000), Cagetti and De Nardi (2006) and Hurst and Lusardi (2004)). In Figure 3, we show that: (1) not surprisingly, founders

[9] In practice, we drop those samples with standard deviations in the top and bottom 1% of the samples, as those are probably outliers.

with wealth in the top 10 percentile will have firm assets on average 2.7 times larger;[10] there are some variations across firm ages, but still the differences in firm sizes are substantial. (2) quite closely related, we find wealth-rich founders have lower firm leverage ratios, on average about 5 percentage points lower. Again, the estimate is quite precise but there are some variations across different firm ages. In sum, the traditional channel that entrepreneurs' wealth may play an important role for starting new firms is clear in the data; whereas our focus in this paper is on the human capital components of the entrepreneurs and at the same time incorporating the traditional channel as well.

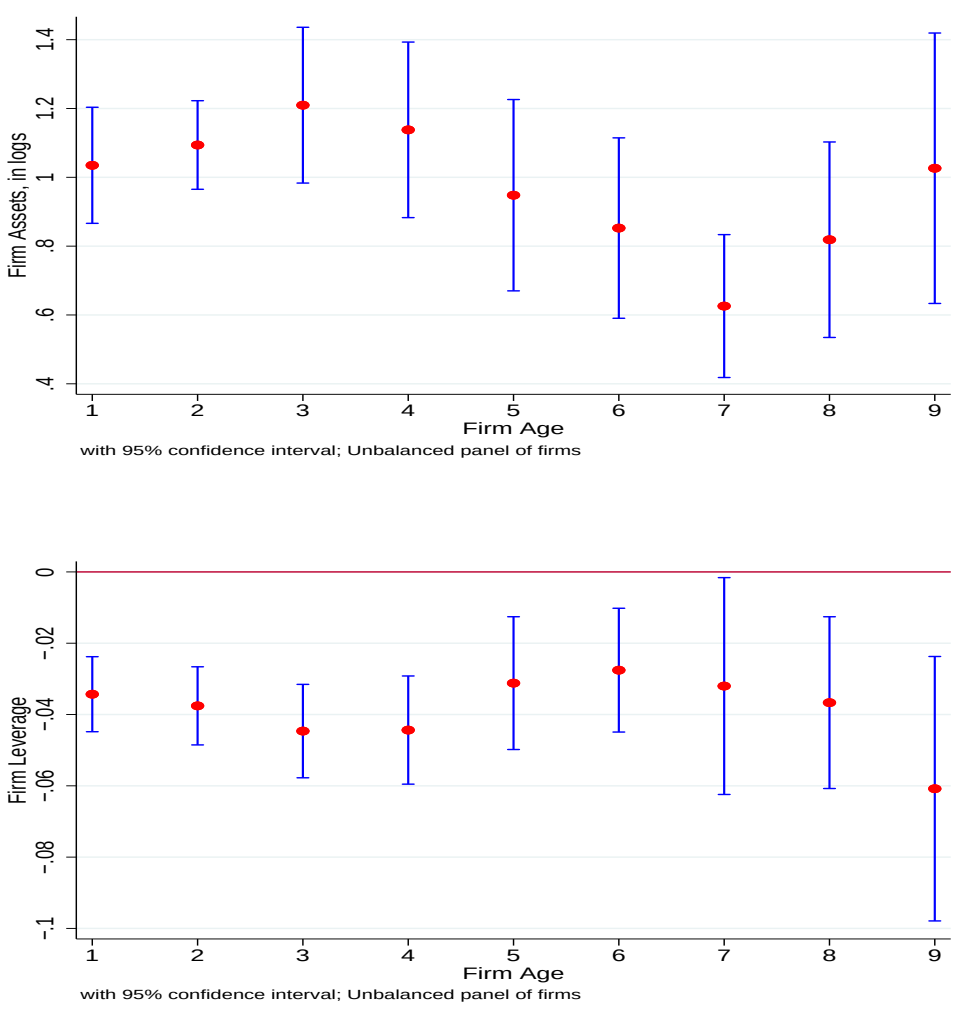


Figure 3: Firm size and firm leverage differences: New firms founded by wealth-rich and wealth-poor

[10] In the figure, we have used natural logarithm and the differences are about 1.0; so transform the numbers, we have to use $exp(1.0) - 1 \approx 2.7$

2.3 What are associated with Entrepreneurs' productivity?

So far we have looked at the differences of entrepreneur firms' productivity between wealth-rich and wealth-poor founders. Likely, our measurement of entrepreneurs' productivity is highly associated with entrepreneurs' skills and efficiencies in organizing and managing firms, the so called entrepreneurs' "human capital". In this section, we directly link entrepreneurs' productivity to their education, prior entrepreneur experience and other characteristics, and provide a more complete picture for entrepreneurs' human capital.

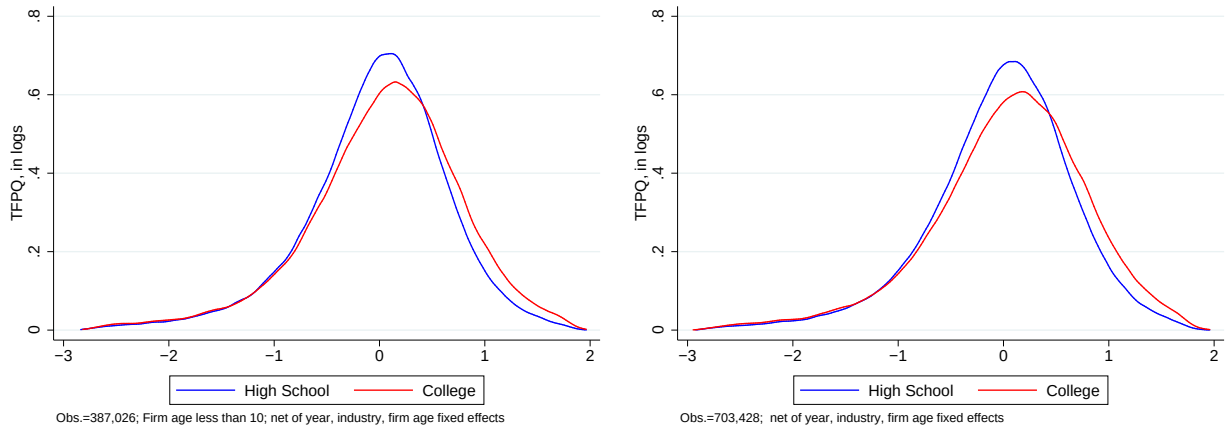


Figure 4: TFPQ distributions by Owner Education

First, in Figure 4 we simply plot firm productivity by entrepreneurs' education (left panel for young firms with firm age less than 5 and right panel for all firms). Note that we net of any industry and year fixed effects for TFPQ and trim extreme values in the figure. Evidently, we can see: (1) College educated entrepreneurs are associated with higher productivity than high-school educated entrepreneurs. (2) If we compare young firms vs. other firms, it seems the patterns are quite similar. This exercise is for any entrepreneurs; next we look at entrepreneurs with newly founded firms in Figure 5. For founders with college education, we find on average they have higher productivity by about 10% than other founders with just high-school education. Over new firms' ages, we can see this difference may vary, nevertheless it is quite significant and estimated precisely.

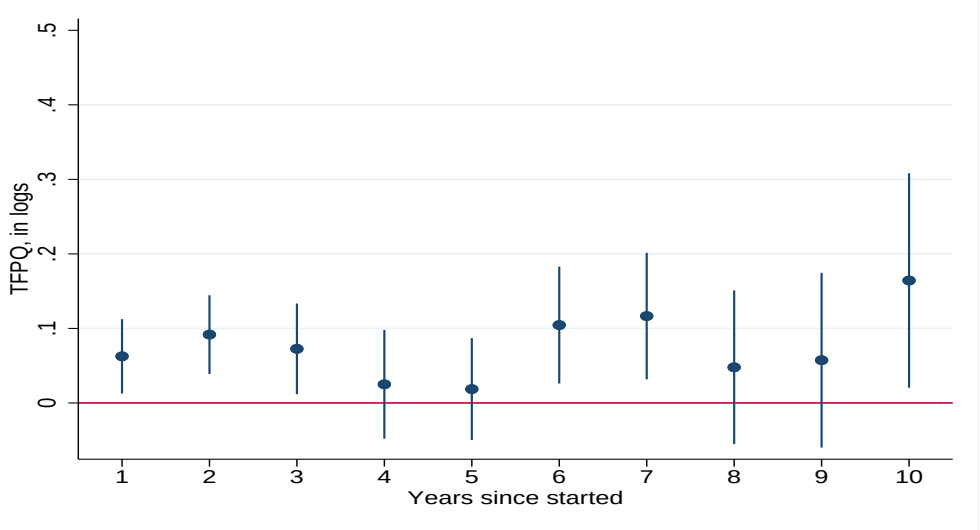


Figure 5: Differences in firm productivity between founders with different education levels

Lastly, we regress firm productivity on a set of entrepreneurs' characteristics in Table 10. In column (1), we can confirm that entrepreneurs' productivity is higher for college graduates after controlling for demographics and industry and year effects. We can also see that entrepreneurs' firm productivity is increasing in the traditional measurement of labor market human capital. Importantly, in columns (3) and (4), we find that the productivity is significantly higher if the entrepreneur has some prior experience in being entrepreneurs. Lastly, we also see entrepreneurs' parent income or wealth are positively correlated with firm productivity; Perhaps one interpretation is that, richer families could invest more on their children's education (Becker (1962), Becker and Tomes (1976), Becker and Tomes (1986)), or indirectly, richer parents may have some other social resources that could be used by the younger generation of entrepreneurs. In short, we find entrepreneurs' productivity in managing firms could be related to his/her education, prior experience and family background. This motivates us to use a model to take into account of the endogenous evolution of entrepreneurs' human capital later on.

2.4 Firm Productivity since Owner Premature Death

Previously we have shown that entrepreneurs' initial wealth and other characteristics are positively correlated with entrepreneurs' productivity - which will be useful for disciplining our structural model and the subsequent interpretations - while in this section, we provide direct evidence on the importance of founders/entrepreneurs to their firm productivity. Following empirical literature, we use individual premature death as a source of exogenous variation in firm mangers' human capital. The underlying idea is that, if a firm is truly independent of its managers, and its performance is only affected by factors available through markets (such as capital, labor intermediate goods input, and hiring managers as well), then following sudden and exogenous premature entrepreneurs' death shocks, we should not see too much changes in the treated firm's performance (see similar

arguments in Jaravel et al. (2018), Jäger (2016) , and Smith et al. (2017)).

Defining event and sample selection In Norwegian registry data, we can observe individuals' official registry on dates of death. For entrepreneurs, we define a premature death if he/she dies before 65 and there is no registry data in the year of death. We require that the owner should hold the firm for at least 3 years before the event. We then follow the firms owned by entrepreneurs. In our sample period of 2002 to 2012, in total we have about 2,300 such firms. If an entrepreneur hold multiple firms, we then track all of those firms. In what follows, we also provide additional check if we restrict to some particular firms. If a firm is associated with two or more deaths (2 cases in total) we simply drop those firms.

Firm dynamics following Owner Premature Death Table 23 in the appendix shows the distribution of these treated firms by different characteristics. Across years, the distribution of these events are not even, with only about 2.5% fraction of firms in 2005 and more than 17% in 2006; however, the probability of death clearly increases in owners' ages. Across owners' wealth percentiles, most of the events happened to top rich entrepreneurs, simply because there are more top rich entrepreneurs as pointed out before; But if we look at the distribution across firm assets three years before the event, it is more or less evenly distributed.

To have a sense about firm dynamics since owner death, we can look at the average statistics in Table 24 before going to rigorous analysis. For each treated firm, we track it from 3 years before the event year t_0 to 3 years after. At the extensive margin, for the survival probability conditional on survived the year before, it is almost close to 100% in the year of $t_0 - 2$ and $t_0 - 1$, but drops substantially to about 90% around t_0 and further to about 85% in the following two years before it becomes stable over time (our sample is relatively short, so we cannot say too much about the long-run behaviour after the event). Conditional on firm survived, we can also look at firms' performance. Firm revenue year-over-year growth rates are relatively stable before the event but drops a large amount after the event; Firms' total fixed assets and number of employees have similar patterns, but the magnitude of drops are relatively smaller.

Econometric method To study the impact of owners' death on firm productivity, first, we need to find firms with similar characteristics before the event. To do so, for each treated firm, we match similar firms at $t_0 - 3$ within the same 3-digit industries, within the same firm assets size classes (by quintile), the same owner's age, and find the closest firms in terms of productivity by using a matching algorithm. If there are more than one firms matched, we assume the regression weights are inverse to the total number of matches. If there is no match, we simply drop the treated firm.

Our econometric regression is:

$$\begin{aligned}\Delta Y_{p(i),i,t} &= \sum_{k=\{-2,-1,0,1,2,3\}} \beta_k \times D^k_{p(i),i,t} \\ &+\beta_L \times \sum_{k<=-4} D^k_{p(i),i,t} + \beta_R \times \sum_{k>=4} \times D^k_{p(i),i,t} \quad (3) \\ &+ \delta_0\, Year_{p(i),i,t} + \delta_1\, Industry_{p(i),i,t_0} + \epsilon_{p(i),i,t}, \quad (4)\end{aligned}$$

where $p(i)$ denotes the matched pair for a treated firm i. Potentially, a firm i could be matched with many firms and we use the inverse of the total number of matches as regression weight for each pair. For each pair $p(i)$, we compute the differences in the outcome variables at time t, $\Delta Y_{p(i),i,t}$. We denote the event year as t_0 and use variables $D^k_{p(i),i,t}$ to indicate if $t = t_0 + k$, the calendar year is k years away from the event year for firm i. Given our data structure, we choose to bunch the differences between the two firms before and after 4 years into simple variables, and use two coefficients β_L and β_R to summarize the estimates. We also control for year and industry fixed effects. We cluster the errors within each matched pair. Since we are mostly interested in the differences before and after owner death, we normalize $\beta_{k=-3} = 0$ so that it is easier to see the dynamics of the differences.

In what follows, we further estimate the model within different groups. In particular, we look at the deceased owner's wealth percentile for the treated firm at $k = -3$, and based on this measure we divide the whole sample into different groups (1%, 5%, 10% and others).

We first examine the dynamics of firm survival probability in Figure 6. It is natural to conjecture that firms with sudden owner death shocks may have higher probability of exiting, since entrepreneurs' managing skills may be particularly important for firm businesses. We show this is true: (1)For the whole sample, firm survival probability on average drops about 15% for the treated firms relative to the control group. The total pairs used is about 4,100 and the estimates are significant and quite precise. Comparing to the dynamics before the events, we can see that there is virtually no differences in firm survival probability between the two groups. (2) Across groups with different levels of owners' initial wealth, the dynamics of (relative) firm survival probability is somewhat heterogenous but not so quite different.

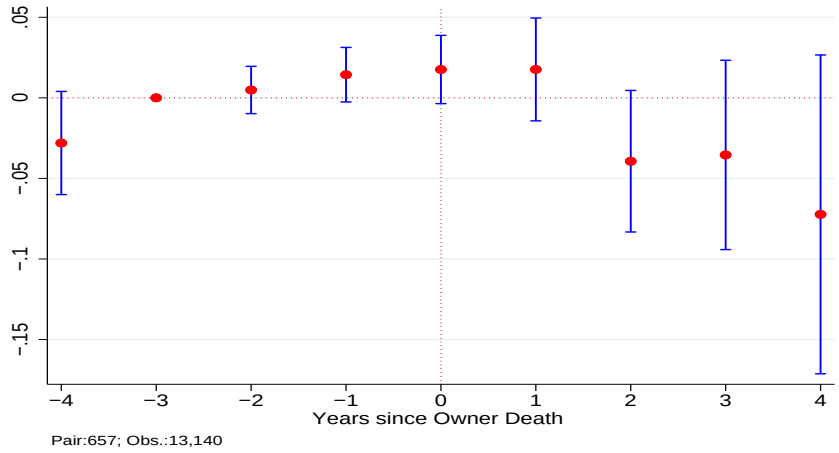
We then study the dynamics for firm productivity conditional on firm survival. To do so, we require that firms have should observations at least 3 years before and after the event. In Figure 7, we plot the time series for β_k where we measure firm productivity by TFPQ. A few points are worth noting: (1) We find for the whole sample of firms that survive at least 6 years around the event (the lower right panel in the figure), there is no significant differences in firm productivity between the two groups. The mean estimates for the differences are slightly negative - meaning that treated firms on average become slightly unproductive - nevertheless, the estimates are not so precise and the confidence intervals are quite large. (2) If we only look at death of top rich owners, we find firm productivity drops substantially, as in the top panel for the top 1% owners and in the middle panel for the top 5% owners. Firm productivity could drop 40% to 50% 2 or 3 years

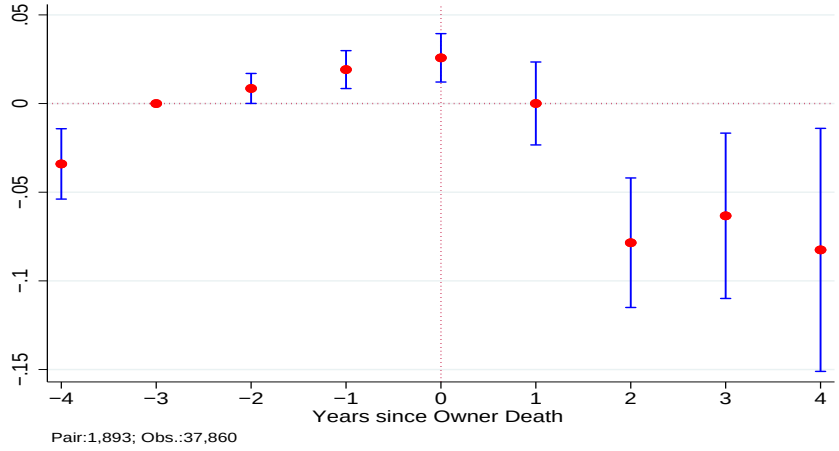
after the event. But for firms with top 10% owners, this pattern is becoming not so clear and the estimates are quite noisy.

Measuring firm productivity in other ways We also check our results by measuring firm productivity in other ways. In Figures 23 and 24, we show that firm productivity drops substantially for top rich owners and this is quite robust whether we use TFPR, the total factor productivity of revenuer, or use output capital ratio (Value added/Assets). It is also worth noting that, the drop is more pronounced among the top 1% or top 5% owners versus top 10% owners. It could be possible that the wealth-rich owners are associated with higher human capital in managing firms, as suggested in the previous cross-sectional analysis; as a consequence, we see firm productivity drops more for firms with top rich owners.

Robustness and Heterogeneity We also provide numerous robustness check for our results. In Table 25, we look at firm dynamics by using different matching procedures and different entrepreneurs' characteristics. For simplicity, we report the estimated differences for paired firms in the years $k >= 2$ relative to the years $k <= -2$. For instance, in columns (2) to (6) we restrict the number of control firms for each treated firm and re-estimate the model. Sometimes the matching between treated firm and control firm is not perfect and subject to some random errors (we only require firms are matched within some cells and close in firm productivity). As can be seen, the magnitude of results may vary; nevertheless, we still find that firm productivity drops substantially for top rich owner firms, not so much for other firms. In columns (7) to (12), we report the regression results by owner ages, sex, and education. We find that it matters more for firm productivity if the deceased owner is aged less than 55, versus others between 55 and 65; We didn't find so much different results regarding the owner is male or female, but our estimates for male samples are slightly more precise (perhaps because we have more observations for them); for owners with different educations, it seems we didn't find a strong pattern of differences - both high-school and college educated entrepreneurs matter for their firms, and this is more evident for top-rich owners.

In Table 26, we also look at firm dynamics following owner death by different firm characteristics. (1) In columns (2) and (3), we compare young firms (aged less than the median value of 11 years in the event year) versus mature firms. We find mature firms clearly have more productivity drops than young firms. It suggests that top-rich owners are more important for mature firms, perhaps because those owners have helped develop successful and mature business models and management styles, and thus their sudden death may have more impact. (2) Closely related, in columns (4) and (5) we also find large firms' productivity dropped more than small firms. (3) Finally, there is substantial heterogeneity in the responses across different sectors, as in columns (6), (7) and (8). It seems top 1% owners matter relatively more in the manufacturing sector but not so much in the professional service sector, while other top 10% owners matter more for the service sector.





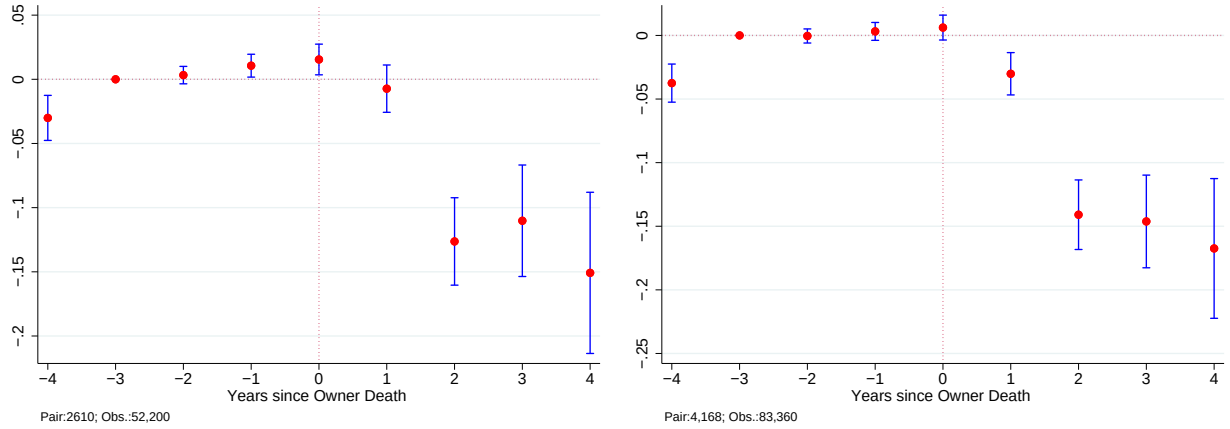


Figure 6: Differences in Firm survival probability since Owner death: by Initial wealth (1% in Top panel, 5% in Middle panel, 10% in Lower left panel, and Lower right panel for the whole sample)

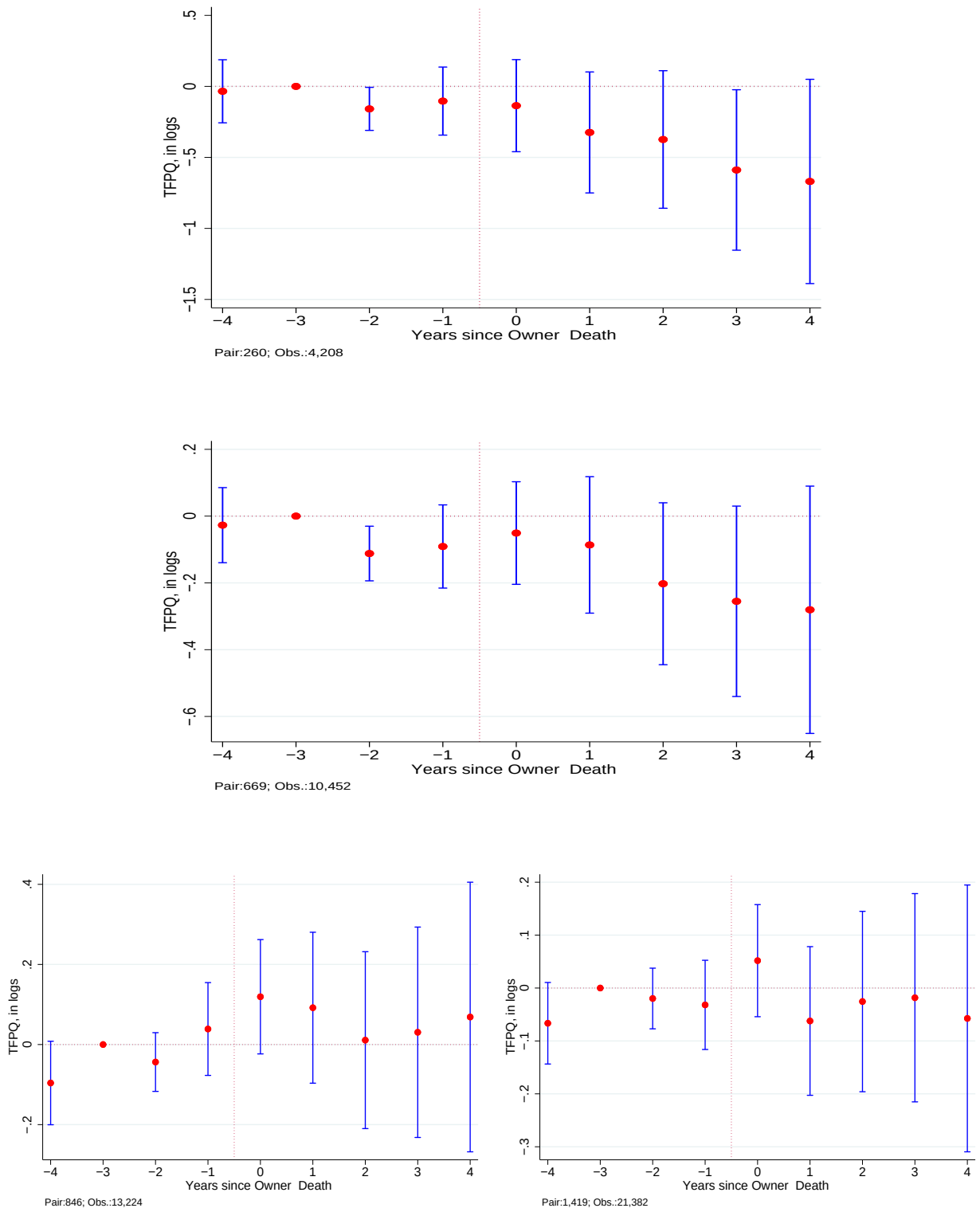


Figure 7: Firm Productivity since Owner death: by Initial wealth (1% in Top panel, 5% in Middle panel, 10% in Lower left panel, and Lower right panel for the whole sample)

3 Quantitative Model

Motivated by the previous empirical facts on entrepreneurs' human capital and entrepreneurs' portfolio choices in the presence of private equities, in this section, we ask how important are entrepreneurs' human capital in determining the investment in their private businesses, and consequently the macroeconomic implications on output and cross-sectional wealth inequality. We do this through the lens of a structural model. In particular, traditional literature focuses and highlights the importance of entrepreneurs' *financial capital* in determining the entry and production for entrepreneurial firms. Here we focus on the special characteristics of entrepreneurs' human capital: it is embodied in and inalienable from entrepreneurs. Consequently, entrepreneurs' investment is endogenously illiquid since they may face price discount due to human capital specificity. In addition, entrepreneurs face incomplete markets for their investment risk since there is no insurance against entrepreneurs' future human capital risk. Using rich administration data from Norway, we are able to bring the model to data and study the importance of entrepreneurs' human capital empirically and quantitatively.

Model Structure

The model is a relatively standard model for entrepreneurs that we can take it to the data (relative to the papers by Quadrini (2000), Benhabib et al. (2015), and Midrigan and Xu (2014), Moll (2014)), while we also allow for rich economic features for the entrepreneurs: (1) entrepreneurs are risk averse and face possible financial constraint, as in standard models; (2) entrepreneurs' human capital for running private business firms, contributes to firm productivity but is entrepreneur-specific; (3) When entrepreneurs selling their private firms to the market, there is a feature of endogenous illiquidity due to the fact that entrepreneurs' human capital is entrepreneur-specific and separate from the firm.

Assume each household has a one-time take-it or leave-it opportunity in starting a new firm; if he doesn't choose to become an entrepreneur, he simply lives on his financial wealth and his other income in the background. His value function is denoted as V^O:

$$V^O(a_t, \eta_t) = \max_{c_t, a_{t+1}} \quad u(c) + \beta E V^O(a_{t+1}, \eta_{t+1}) \tag{5}$$

$$c_t = a_t R^m - a_{t+1} + y \tag{6}$$

$$a_{t+1} \geq \bar{m}, \tag{7}$$

where $u(c) = \frac{c^{1-\sigma}}{1-\sigma}$, η denotes the entrepreneur's ability in managing firms, drawn from some distribution of $G_\eta(\eta)$, and follows some stochastic process that will be specified later.[11] We could think of the background income y as labor income; for simplicity, we assume y is constant over time and is not correlated with η.

[11] As in the recent literature, several papers argue that the return to financial assets investment could be different across different households (Benhabib et al. (2015), Fagereng et al. (2016), and Gabaix et al. (2016)). In the extensions, we could also allow the return to financial assets $R^m(\eta)$ correlated with η.

When the agent chooses to take this investment opportunity, his optimization problem is given by:

$$V^{Start}(a_t, \eta_t) = \max_{c_t, a_{t+1}, k, \alpha} \quad u(c) + \beta E V^E(a_{t+1}, \eta_{t+1}, z_{t+1}, k, \alpha) \tag{8}$$

$$c_t = a_t R^m - a_{t+1} - k + \alpha k - \varphi(\alpha) k, \tag{9}$$

$$a_{t+1} \geq \bar{m}. \tag{10}$$

when starting the firm, the entrepreneur can choose the size of the firm k and the share of external equity finance α, subject to the external finance costs of $\varphi(\alpha)k$ (e.g., see Jermann and Quadrini (2012)); From the entrepreneur's perspective, a firm is characterized by z, k, α. For the new firm's productivity in the next period, z_{t+1}, we assume it is drawn from some distribution of $G_z(z)$.

At time t with financial assets a_t and ability η_t, the agent maximizes over V^O and V^{Start}:

$$V(a_t, \eta_t) = \max\{V^O(a_t, \eta_t), V^{Start}(a_t, \eta_t)\}. \tag{11}$$

After starting a firm, each period the entrepreneur can choose to continue his business (value function denoted as V^C) or sell the firm (value function denoted as V^S):

$$V^E = \max\{V^C, V^S\} \tag{12}$$

In the data, it suggests the initial size of the firm and the initial owner share of the new firm have a first-order impact on the subsequent firm sizes and owner shares; Therefore, we make the simplifying assumption that once k_t, α_t are chosen, when choosing to continue his business, the entrepreneur does not change it. The problem for the entrepreneur actually becomes simpler, since entrepreneurs now only have to choose consumption and saving in financial assets:

$$\begin{aligned} V^C(a_t, \eta_t, z_t, k, \alpha) = \max_{c_t, a_{t+1}} \quad & u(c) + \beta(1-\chi) E V^E(a_{t+1}, \eta_{t+1}, z_{t+1}, k, \alpha) \\ & + \beta \chi E V^S(a_{t+1}, \eta_{t+1}, z_{t+1}, k, \alpha) \end{aligned} \tag{13}$$

$$c_t = a_t R^m - a_{t+1} + (1 - \alpha_t) F(k, \Psi(z_t, \eta_t)), \tag{14}$$

$$a_{t+1} \geq \bar{m}, c > 0, \tag{15}$$

where χ is some exogenous probability that the entrepreneur has to sell his business. We use this to capture some exogenous events to entrepreneurs that we do not model, such as health shocks, moving shocks, or other occupational choices.[12] In addition to this exogenous shock, entrepreneur's

[12]Without exogenous and endogenous risks for entrepreneurs, the model does not feature a strong incentive for entrepreneurs to sell his business. However, we need the selling channel be operative in the model and this may be important, since when entrepreneurs make decisions on starting firms, firm sizes and firm capital structure, they will take into account of the endogenous illiquidity and risk subsequently.

human capital in η_t is stochastic over time.

Firm productivity is denoted as Ψ, and $\Psi(z,\eta) = (z^\gamma + \eta^\gamma)^{\frac{1}{\gamma}}$, where z denotes the stochastic firm-specific productivity, η is the entrepreneur's personal human capital in managing the firm. These two inputs are complementary to some degree and determine the overall production efficiency $\Psi(z,\eta)$. Assume the firm-specific component z follows a firsr-order Markovian process.

Lastly, if the entrepreneur wants to sell his business, the market price for the firm takes into account the fact that the entrepreneur's skill is separate from the firm (we should use the data on firm dynamics after owner death to discipline this):

$$V^S(a_t,\eta_t,z_t,k,\alpha) = \max_{c_t,a_{t+1}} \quad u(c) + \beta E V^O(a_{t+1},\eta_{t+1}) \tag{16}$$

$$c_t = a_t R^m - a_{t+1} + (1-\alpha)\, P(k,z_t), \tag{17}$$

$$a_{t+1} \geq \bar{m}, \tag{18}$$

$$P(k_t,z_t) = \Psi(z_t,\eta_M)k^\theta + (1-\delta_k-\lambda)k, \tag{19}$$

where $P(k_t,z_t)$ is the valuation of the firm in the market. Note that here we simply assume the buyer (market investor) of the firm, can hire some new entrepreneur or manager with average ability η_M to run the business (simply assuming running for just one model period, say, one year), and then liquidate all the assets, including the remaining parts of the physical assets. Later on we shall experiment and make alternative assumptions on Ψ, λ and the time horizon that the investor will manage the firm - these elements will affect $P(k_t,z_t)$.

3.1 Calibration

Assume the model period is a year. We focus on the entrepreneurs' choices in a partial-equilibrium environment, thus we assume the risk-free rate of return for financial assets investments, R^m, is constant over time. For households, we set the risk aversion parameter σ to 2. We set the R^m to 4%. Recently, Fagereng et al. (2016) use Norwegian income, wealth and financial data, and estimate that from 2005 to 2015, the value-weighted average real return on financial assets is about 4.2%, but it varies considerably across households, with a quite large standard deviation of 14.4%. This value is also close to the standard value used in the literature which typically is for the US economy (for one example, see the estimated results from Benhabib et al. (2015)). Given that Norway is a small open economy and well integrated into the global financial markets, the returns in Norway may be quite close to that in US. In addition, we shall calibrate the discount factor β to the data moments that are related to wealth-income ratios.

For the firms, we assume a standard production function:

$$F(k,\Psi) = \Psi k^\theta,$$

where θ is assumed to be smaller than 1 so that entrepreneurs have decreasing returns to scale; the overall production efficiency is $\Psi(z,\eta) = (z^\gamma + \eta^\gamma)^{\frac{1}{\gamma}}$, with the parameter $\frac{1}{1-\gamma}$ denotes the

Elasticity of Substitution between entrepreneur-specific productivity and firm-specific productivity. We assume the depreciation δ_k is 0.1. For external finance, we simply assume the cost is quadratic in the share of external finance (e.g., see Jermann and Quadrini (2012)):

$$\varphi(\alpha) = \gamma_0(1-\alpha)^2, \gamma_0 > 0,$$

For firm-specific productivity, we normalize its mean to 1 and assume it follows a simple Markovian process, with persistence parameter of ρ_z and the standard deviation for its Gaussian innovations σ_z. For entrepreneur-specific η, we assume it follows a Pareto distribution, $G_\eta(\eta)$, which is characterized by a scale parameter η_m and a shape parameter α, which is known as the tail index. The main reason for this, is that both wealth distribution in many countries and firm size distributions follow a Pareto distribution, while in our model, η is crucially linked to both entrepreneurs' wealth and entrepreneurs' firm sizes. In addition, we assume each period, the entrepreneur can have a probability of $1-\rho_\eta$ to draw a random η' from the Pareto distribution, with probability of ρ_η his η is not changing.

Summarizing the parameters to be calibrated: More to do:

Meaning			(Reasons/Targets)
Discount factor	β	0.96	Wealth/Income ratios
Persistence of idiosyncratic prod.	ρ_z	0.867	firm productivity process
Std. of idiosyncratic prod.	σ_z	0.05	firm productivity process
Persistence of η	ρ_η	0.9	Wealth distributions ...
scale parameter for η	η_m	1.0	Normalization...
shape parameter for η	α	1.30	Wealth distributions...
External finance costs	γ_0	0.05	...
Price discount in selling physical capital	k	0.00	...
Return to scale in production	θ	0.00	...
Exogenous prob. to sell the firm	χ	0.00	...

Table 1: Calibration

3.2 Preliminary Results for the Quantitative Model

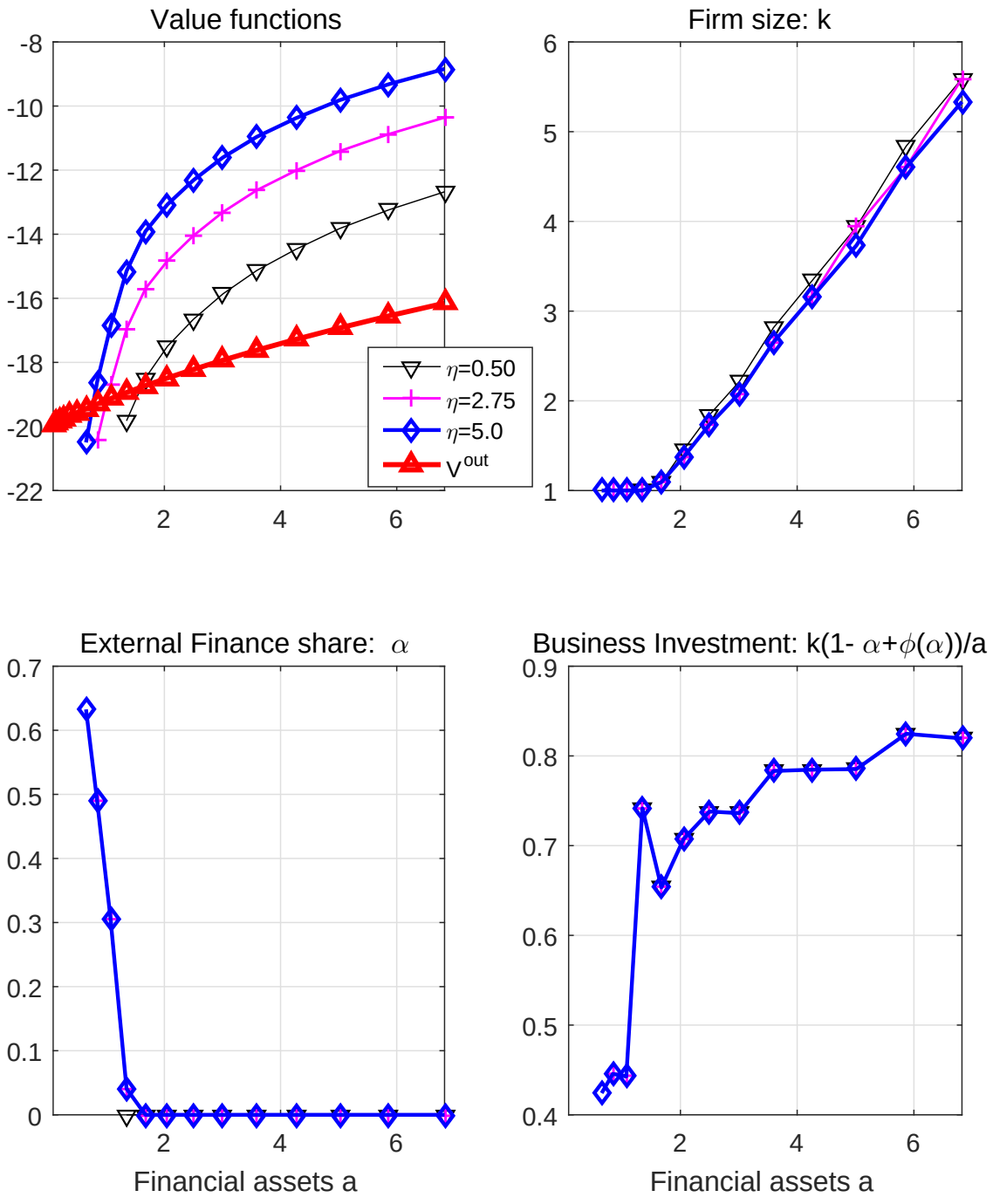


Figure 8: Value function and decisions for starting firms

NOTE: This figure plots the value functions $V^O(a)$ and $V^{Start}(a,\eta)$ as a function of financial assets a in Panel (a); Conditional on starting firms, the decisions on firm size k, external finance share α, and business investment as a share of financial assets a, are plotted in other panels.

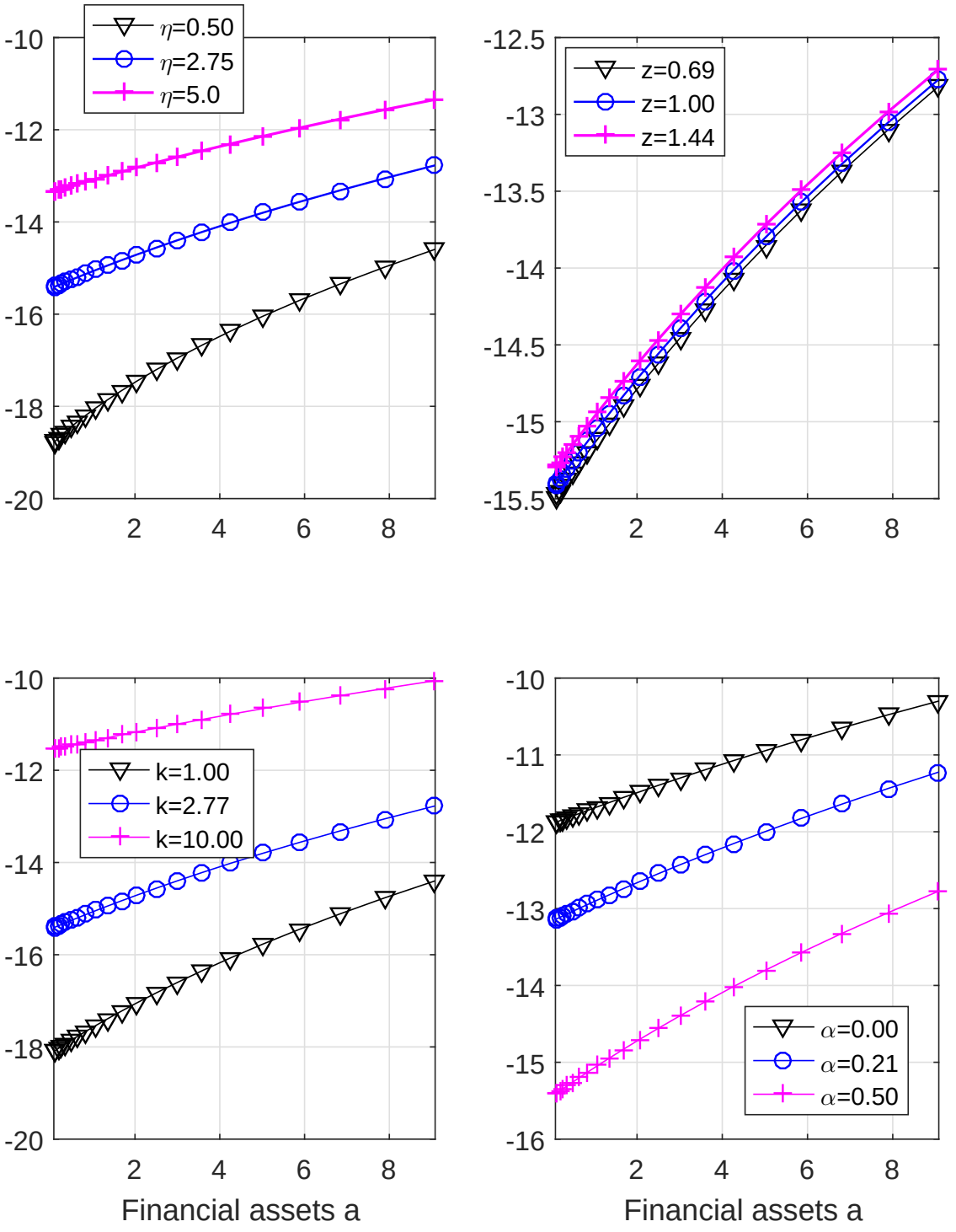


Figure 9: Value function for continuing business

NOTE: This figure plots the value functions $V^C(a, \eta, z_t, k, \alpha)$ as a function of financial assets a. Since V^C is a function of several arguments, in the figures, whenever not stated, parameters are evaluated at: $\eta = 2.75$, $z = 1.00$, $k = 2.77$, $\alpha = 0.50$.

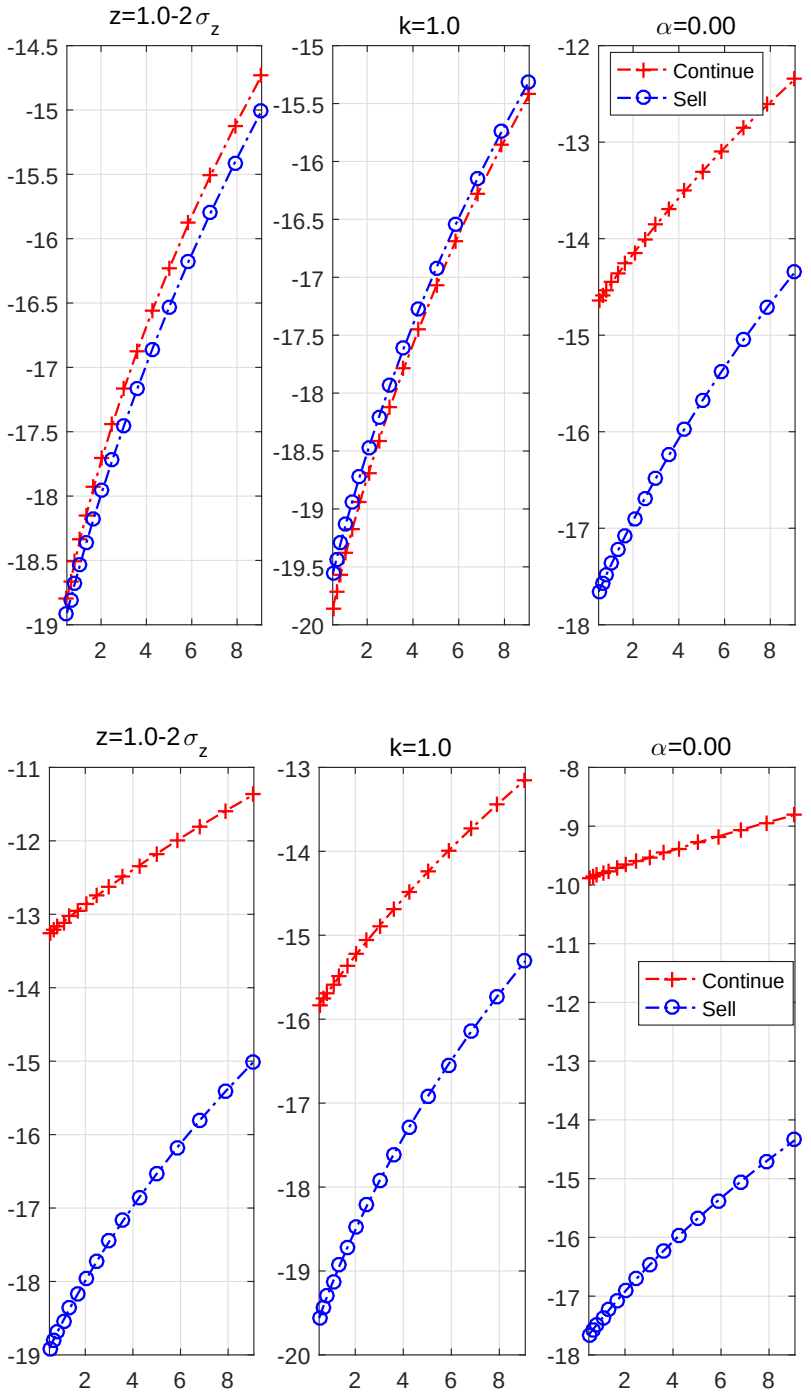


Figure 10: To sell firms or to continue business; (Upper panel: $\eta = 1.00$; Lower panel: $\eta = 5.00$)

NOTE: This figure plots the value functions $V^C(a, \eta, z_t, k, \alpha)$ and $V^S(a, \eta, z_t, k, \alpha)$ as a function of financial assets a. In the upper panel, whenever not stated, parameters are evaluated at: $\eta = 0.50$, $z = 1.00$, $k = 2.77$, $\alpha = 0.50$; Similarly, in the lower panel, parameters are evaluated at: $\eta = 5.00$, $z = 1.00$, $z = 2.77$, $\alpha = 0.50$;

:

3.3 More to do: Quantitative Model and implications

- Calibration of the model: compare the model and data seriously
- Optimal decisions in the model: extensive margin of starting business; portfolio choices in the presence of private equities when entrepreneurs have different levels of human capital
- Comparative statistics; counterfactual analysis with death shocks (as in the data)
- Implications on allocation of talents, output and welfare
- Policy implications: different tax incentives; or public subsidy for private entrepreneurs
- Further Possible extension and exercise: The return to financial assets investment across different agents are different: say, R^m is positively correlated with the entrepreneurial ability

4 Concluding Remarks

To be added...

5 Appendix for Empirical Analysis

5.1 Data Source

Our analysis uses several data sets maintained by Statistics Norway. These data sets can be combined together through unique personal identifiers over time. Below, the details of the data sets are provided.

Firm Registry Data: Basic information

- The firm registry data on basic information is available from 1995 to 2015. For each year and each firm, it provides information on firm ID, the registered starting dates, firm organization types (Limited liability, Sole proprietorship or Partnership), possible different establishment IDs and the corresponding locations (municipality), the sector code and industry code for the main business.
- Sample selection: we exclude firms with missing information on firm IDs or registered dates. For firms with multiple establishments, we only keep track of the records at the firm level.

Firm Registry Data: accounting data on income statement and balance sheet

- The data is from Statistics Norway. It covers all limited liability firms in Norway with annual information on firms' income statements and balance sheet variables from 1994 to 2014. If a firm has several establishments, the data is for the firm level.
- Variables selected: Book Value of Total Assets, Total Fixed Assets, Total Current Assets, Total Value of Intangible Assets, Total Liability, Total Current Liability, Total Equity; Operating income and operating expenses, Total Revenue, Costs of materials, Total Wage Bill, Dividend, Retained Earnings. In addition, we have information on firm starting years, industries for main business, institutional sectors and main business locations.
- Sample selection: we exclude firms with missing information on total assets or value added. In addition, we impose sample restrictions so that firms should have positive value added, positive number of employees and wage bills, and the measure of productivity is not missing. We lastly exclude observations with extreme values in TFPR (top and bottom 1% across all years).

Firm Registry Data: ownership and owner shares definition/procedures/

- The data is available from 2002 to 2012. For each registered firm in Norway, we have information on its owners and owner shares. There are different types of owners in the data: individual households, registered firms, foreign firms and missing information on the ownership (a few cases). [13]

[13]The data is from the Frisch Data Center, and we are very grateful to Anja Myrann for help.

- To trace out ultimate owners of a firm, there could be complicated cases such as firms cross holding each other's shares and there could be chain of linkages through several companies for ownership. For example, company A holds 20% share of company B and company B holds 20% share of company A, and individual C holds 50% of A and 40% of B. Thus, we have to take care of these cross-ownerships and chain of linkages. Also, in the data if there is missing information on a firm's owners then we drop these observations of firms.
- If an owner has shares less than 2% then we think he/she is an investor (e.g., investing through equity holdings) and not an active owner. We exclude these owners in our definitions of active owners.

Firm Registry Data: Firm board members and managers

- The data is available from 2002 to 2012. For each registered firm in Norway, it is mandatory to report information on Owners (if Sole proprietorship or Partnership), or board members and managers for limited liability firms. Based on official role types, typical positions in the data include: DAGL - General Manager; CONTACT - Contact person; INNH - Proprietor; LEDE - Chairman of the Board; NEST - Deputy; MEDL - Board member; VARA - Deputy member; REPR - Norwegian representative for foreign unit; BEFORE - Business Manager; DTSO - Participant with full responsibility; DTPR - Participant with shared responsibility; EIKM - municipality Owner; BEST - Managing Director; BOBE - Trustee; SAM - co-owners; KOMP - Complementar; REGN - Accountant; REVI - Auditor.

The Central Population Register

For all Norwegian residents from 1992 to 2014, the data contains yearly individual demographic information. This includes constant personal variables (Country of birth, First stay date, Immigration category, Country Background, Gender, Date of birth) as well as changing characteristics in each year (Marital status, Spouse ID if married). We also have family identifiers to link spouses and cohabiting couples with common children. Family structure and family types variables are also available for analysis (Total number of persons in the family, the age of youngest child, the age of youngest and oldest person in the family, Number of children under the age of 18/16/11/6, Family Type, Father ID and Mother ID at the time of birth). A cautionary note is that, some of these variables are missing for several years (like Family Type).

National Educational Database

All individual statistics on education are gathered in The National Education Database (NUDB) since 1970. Educational attainment is reported by the educational establishment directly to Statistics Norway at each individual level. By October 1 of each year, the completed education from the previous school/academic year is updated and the information containing highest attained level of education for the whole population is updated as well.

Administrative Tax and Income Records

Households in Norway are subject to income and wealth tax, and they are obliged to report their complete income and wealth holdings to the tax authority every year. Also, employers, banks, brokers, insurance companies and any other financial intermediaries are obliged to send the information on the value of the assets owned by the individual to the individual and to the tax authority. Traded financial securities are reported at market value; Value of shares in private companies are reported by individuals as well as private companies to the tax authority. The tax authority will combine the information from companies' report on net worth with individuals', and adjust if necessary. For more details, see annual reports from the tax authority (http://www.skatteetaten.no) as well as the literature (e.g., Andreas Fagereng, Luigi Guiso and Luigi Pistaferri (2016)).

Income Registry Data

Specifically, in the income registry data, we select and report the details for several items below:

- Earned income includes cash salary, taxable benefits and sickness and maternity benefits during calendar year.
- Net entrepreneurial income includes income from land and forestry, fishing and hunting, income from other business activities and sickness benefits in employment during the calendar year.
- Capital investment income: includes Interest income, dividends, realized gains and other investment income during the calendar year:
- Unemployment benefits paid to wage earners and self-employed
- Pensions: includes pensions from national insurance and also includes payments from individual pension agreement
- Transfers; and other Miscellaneous items in the income tax record

Wealth Registry Record

For persons 17 years and older, we have the Wealth Registry Record from the tax authority every year. To better understand the wealth data, it could help by looking at the corresponding Tax Form entries in 2015.[14] We detailed items on Bank Deposits, Value of Shares in Mutual Funds, Value of Financial Securities, Value of Shares in Private Companies, Tax value of housing and other real property, Value of Home ownership, Premium funds and individual pension agreements, Value of life insurance policies, Other capital, Total Debt, Total net worth.

Employer-Employee Register

Statistics Norway combine the required report from each firm that hires workers and the tax record from individuals, and maintain the matched data set: Employer-Employee Register. The data includes detailed labor market information for every worker each year (worker ID, employers (firms) ID, job starting date with each employer, job ending date with each employer, total payments to workers from each employer, industry, occupation, actual and expected working hours, total number of days worked, indicator for full-time/part-time employment).

[14]More information about Norwegian tax form could be found at The Norwegian Tax Administration. See the link http://www.skatteetaten.no/en/person/Tax-Return/Find-item/#&del1=1&del2=1&del3=1&del4=1&del5=1.

5.2 More details on sample selection and data matching

- First obtaining individual entrepreneurs' information:

    1. First, from the firm registry data on owners and owner shares, we can match it with registry data on managers/board members by using unique firm ID. This is done year by year and the data is from 2002 to 2012. Note that each year a firm could have multiple owners and typically have multiple management positions with person IDs.
    2. Second, by using unique firm ID, we can link the above matched data to firms' balance sheet data. Note that balance sheet data is available from 1994 to 2014, so we can have information on firms before 2002 even if we do not know the information on firms' owners at that time.
    3. In the matched data obtained in the first step, we can define owners/active owners/entrepreneurs.
    4. By using unique person ID we can link with individual information on income/wealth/education/demographics.

- Obtaining more information for the whole population and at the household level:

    1. Using The Central Population Register data, we can track each person's marriage status every year and link to his spouse ID if necessary;
    2. Using The Central Population Register data, we can also link to the person's father ID and mother ID at the time of his/her birth; we can also link to each of his children ID. Therefore, we obtain information on family size, number of children and young children.
    3. For each person, using the person ID, spouse ID, father ID and mother ID, and Children's ID, we are allowed to have information on the spouse's income and wealth, father's income and wealth, and each children's income and wealth if older than 17. Therefore, we can construct household-level income and wealth. (The administration registry does not keep track of household-level income and wealth).

5.3 Empirical Analysis

5.3.1 Descriptions

Table 2: Descriptive Statistics

	# of Obs.	Mean	S.D.	1th	10th	25th	50th	75th	90th	99th
Male	4636574	0.79	0.17	0	0	1	1	1	1	1
Age	4636574	44.41	13.57	15	27	35	44	54	62	76
Married	4636574	0.70	0.46	0	0	0	1	1	1	1
Wages (000s)	4605549	365	475	0	0	86	303	498	750	1748
Capital Income (000s)	4632131	482	10462	-207	0	0	4	80	482	6007
Business Income (000s)	4468720	78	1165	-124	0	0	0	0	180	1243
Total HH Income (000s)	4635619	959	10793	0	120	256	426	721	1310	7380
HH Disposable Income (000s)	4635740	683	10383	-172	89	189	303	487	862	5387
Private Equity (deflated) (000s)	3691831	7770	158424	0	0	0	67	861	4362	77111
Gross Wealth (deflated) (000s)	4565558	9756	156830	0	129	475	1225	3278	8911	94197
Firm Age	1733966	9.35	8.97	0	1	3	7	13	20	43
Firm Fixed Assets (000s)	1734266	6567	95618	0	0	63	466	2426	8090	83299
Firm Full-time Employees	1734266	11.1	42.4	1.0	1.0	2.0	4.8	9.7	20.0	105.5
Firm Total Assets (000s)	1734266	10847	117551	8	230	710	2100	5822	15538	126584
Firm Intangible Assets (000s)	1734266	190	6329	0	0	0	0	10	122	2223
Firm Total Equity (000s)	1734266	4344	65434	-2501	-126	102	413	1584	5292	57840
Firm Wage Bills (000s)	1734266	1505	7682	0	0	0	239	1311	3369	17120
Firm Costs of Goods Sold (000s)	1734266	3514	43159	0	0	0	4	1283	5854	51418
Firm Value Added (000s)	1734266	2020	11782	-888	-41	-4	479	1792	4495	23161
Log (TFPQ)	704262	3.83	0.88	0.99	2.90	3.42	3.90	4.34	4.76	5.70
Log (TFPR)	704262	0.09	0.47	-1.49	-0.29	-0.05	0.12	0.28	0.45	1.26
Log(Value Added/Assets)	1596939	0.26	2.67	-5.18	-2.69	-1.25	-0.16	1.04	4.57	7.14
Log(Labor Productivity)	1087178	0.29	1.27	-4.07	-0.41	-0.01	0.17	0.48	1.23	4.98
Owner Shares	1780103	0.68	0.26	0.33	0.34	0.50	0.53	1.00	1.00	1.00
# of Managing Positions for the owner	1780103	1.55	0.61	0	1	1	2	2	2	2
Total # of Active Owners	1780103	1.47	0.60	1	1	1	1	2	2	3

NOTE: Wealth is the deflated (2005 constant), total household-level gross wealth. Private Equity is also deflated at the household level. Other nominal variables are also deflated to 2005 constant when computing summary statistics. For computing TFPQ, TFPR and Value Added/Assets, we used the averages of the book value of total fixed assets at the beginning and at the end of this period. "Full-time Employees" report the full-time equivalent number of employees, using the matched employer-employee data.

Table 3: Sample size with different requirements

Matched Entrepreneurs with Firms	1,780,103	100 %
Longest firm that Entrepreneurs have	1,283,786	72 %
Positive # of employees and wage bills	603,088	34 %
Trimming top and bottom 1% of TFPQ	562,194	32 %
Entrepreneurs Household side information	4,636,574	

NOTE: This table provides the number of observations when we impose different requirements on the original data.

Table 4: Registered management positions for Norwegian firms

Positions	# of Obs.	percent	Cum. percent
"BEST": **Managing Director**	1	0	0
"DAGL": **General Manager**	1,124,868	28.89	28.89
"DTPR": **Participant with shared responsibility**	19	0	28.89
"DTSO": **Participant with full responsibility**	3,464	0.09	28.98
"FFR": **Manager**	4,678	0.12	29.1
"KONT": **Contact person**	224,061	5.75	34.85
"LEDE": **Chairman of the Board**	1,343,049	34.49	69.34
"MEDL": **Board member**	940,700	24.16	93.5
"NEST": **Deputy**	51,922	1.33	94.83
"OBS": **Observer**	227	0.01	94.84
"REGN": **Accountant**	3,231	0.08	94.92
"SAM": **Co-owners**	1	0	94.92
"VARA": **Deputy member**	197,671	5.08	100
Total	3,893,892		100

NOTE: "BEST" and other types of positions refer to the Norwegian names in the original data. This table displays simple count for different types. Note that a firm could have multiple positions.

Table 5: Statistics on labor shares

	Mean	S.D.	5th	10th	25th	50th	75th	90th	95th	# of Obs.
Labor Share	0.715	0.229	0.217	0.372	0.601	0.775	0.890	0.954	0.976	1,041,822
Labor Share Weighted by Value Added	0.710	0.233	0.185	0.364	0.598	0.775	0.884	0.947	0.972	1,041,822
Labor Share by Sectors Weighted by Value Added:										
Manufacturing	0.713	0.182	0.380	0.457	0.609	0.738	0.853	0.927	0.958	107,866
Construction	0.781	0.159	0.480	0.566	0.704	0.813	0.898	0.951	0.973	142,980
Wholesale/Retail Trade	0.703	0.193	0.326	0.427	0.596	0.737	0.849	0.925	0.957	310,435
Professional Service	0.712	0.233	0.217	0.364	0.590	0.784	0.885	0.944	0.969	191,092

NOTE: Classification of sectors is according to the industry standard classification 2002 and 2007 at Statistics Norway. For details on sample selection and variable definitions please see the body text and the data appendix.

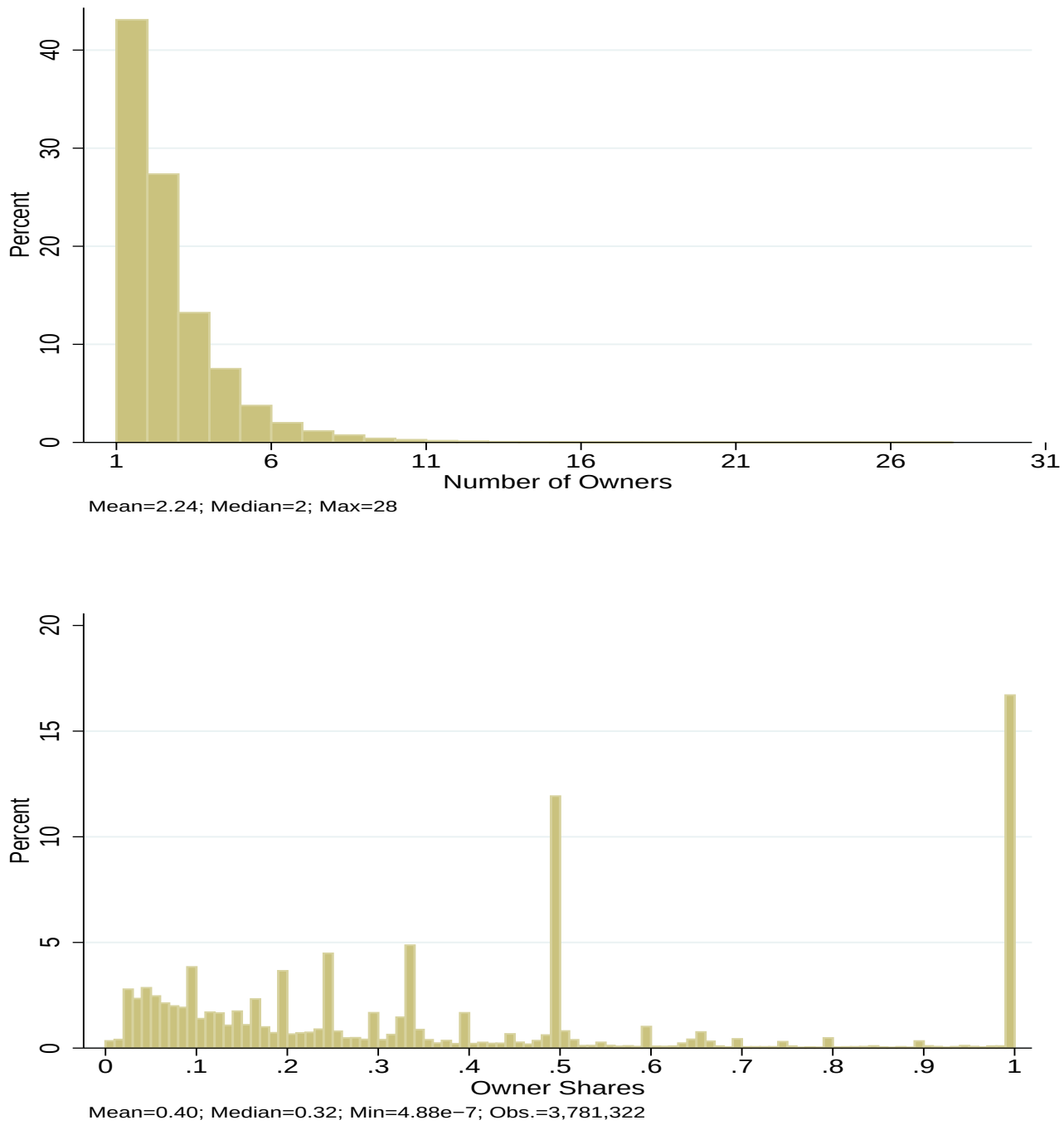


Figure 11: Distribution for Total number of any owners and Owner shares

NOTE: The data is from 2002 to 2012 for all Norwegian limited liability firms. For details on sample selection and variable definitions please see the body text and the data appendix.

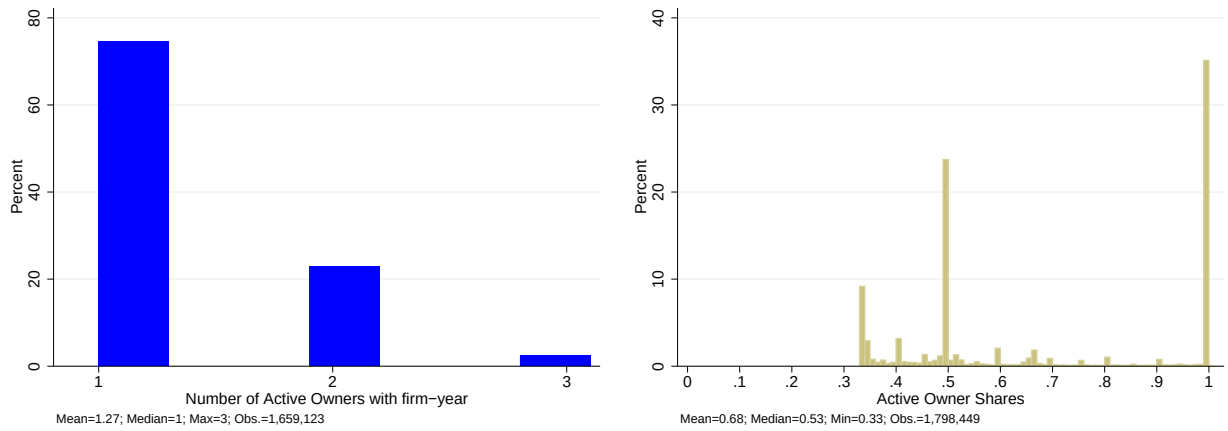


Figure 12: Distribution for the number of entrepreneurs and owner shares within a firm

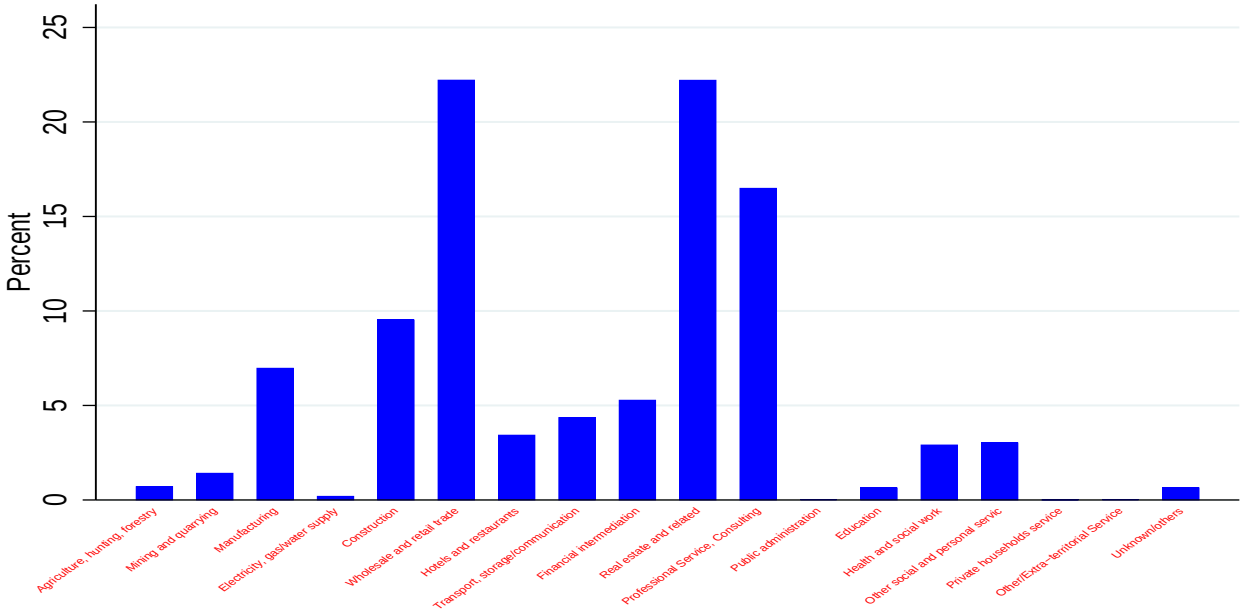
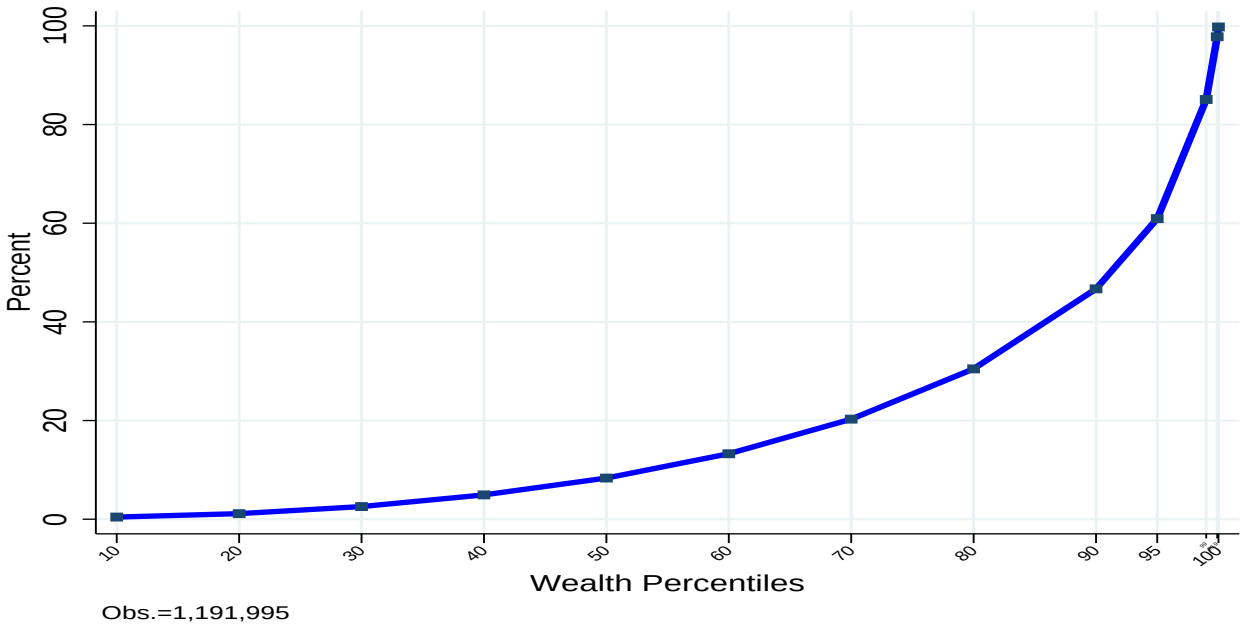


Figure 13: Distribution of entrepreneurs across sectors

NOTE: The data is from 2002 to 2012 for all Norwegian limited liability firms. "entrepreneurs" are defined as active owners, which requires that the owner should have at least 33% shares in the firm and should at least have one management position. For details on sample selection and variable definitions please see the body text and the data appendix.



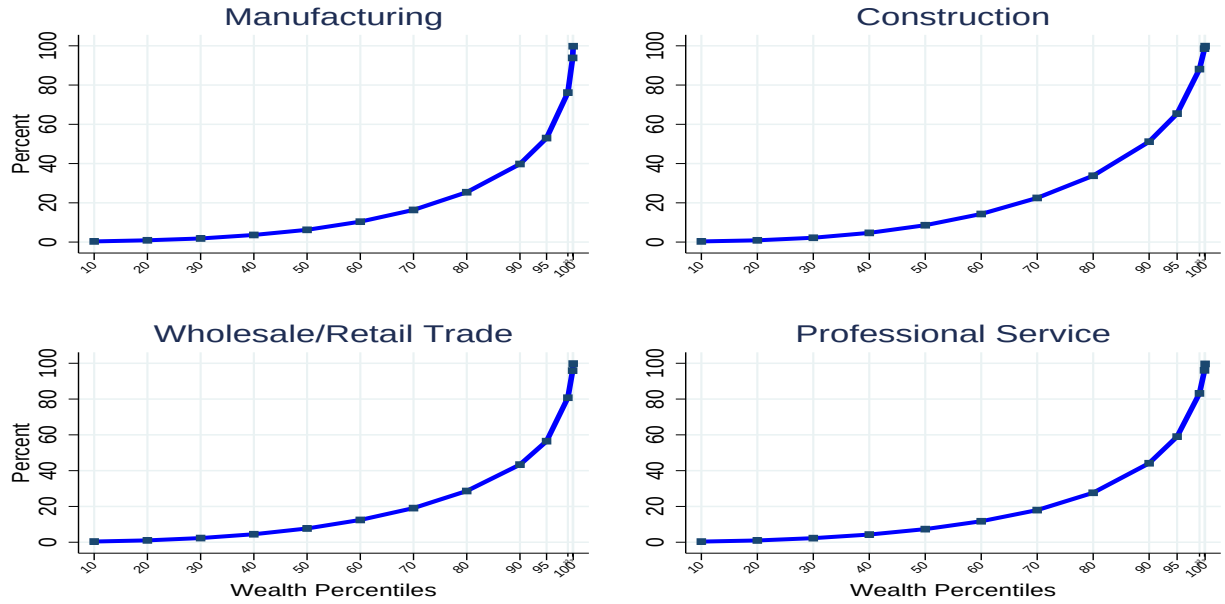


Figure 14: Distribution of entrepreneurs by wealth percentiles and by sectors

NOTE: This figure displays the distribution of entrepreneurs by wealth percentiles in the upper panel and in addition by sectors in the lower panel. "entrepreneurs" are defined as active owners, which requires that the owner should have at least 33% shares in the firm and should at least have one management position. Wealth is the deflated, total household-level gross wealth in the same year when the household head is an active owner. For the definition of wealth percentile, we first find the percentiles for household-level wealth from the population data for all Norwegian households in each year; Second, we classify each entrepreneur according to his/her wealth by year. The figure shows the percentiles of 10th, 20th, 30th, 40th, 50th, 60th, 70th, 80th, 90th, 95th, 99th and 99.9th. For the industry sector, Standard Industrial Classification 2002 according to SSB is used (see the link "https://www.ssb.no/en/klass/klassifikasjoner/6/versjoner")

5.3.2 Firm dynamics

Table 6: More firm characteristics

	2005	2006	2007	2008	2009	2010	2011	2012	Averages
Fraction of firms: Negative Value Added	25.91 %	32.48 %	33.87 %	35.74 %	35.91 %	35.47 %	35.19 %	31.04 %	33.20 %
Firm exit rate	4.33 %	4.14 %	4.53 %	4.92 %	5.26 %	4.84 %	5.78 %	5.30 %	4.89 %

Summary for Growth rates:

	Mean	**S.D.**	**5th**	**10th**	**25th**	**50th**	**75th**	**90th**	**95th**	**# of Obs.**
Value Added	23.25 %	89.04 %	-62.52 %	-36.04 %	-10.14 %	6.97 %	26.48 %	60.66 %	100.69 %	1 015 562
Revenue	8.68 %	80.27 %	-43.19 %	-24.21 %	-6.35 %	5.17 %	19.46 %	46.02 %	77.98 %	996 973
Fixed Assets	1.77 %	98.17 %	-103.05 %	-58.06 %	-26.31 %	-5.10 %	23.21 %	86.78 %	144.96 %	964 883
Wage bills	10.60 %	61.49 %	-39.56 %	-20.98 %	-3.98 %	6.34 %	19.69 %	45.68 %	79.56 %	1 015 567
Employees	4.89 %	31.49 %	-38.08 %	-22.00 %	-4.33 %	0.00 %	12.06 %	35.42 %	60.61 %	938 115
TFPQ	4.65 %	52.24 %	-81.30 %	-52.09 %	-18.84 %	4.95 %	28.21 %	61.07 %	90.96 %	906 510
TFPR	0.78 %	40.16 %	-62.84 %	-40.52 %	-15.60 %	1.58 %	17.49 %	40.12 %	61.78 %	906 510

	TFPQ (logs)	**TFPR (logs)**	**VA/Assets (logs)**	**Labor Productivity (logs)**
Productivity				
Lagged Productivity	0.681***	0.566***	0.770***	0.363***
	(0.00183)	(0.00216)	(0.00146)	(0.00277)
Observations	902,295	902,295	918,668	1,003,698
adjusted R-squared	0.511	0.363	0.649	0.209
Year dummies	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES
Root of MSE	0.654	0.439	1.018	0.472

NOTE: "Firm exit rates" documents the average probability that firms exit this year conditional on survived the year before (we call a firm survive in a year if it has registry data and not being associated with any bankruptcy, insolvency, liquidation, and other merger and acquisition activities.) For the growth rates, we use $2\frac{x_t - x_{t-1}}{x_t + x_{t-1}}$. "Root of MSE" reports the root of mean squared error in the corresponding regression. "Industry dummies" are at 3-digit level. Robust standard errors are in parentheses;*** p<0.01, ** p<0.05, * p<0.1.

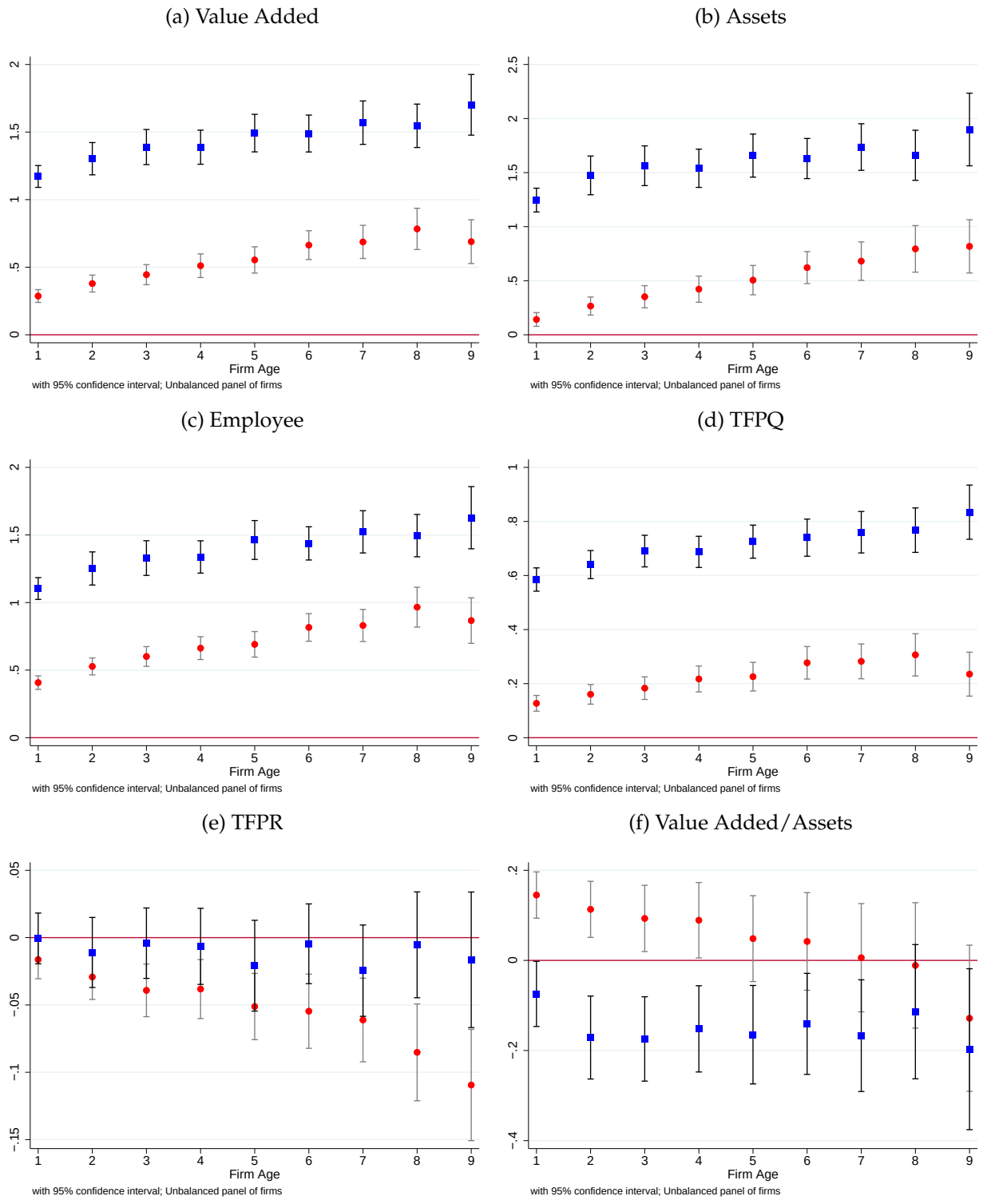


Figure 15: Firm dynamics; (Dot: Wealth-poor founders; Square: wealth-rich founders

NOTE: This figure shows the dynamics for new firms' variables. Wealth-rich and wealth-poor founders are defined as before, using initial households wealth before firm founded. All firm variables are in logs, and are net of year, 3-digit industry fixed effects. The regression uses the entrepreneur's value added according to his/her shares of the firm as weights.

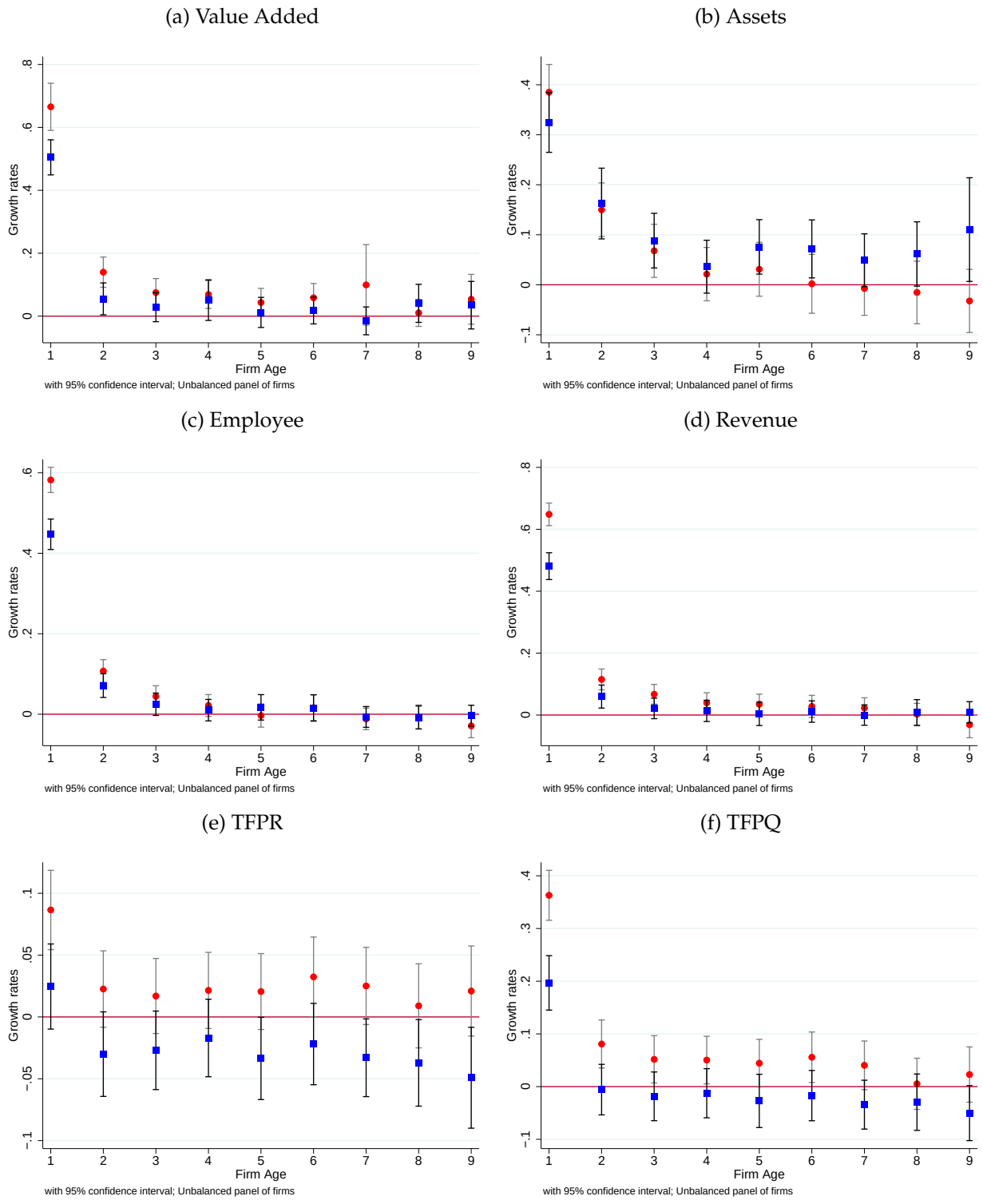


Figure 16: Firm growth rates; (Dot: Wealth-poor founders; Square: wealth-rich founders

NOTE: This figure shows the dynamics for new firms' growth rates for different variables. Wealth-rich and wealth-poor founders are defined as before, using initial households wealth before firm founded. All firm variables are in logs, and are net of year, 3-digit industry fixed effects. The regression uses the entrepreneur's value added according to his/her shares of the firm as weights.

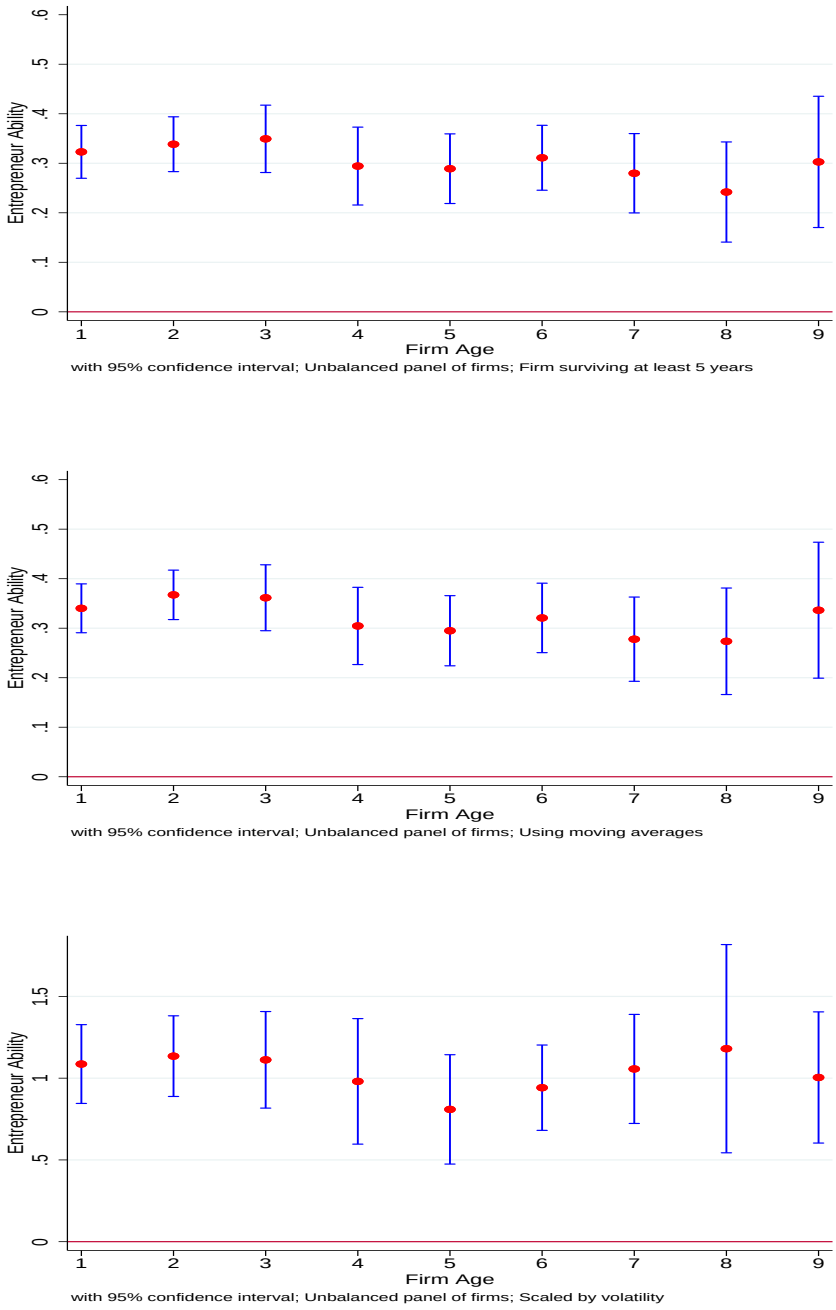


Figure 17: Differences in Entrepreneurs' productivity between wealth-rich and wealth-poor founders: (Upper panel: New firms surviving at least 5 years), (Middle panel: using moving averages), (Lower panel: scaled by firm volatility)

NOTE: These figures report the differences in entrepreneurs' productivity between wealth-rich and wealth-poor founders. "entrepreneurs" are defined as active owners, which requires that the owner should have at least 33% shares in the firm and should at least have one management position. Wealth is the deflated, total household-level gross wealth before the year the new firm is founded. entrepreneurs' productivity is measured by TFPQ (in logs) and net of any industry and year fixed effects. The middle panel uses 2-period moving-averages of a firm's TFPQ as a way to smooth the measurement. The lower panel computes a firm's standard deviation of the TFPQ time series, and uses it to scale the firm's TFPQ; after that, we then take logs and net of any fixed effects.

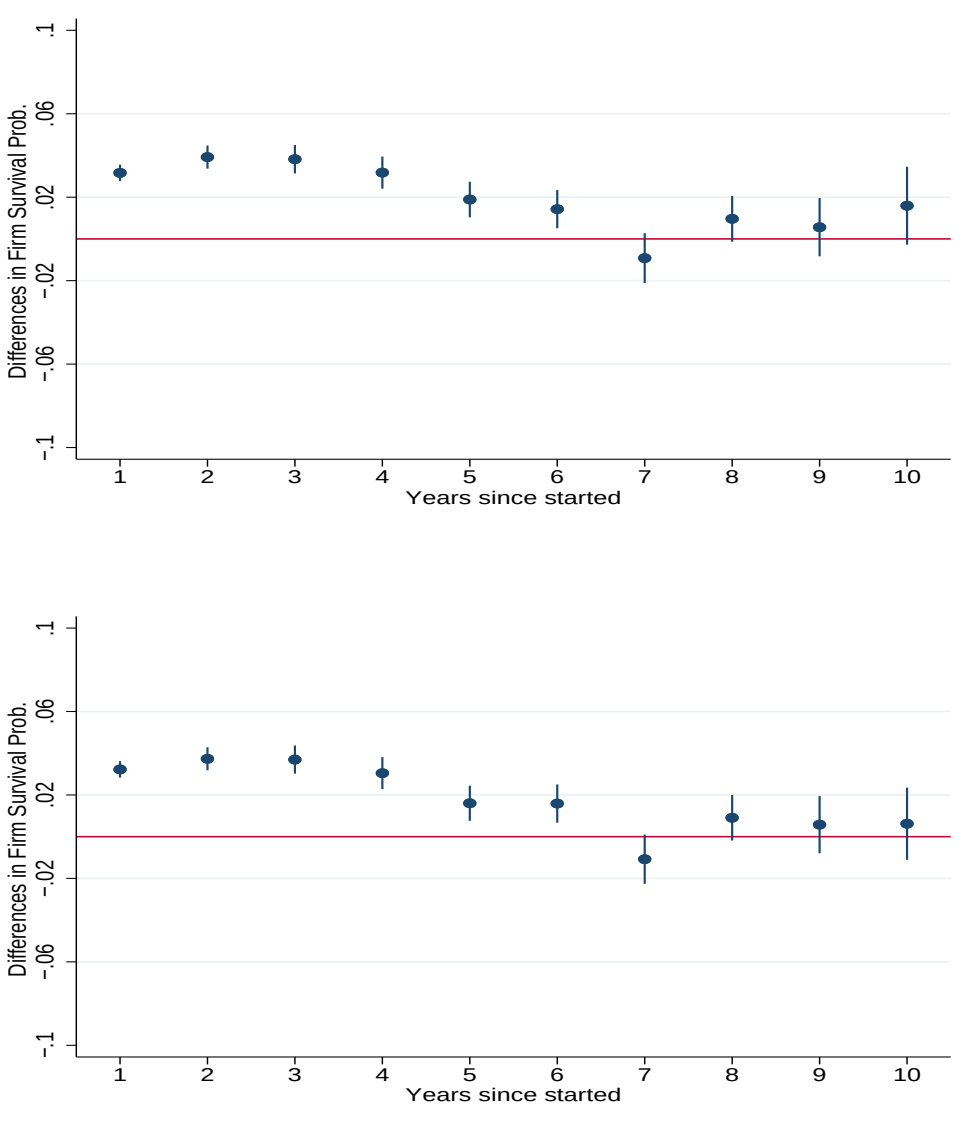


Figure 18: Differences in New firm survival probability between wealth-rich and wealth-poor founders: longest founder and owner (Upper panel), only founder and owner (Lower panel)

NOTE: These figures report the differences in the new firm's survival probability between wealth-rich and wealth-poor founders. "entrepreneurs" are defined as active owners, which requires that the owner should have at least 33% shares in the firm and should at least have one management position. Wealth is the deflated, total household-level gross wealth before the year the new firm is founded. We call a firm survived in a year if it has non-missing registry data, not being associated with any bankruptcy, insolvency, liquidation, and other merger and acquisition activities.

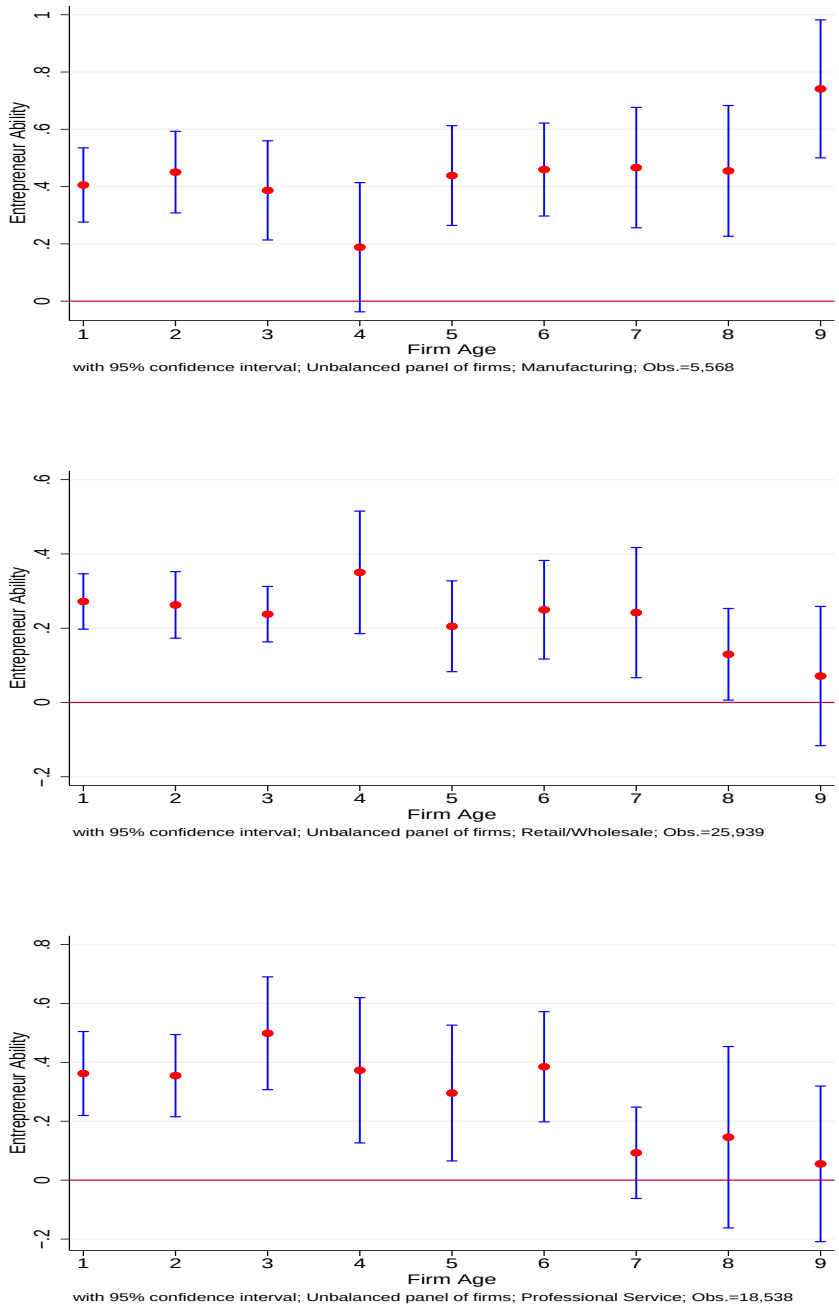


Figure 19: Differences in Entrepreneurs' productivity between wealth-rich and wealth-poor founders: (Upper panel: Manufacturing), (Middle panel: Wholesale/Retails), (Lower panel: Professional Services)

NOTE: These figures report the differences in entrepreneurs' productivity between wealth-rich and wealth-poor founders. "entrepreneurs" are defined as active owners, which requires that the owner should have at least 33% shares in the firm and should at least have one management position. Wealth is the deflated, total household-level gross wealth before the year the new firm is founded. entrepreneurs' productivity is measured by TFPQ (in logs) and net of any industry and year fixed effects.

Table 7: Differences in productivity of New firms founded by wealth-rich and wealth-poor, with different weights

VARIABLES	(1) $TFPQ_{t_0+1}$	(2) $TFPQ_{t_0+2}$	(3) $TFPQ_{t_0+5}$	(4) $TFPQ_{t_0+6}$	(5) $TFPQ_{t_0+9}$	(6) $TFPQ_{t_0+10}$
A: Basic						
I(Initial Wealth Rich)	0.182***	0.167***	0.127***	0.113***	0.0857***	0.0864*
	(0.00939)	(0.0102)	(0.0149)	(0.0178)	(0.0323)	(0.0487)
Observations	28,448	22,067	10,017	6,807	2,256	1,000
R-squared	0.035	0.027	0.011	0.007	0.004	0.003
B: Longest Founder						
I(Initial Wealth Rich)	0.176***	0.139***	0.103***	0.0817***	0.0734**	0.0864*
	(0.0109)	(0.0117)	(0.0162)	(0.0191)	(0.0331)	(0.0487)
Observations	21,937	17,674	8,769	6,096	2,144	1,000
R-squared	0.033	0.022	0.008	0.004	0.004	0.003
C: Only Founder						
I(Initial Wealth Rich)	0.226***	0.205***	0.163***	0.156***	0.138***	0.0516
	(0.0129)	(0.0141)	(0.0198)	(0.0237)	(0.0411)	(0.0629)
Observations	13,996	11,003	5,415	3,690	1,332	626
R-squared	0.040	0.029	0.016	0.016	0.010	0.001
D: Weighted by Firm Value Added						
I(Initial Wealth Rich)	0.298***	0.273***	0.212***	0.237***	0.146***	0.0783
	(0.0174)	(0.0233)	(0.0314)	(0.0347)	(0.0493)	(0.0820)
Observations	28,448	22,067	10,017	6,807	2,256	1,000
R-squared	0.073	0.067	0.037	0.045	0.020	0.018
E: Weighted by Firm Assets						
I(Initial Wealth Rich)	0.196***	0.233***	0.141***	0.212***	0.158*	0.116
	(0.0695)	(0.0374)	(0.0524)	(0.0468)	(0.0955)	(0.0935)
Observations	28,447	22,067	10,015	6,807	2,256	1,000
R-squared	0.034	0.039	0.014	0.027	0.015	0.013
Year dummies	YES	YES	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

NOTE: Wealth is the deflated, total household-level gross wealth before the entrepreneur found the new firm. We use a dummy variable, with values of 0 for those with wealth below the 50th percentile (benchmark category), 2 for those above 90th percentile and 1 for those in between. Here **I(Initial Wealth Rich)** only report the estimates for the case of 2. Industry is at 3-digit NAICS level (according to the industry standard classification 2002 and 2007 at Statistics Norway). **TFPQ** are in logs, and net of 3-digit industry fixed effects and year fixed effects. See the text for the more details on sample selection and variable definitions. "Basic" refers to the pooling OLS for all entrepreneurs and is without any weighting; "Longest Founder" requires that the new firm is the firm that the founder stays longest among all the firms he founds and owns; "Only Founder/Owner" restricts the sample further so that the entrepreneur is also the only founder and owner of the firm; "Weighted by firm VA" uses the entrepreneur's value added according to his/her shares of the firm as weight for the OLS; "Weighted by Firm Assets" uses the entrepreneur's firm assets according to his/her shares of the firm as weight for the OLS.

Table 8: Differences in productivity of New firms founded by wealth-rich and wealth-poor, across industries

VARIABLES	(1) $TFPQ_{t_0+1}$	(2) $TFPQ_{t_0+2}$	(3) $TFPQ_{t_0+5}$	(4) $TFPQ_{t_0+6}$	(5) $TFPQ_{t_0+9}$	(6) $TFPQ_{t_0+10}$
Manufacturing						
A: Basic						
I(Initial Wealth Rich)	0.289***	0.224***	0.223***	0.232***	0.336***	0.374**
	(0.0427)	(0.0433)	(0.0610)	(0.0748)	(0.127)	(0.186)
B: Only Founder/Owner						
I(Initial Wealth Rich)	0.388***	0.245***	0.279***	0.384***	0.519***	0.622***
	(0.0600)	(0.0608)	(0.0881)	(0.104)	(0.189)	(0.227)
C: Weighted by Firm VA						
I(Initial Wealth Rich)	0.372***	0.334***	0.402***	0.488***	0.733***	0.503***
	(0.0765)	(0.0868)	(0.0977)	(0.131)	(0.150)	(0.160)
D: Weighted by Firm Assets						
I(Initial Wealth Rich)	0.436***	0.250**	0.454***	0.580***	0.789***	0.376**
	(0.114)	(0.115)	(0.118)	(0.140)	(0.284)	(0.174)
Wholesale/Retail Trade						
A: Basic						
I(Initial Wealth Rich)	0.157***	0.143***	0.130***	0.0565*	0.0532	0.0106
	(0.0215)	(0.0215)	(0.0289)	(0.0340)	(0.0586)	(0.0972)
B: Only Founder/Owner						
I(Initial Wealth Rich)	0.154***	0.161***	0.156***	0.0384	0.0776	-0.0723
	(0.0304)	(0.0307)	(0.0401)	(0.0454)	(0.0738)	(0.130)
C: Weighted by Firm VA						
I(Initial Wealth Rich)	0.275***	0.259***	0.227***	0.150**	0.124	0.252
	(0.0383)	(0.0332)	(0.0504)	(0.0598)	(0.0978)	(0.200)
D: Weighted by Firm Assets						
I(Initial Wealth Rich)	0.252***	0.263***	0.268***	0.189**	0.305	0.331
	(0.0599)	(0.0390)	(0.0633)	(0.0941)	(0.193)	(0.211)
Professional Service						
A: Basic						
I(Initial Wealth Rich)	0.152***	0.118***	0.0760**	0.0527	0.0715	0.0255
	(0.0231)	(0.0247)	(0.0353)	(0.0442)	(0.0861)	(0.112)
B: Only Founder/Owner						
I(Initial Wealth Rich)	0.180***	0.113***	0.0927**	0.0934*	0.100	-0.0753
	(0.0299)	(0.0326)	(0.0432)	(0.0551)	(0.1000)	(0.144)
C: Weighted by Firm VA						
I(Initial Wealth Rich)	0.280***	0.259***	0.177**	0.149	0.0520	-0.153
	(0.0435)	(0.0730)	(0.0693)	(0.0917)	(0.104)	(0.162)
D: Weighted by Firm Assets						
I(Initial Wealth Rich)	0.116	0.174*	-0.0126	-0.0272	-0.0873	-0.0483
	(0.0731)	(0.101)	(0.0790)	(0.0934)	(0.214)	(0.181)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

NOTE: Wealth is the deflated, total household-level gross wealth. We use a dummy variable, with values of 0 for those with wealth below the 50th percentile (benchmark category), 2 for those above 90th percentile and 1 for those in between. Here **I(Initial Wealth Rich)** only report the estimates for the case of 2. Industry is at 3-digit NAICS level (industries and sectors are according to the industry standard classification 2002 and 2007 at Statistics Norway). **TFPQ** are in logs, and net of 3-digit industry fixed effects and year fixed effects. See the text for the more details on sample selection and variable definitions. In the regression, year dummies are also always included. "Basic" refers to the pooling OLS for all entrepreneurs and is without any weighting; "Only Founder/Owner" restricts the sample further so that the entrepreneur is also the only founder and owner of the firm; "Weighted by firm VA" uses the entrepreneur's value added according to his/her shares of the firm as weight for the OLS; "Weighted by Firm Assets" uses the entrepreneur's firm assets according to his/her shares of the firm as weight for the OLS.

Table 9: Entrepreneurs' Initial wealth, Initial Firm Size, and Firm growth

	(1)	(2)	(3)	(4)	(5)
	Y growth rates	**Assets growth rates**	**Employee growth rates**	**TFPQ growth rates**	**TFPR growth rates**
I(Initial Firm Size $\{Q_2\}$ **)**	-0.130***	-0.0845***	-0.0306***	-0.0481***	-0.0277***
	(0.0301)	(0.0154)	(0.00882)	(0.00816)	(0.00610)
I (Initial Firm Size $\{Q_3\}$	-0.155***	-0.163***	-0.0648***	-0.0606***	-0.0189***
	(0.0115)	(0.0156)	(0.00883)	(0.00847)	(0.00631)
I (Initial Firm Size $\{Q_4\}$	-0.200***	-0.227***	-0.0771***	-0.0756***	-0.0196***
	(0.0146)	(0.0185)	(0.0105)	(0.0101)	(0.00748)
I(Initial Wealth Rich)	-0.00373	0.0743***	-0.0316**	-0.0875***	-0.0520***
	(0.0259)	(0.0256)	(0.0153)	(0.0130)	(0.00859)
I (Initial Firm Size $\{Q_2\}$ **) × I(Initial Wealth Rich)**	0.00204	-0.00936	0.0294*	0.0148	0.00398
	(0.0417)	(0.0303)	(0.0179)	(0.0158)	(0.0111)
I(Initial Firm Size $\{Q_3\}$ **) × I(Initial Wealth Rich)**	0.00266	0.00907	0.0327*	0.00952	-0.00325
	(0.0427)	(0.0292)	(0.0176)	(0.0155)	(0.0108)
I(Initial Firm Size $\{Q_4\}$ **) × I(Initial Wealth Rich)**	-0.0327	-0.0275	0.00761	0.0124	0.00344
	(0.0285)	(0.0305)	(0.0185)	(0.0163)	(0.0110)
Observations	73,576	73,576	62,852	67,758	67,758
Year dummies	YES	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES	YES
Firm Age dummies	YES	YES	YES	YES	YES
adjusted R-squared	-0.00119	0.0669	0.230	0.0803	0.0276

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

NOTE: In this table we report the relation between Firm growth and Entrepreneurs' wealth, Initial Firm Size. The sample requirement is the same as before: entrepreneurs associated with newly founded firms that have positive wage bills and positive number of employees, TFPQ outliers are excluded. **Initial Firm Size** are measured with real, book value of total firm assets, and we use dummies variable to represent its 4 quartile values; for example, $\{Q_2\}$ refers to the firms with initial assets between the 25th and 50th percentiles of the cross-sectional distribution; $\{Q_1\}$ is the benchmark category and being omitted.

Table 10: Firm productivity on Entrepreneurs' Characteristics

TFPQ	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
I(College graduate)	0.0709***							
	(0.00358)							
Prior Labor Income$_{t-5}$		0.0524***						
		(0.00153)						
Had being Entrepreneur$_{t-5}$			0.0210***					
			(0.00396)					
#. of years in Entrepreneur$_{t-5}$				0.00485***				
				(0.000561)				
I(Father College graduate)					-0.00169			
					(0.00339)			
I(Mother College graduate)						-0.00376		
						(0.00338)		
Parent's income$_{t-5}$							0.0771***	
							(0.00471)	
Parent's wealth$_{t-5}$								0.0367***
								(0.00216)
Age$_{t-5}$	0.0111***	0.0200***	0.0114***	0.0113***	0.0119***	0.0118***	0.0251***	0.0236***
	(0.00110)	(0.00128)	(0.00110)	(0.00110)	(0.00110)	(0.00111)	(0.00222)	(0.00222)
Age Squared$_{t-5}$**(/100)**	-0.0169***	-0.0273***	-0.0173***	-0.0176***	-0.0176***	-0.0175***	-0.0329***	-0.0333***
	(0.00131)	(0.00157)	(0.00131)	(0.00131)	(0.00132)	(0.00133)	(0.00302)	(0.00303)
Married$_{t-5}$	0.0408***	0.0383***	0.0393***	0.0392***	0.0391***	0.0389***	0.0440***	0.0435***
	(0.00409)	(0.00443)	(0.00409)	(0.00410)	(0.00411)	(0.00411)	(0.00527)	(0.00528)
Obs.	166,146	138,679	166,146	166,146	166,146	166,146	81,542	81,087
R-squared	0.015	0.024	0.012	0.013	0.012	0.012	0.021	0.021
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

NOTE: In this table we report the OLS estimates by regressing Firm productivity, TFPQ (in logs) on entrepreneurs' characteristics. **TFPQ** are in logs, and net of 3-digit industry fixed effects and year fixed effects. The sample requirement is the same as before: entrepreneurs associated with firms that have positive wage bills and positive number of employees, TFPQ outliers are excluded, and we select the firm that the entrepreneur stays the longest if he/she has multiple firms in the same year. **Had being Entrepreneur** equals 1 if the entrepreneur had any entrepreneur experience before and 0 otherwise. **#. of years in Entrepreneur** records the number of years with entrepreneur experience in the history. **Prior Labor Income** is the labor market wages prior the entrepreneur experience; in particular, wages (log, real labor earnings) are first net of age, age squared, and year fixed effects, and then for each individual we compute the 3-years moving averages of residual wages to avoid sometimes we may have missing observations on predicated wages.

5.4 Empirical Analysis: owner incentives and portfolios

5.4.1 Owner portfolios in wealth

Figure 20: Private Equity/HH Wealth and Firm Productivity

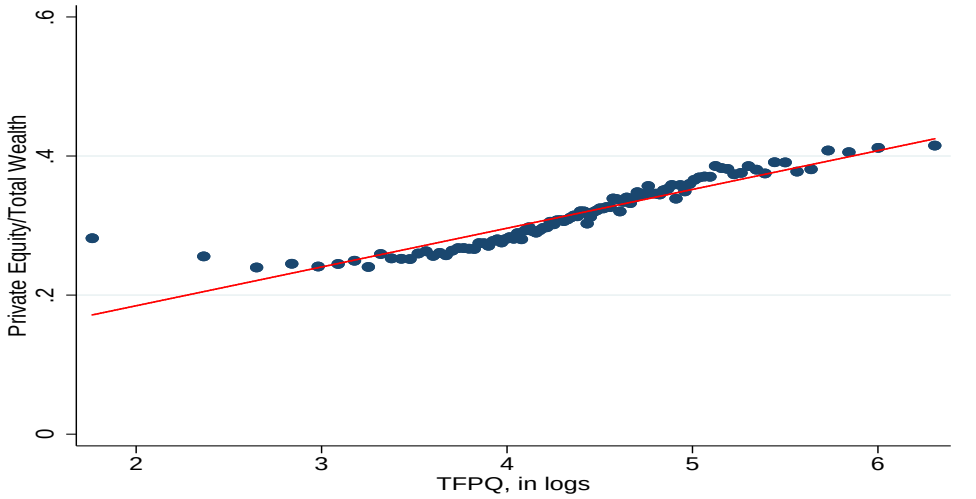
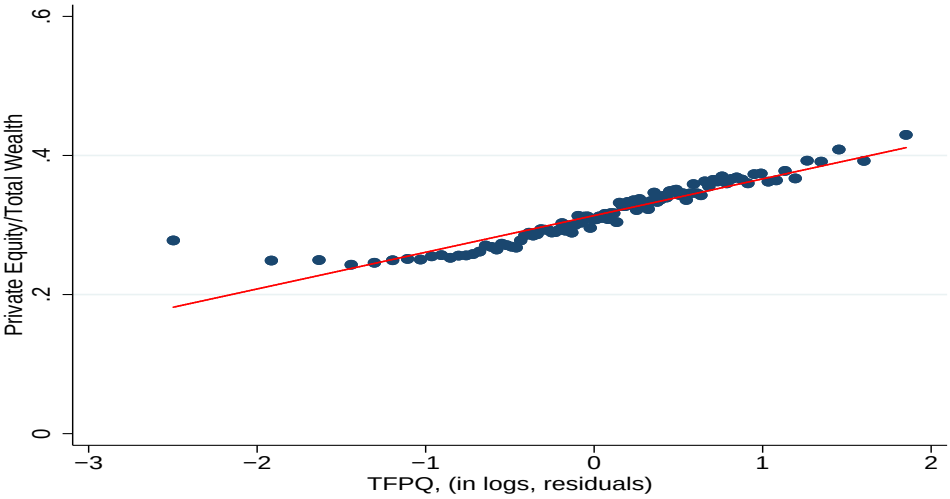


Figure 21: Private Equity/HH Wealth and Firm Productivity (residuals)



NOTE: This figure shows the raw data for Private Equity/HH Wealth ratio and entrepreneurs' firm productivity. The sample is restricted to entrepreneurs who have owner shares bigger than 99% in his firms, and the entrepreneur should be active owner and manager. "Private Equity/HH Wealth" computes the owner' share in firm equity (in book value) to the reported, total household-level gross wealth. For other details on variable definitions and sample selections, please see the body text. "Firm Productivity (residuals)" refer to TFPQ (in logs) net of year fixed effects, 3-digit industry fixed effects and firm age fixed effects.

Table 11: Entrepreneur portfolio and Firm performance; Pooling OLS

TFPQ	**No size**	**Firm size**	**Benchmark**	**Young firms**	**Mature firms**	**Small shares**	**Large shares**	**Other HH**	**Top rich HH**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Portfolio ratios def. 1; Sample 1									
I $\{Q_2\}$	0.162***	0.162***	0.405***	0.385***	0.412***	0.530***	0.573***	0.123***	0.469***
	(0.0128)	(0.0128)	(0.0121)	(0.0158)	(0.0188)	(0.0135)	(0.0262)	(0.0249)	(0.0137)
I $\{Q_3\}$	0.247***	0.256***	0.676***	0.682***	0.650***	0.983***	1.014***	0.396***	0.752***
	(0.0125)	(0.0125)	(0.0120)	(0.0157)	(0.0187)	(0.0140)	(0.0261)	(0.0242)	(0.0137)
I $\{Q_4\}$	0.424***	0.452***	1.027***	1.060***	0.965***	1.456***	1.467***	0.824***	1.048***
	(0.0125)	(0.0126)	(0.0122)	(0.0160)	(0.0190)	(0.0154)	(0.0264)	(0.0242)	(0.0142)
Observations	169,723	169,723	169,691	95,719	73,972	60,816	108,875	65,089	104,602
adjusted R-squared	0.0956	0.0988	0.271	0.290	0.252	0.395	0.306	0.238	0.226
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES
Portfolio ratios def. 2; Sample 1									
I $\{Q_2\}$	0.117***	0.117***	0.465***	0.457***	0.455***	0.567***	0.603***	0.152***	0.494***
I $\{Q_3\}$	0.140***	0.143***	0.701***	0.710***	0.670***	0.945***	1.007***	0.388***	0.741***
I $\{Q_4\}$	0.222***	0.231***	1.008***	1.031***	0.953***	1.296***	1.388***	0.752***	1.000***
Portfolio ratios def. 3; Sample 1									
I $\{Q_2\}$	0.179***	0.179***	0.400***	0.379***	0.411***	0.531***	0.562***	0.137***	0.468***
I $\{Q_3\}$	0.273***	0.283***	0.673***	0.678***	0.651***	0.980***	1.004***	0.411***	0.752***
I $\{Q_4\}$	0.459***	0.490***	1.022***	1.053***	0.965***	1.453***	1.456***	0.832***	1.049***
Portfolio ratios def. 1; Sample 2									
I $\{Q_2\}$	0.0969***	0.0968***	0.370***	0.371***	0.346***	0.509***	0.558***	0.172***	0.397***
I $\{Q_3\}$	0.163***	0.163***	0.620***	0.653***	0.559***	0.949***	1.009***	0.424***	0.653***
I $\{Q_4\}$	0.317***	0.316***	0.936***	0.995***	0.841***	1.415***	1.460***	0.823***	0.911***
Portfolio ratios def. 2; Sample 2									
I $\{Q_2\}$	0.0484***	0.0485***	0.398***	0.407***	0.361***	0.528***	0.559***	0.203***	0.404***
I $\{Q_3\}$	0.0586***	0.0556***	0.616***	0.643***	0.556***	0.910***	0.975***	0.421***	0.627***
I $\{Q_4\}$	0.115***	0.107***	0.887***	0.931***	0.805***	1.269***	1.349***	0.756***	0.849***
Portfolio ratios def. 3; Sample 2									
I $\{Q_2\}$	0.113***	0.113***	0.367***	0.369***	0.345***	0.505***	0.555***	0.175***	0.398***
I $\{Q_3\}$	0.191***	0.191***	0.621***	0.653***	0.561***	0.943***	1.010***	0.430***	0.658***
I $\{Q_4\}$	0.353***	0.354***	0.935***	0.994***	0.842***	1.410***	1.459***	0.824***	0.916***
Portfolio ratios def. 1; Sample 3									
I $\{Q_2\}$	0.130***	0.131***	0.386***	0.376***	0.379***	0.523***	0.546***	0.165***	0.421***
I $\{Q_3\}$	0.205***	0.209***	0.647***	0.667***	0.604***	0.969***	1.001***	0.431***	0.689***
I $\{Q_4\}$	0.371***	0.382***	0.980***	1.027***	0.902***	1.443***	1.453***	0.844***	0.966***
Portfolio ratios def. 2; Sample 3									
I $\{Q_2\}$	0.0756***	0.0754***	0.420***	0.418***	0.400***	0.547***	0.548***	0.204***	0.431***
I $\{Q_3\}$	0.0945***	0.0934***	0.650***	0.664***	0.609***	0.927***	0.969***	0.438***	0.667***
I $\{Q_4\}$	0.160***	0.157***	0.937***	0.968***	0.874***	1.292***	1.344***	0.789***	0.905***
Portfolio ratios def. 3; Sample 3									
I $\{Q_2\}$	0.147***	0.148***	0.383***	0.370***	0.382***	0.520***	0.542***	0.174***	0.421***
I $\{Q_3\}$	0.232***	0.237***	0.646***	0.663***	0.609***	0.962***	0.998***	0.443***	0.691***
I $\{Q_4\}$	0.407***	0.420***	0.977***	1.021***	0.906***	1.438***	1.448***	0.850***	0.969***

NOTE: This table reports the results of regressing firm productivity on entrepreneurs' portfolio ratio using simple OLS with pooled data. In this table, we have different sample selection requirements: (1) The sample is restricted to entrepreneurs with owner shares bigger than 51%; (2) The entrepreneurs' owner shares should be bigger than 33%; (3) The sample is restricted to either entrepreneurs with owner shares bigger than 33%, or entrepreneurs could have lower shares but stay the longest with the firm among all of the firm's entrepreneurs. "owner portfolio ratio" is measured with different definitions: (1) the owner' share in firm equity (in book value) to the reported, total household-level gross wealth; (2) the owner' share firm equity to the reported, total household-level financial wealth (gross wealth net of the reported value of housing and other real estate); (3) the owner' share firm equity to the adjusted, total household-level gross wealth (housing values in the registry data before 2010 are adjusted upward by 30%). For each measure, we then find the 4 quartile values for the cross-sectional distribution, and use dummy variables to indicate each category respectively. "**Benchmark** " includes firm total assets (in logs) and household total wealth as controls; "**No size** " are without these controls. "**Young firms** " requires that firm age is less than 10, and "**Mature firms** " is for firm age greater than 10. "**Small shares** " requires that owner's shares times firm equity/assets ratio is less than the median value of the cross-sectional distribution, and "**Large shares** " is for those above the median. "**Top rich HH** " requires that entrepreneurs should have wealth greater than 90% of the households in the population; otherwise, entrepreneurs are labelled as "**Other HH** ".

Table 12: Entrepreneur portfolio and Firm performance; Controlling for Firm fixed effects

TFPQ	**No size**	**Benchmark**	**Young firms**	**Mature firms**	**Small firms**	**Large firms**	**Other HH**	**Top rich HH**
Portfolio ratios; Definition 1								
I $\{Q_2\}$	0.184***	0.222***	0.221***	0.216***	0.241***	0.182***	0.154***	0.230***
	(0.00796)	(0.00738)	(0.0105)	(0.0110)	(0.00968)	(0.0129)	(0.0169)	(0.00868)
I $\{Q_3\}$	0.289***	0.380***	0.410***	0.351***	0.424***	0.306***	0.372***	0.368***
	(0.00829)	(0.00776)	(0.0110)	(0.0116)	(0.0103)	(0.0134)	(0.0169)	(0.00944)
I $\{Q_4\}$	0.417***	0.585***	0.642***	0.526***	0.661***	0.474***	0.635***	0.536***
	(0.00862)	(0.00820)	(0.0117)	(0.0122)	(0.0111)	(0.0139)	(0.0173)	(0.0102)
Observations	290,439	290,393	154,943	135,450	146,557	143,836	104,872	185,521
adjusted R-squared	0.663	0.706	0.705	0.738	0.717	0.720	0.673	0.706
Portfolio ratios; Definition 2								
I $\{Q_2\}$	0.155***	0.209***	0.215***	0.189***	0.234***	0.164***	0.220***	0.204***
	(0.00823)	(0.00768)	(0.0111)	(0.0111)	(0.0104)	(0.0129)	(0.0265)	(0.00835)
I $\{Q_3\}$	0.237***	0.345***	0.374***	0.312***	0.388***	0.275***	0.414***	0.329***
	(0.00863)	(0.00814)	(0.0118)	(0.0117)	(0.0111)	(0.0135)	(0.0265)	(0.00912)
I $\{Q_4\}$	0.359***	0.540***	0.595***	0.477***	0.609***	0.437***	0.652***	0.490***
	(0.00886)	(0.00851)	(0.0124)	(0.0124)	(0.0117)	(0.0140)	(0.0266)	(0.00989)
Observations	290,439	290,393	154,943	135,450	146,557	143,836	104,872	185,521
adjusted R-squared	0.661	0.704	0.702	0.737	0.715	0.719	0.668	0.705
Portfolio ratios; Definition 3								
I $\{Q_2\}$	0.189***	0.224***	0.219***	0.224***	0.242***	0.187***	0.162***	0.232***
	(0.00789)	(0.00731)	(0.0102)	(0.0110)	(0.00950)	(0.0128)	(0.0161)	(0.00871)
I $\{Q_3\}$	0.295***	0.383***	0.409***	0.360***	0.425***	0.313***	0.378***	0.372***
	(0.00823)	(0.00768)	(0.0108)	(0.0116)	(0.0101)	(0.0134)	(0.0161)	(0.00945)
I $\{Q_4\}$	0.421***	0.585***	0.637***	0.534***	0.658***	0.480***	0.638***	0.538***
	(0.00857)	(0.00812)	(0.0115)	(0.0123)	(0.0110)	(0.0138)	(0.0165)	(0.0102)
Observations	290,439	290,393	154,943	135,450	146,557	143,836	104,872	185,521
adjusted R-squared	0.663	0.705	0.704	0.738	0.717	0.720	0.672	0.706
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

NOTE: This table reports the results of regressing firm productivity on entrepreneurs' portfolio ratio using fixed effect model. In this table, the sample is restricted to entrepreneurs with owner shares bigger than 51%. "owner portfolio ratio" is measured with different definitions: (1) the owner' share firm equity (in book value) to the reported, total household-level gross wealth; (2) the owner' share firm equity to the reported, total household-level financial wealth (gross wealth net of the reported value of housing and other real estate); (3) the owner' share firm equity to the adjusted, total household-level gross wealth (housing values in the registry data before 2010 are adjusted upward by 30%). For each measure, we then find the 4 quartile values for the cross-sectional distribution, and use dummy variables to indicate respectively. "**Benchmark** " includes firm total assets (in logs) and household total wealth as controls; "**No size** " are without these controls. "**Young firms** " requires that firm age is less than 10, and "**Mature firms** " is for firm age greater than 10. "**Small firms** " requires that firm assets is less than the median value of the cross-sectional distribution, and "**Large firms** " is for those firms above the median. "**Top rich HH** " requires that entrepreneurs should have wealth greater than 90% of the households in the population; otherwise, entrepreneurs are labelled as "**Other HH** ".

Table 13: Entrepreneur portfolio and Firm performance; Controlling for Firm fixed effects; con't; (alternative sample selection 1)

TFPQ	**No size**	**Benchmark**	**Young firms**	**Mature firms**	**Small firms**	**Large firms**	**Other HH**	**Top rich HH**
Portfolio ratios; Definition 1								
I $\{Q_2\}$	0.160***	0.216***	0.222***	0.191***	0.226***	0.186***	0.167***	0.220***
	(0.00535)	(0.00503)	(0.00697)	(0.00763)	(0.00657)	(0.00866)	(0.0113)	(0.00607)
I $\{Q_3\}$	0.255***	0.374***	0.408***	0.320***	0.405***	0.316***	0.376***	0.359***
	(0.00563)	(0.00538)	(0.00754)	(0.00813)	(0.00717)	(0.00915)	(0.0114)	(0.00676)
I $\{Q_4\}$	0.368***	0.573***	0.633***	0.487***	0.637***	0.480***	0.628***	0.519***
	(0.00592)	(0.00584)	(0.00828)	(0.00878)	(0.00805)	(0.00964)	(0.0118)	(0.00752)
Observations	440,908	440,827	240,337	200,490	217,756	223,071	169,628	271,199
adjusted R-squared	0.673	0.715	0.713	0.748	0.727	0.729	0.688	0.716
Portfolio ratios; Definition 2								
I $\{Q_2\}$	0.135***	0.205***	0.213***	0.174***	0.215***	0.177***	0.204***	0.202***
	(0.00547)	(0.00519)	(0.00737)	(0.00760)	(0.00708)	(0.00848)	(0.0166)	(0.00583)
I $\{Q_3\}$	0.207***	0.340***	0.367***	0.290***	0.365***	0.291***	0.380***	0.327***
	(0.00575)	(0.00559)	(0.00801)	(0.00816)	(0.00773)	(0.00904)	(0.0167)	(0.00653)
I $\{Q_4\}$	0.316***	0.527***	0.578***	0.448***	0.574***	0.450***	0.603***	0.481***
	(0.00596)	(0.00597)	(0.00856)	(0.00876)	(0.00835)	(0.00951)	(0.0169)	(0.00731)
Observations	440,908	440,827	240,337	200,490	217,756	223,071	169,628	271,199
adjusted R-squared	0.672	0.712	0.710	0.747	0.724	0.728	0.683	0.715
Portfolio ratios; Definition 3								
I $\{Q_2\}$	0.164***	0.216***	0.220***	0.193***	0.225***	0.187***	0.169***	0.221***
	(0.00533)	(0.00499)	(0.00686)	(0.00767)	(0.00647)	(0.00863)	(0.0107)	(0.00610)
I $\{Q_3\}$	0.261***	0.376***	0.408***	0.325***	0.406***	0.320***	0.378***	0.362***
	(0.00561)	(0.00534)	(0.00743)	(0.00818)	(0.00708)	(0.00911)	(0.0109)	(0.00678)
I $\{Q_4\}$	0.373***	0.572***	0.630***	0.490***	0.632***	0.484***	0.628***	0.520***
	(0.00591)	(0.00581)	(0.00818)	(0.00883)	(0.00799)	(0.00960)	(0.0113)	(0.00753)
Observations	440,908	440,827	240,337	200,490	217,756	223,071	169,628	271,199
adjusted R-squared	0.673	0.715	0.713	0.748	0.727	0.729	0.688	0.716
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

NOTE: This table reports the results of regressing firm productivity on entrepreneurs' portfolio ratio using fixed effect model. In this table, the sample is restricted to entrepreneurs with owner shares bigger than 33% (relaxed comparing to the previous requirement). "owner portfolio ratio" is measured with different definitions: (1) the owner' share firm equity (in book value) to the reported, total household-level gross wealth; (2) the owner' share firm equity to the reported, total household-level financial wealth (gross wealth net of the reported value of housing and other real estate); (3) the owner' share firm equity to the adjusted, total household-level gross wealth (housing values in the registry data before 2010 are adjusted upward by 30%). For each measure, we then find the 4 quartile values for the cross-sectional distribution, and use dummy variables to indicate respectively. "**Benchmark** " includes firm total assets (in logs) and household total wealth as controls; "**No size** " are without these controls. "**Young firms** " requires that firm age is less than 10, and "**Mature firms** " is for firm age greater than 10. "**Small firms** " requires that firm assets is less than the median value of the cross-sectional distribution, and "**Large firms** " is for those firms above the median. "**Top rich HH** " requires that entrepreneurs should have wealth greater than 90% of the households in the population; otherwise, entrepreneurs are labelled as "**Other HH** ".

Table 14: Entrepreneur portfolio and Firm performance; Controlling for Firm fixed effects; con't; (alternative sample selection 2)

$TFPQ$	No size	Benchmark	Young firms	Mature firms	Small firms	Large firms	Other HH	Top rich HH
Portfolio ratios; Definition 1								
I $\{Q_2\}$	0.161***	0.212***	0.217***	0.193***	0.221***	0.186***	0.159***	0.218***
	(0.00538)	(0.00503)	(0.00698)	(0.00760)	(0.00656)	(0.00871)	(0.0110)	(0.00607)
I $\{Q_3\}$	0.260***	0.372***	0.405***	0.324***	0.401***	0.317***	0.368***	0.357***
	(0.00567)	(0.00539)	(0.00755)	(0.00811)	(0.00715)	(0.00920)	(0.0111)	(0.00676)
I $\{Q_4\}$	0.377***	0.571***	0.630***	0.491***	0.634***	0.481***	0.619***	0.517***
	(0.00598)	(0.00583)	(0.00827)	(0.00875)	(0.00800)	(0.00966)	(0.0115)	(0.00751)
Observations	444,636	444,557	242,826	201,731	219,726	224,831	172,032	272,525
adjusted R-squared	0.672	0.714	0.712	0.748	0.727	0.728	0.688	0.716
Portfolio ratios; Definition 2								
I $\{Q_2\}$	0.140***	0.205***	0.213***	0.175***	0.215***	0.178***	0.206***	0.201***
	(0.00554)	(0.00524)	(0.00743)	(0.00766)	(0.00714)	(0.00859)	(0.0163)	(0.00586)
I $\{Q_3\}$	0.217***	0.342***	0.370***	0.295***	0.366***	0.294***	0.384***	0.327***
	(0.00586)	(0.00564)	(0.00806)	(0.00822)	(0.00778)	(0.00915)	(0.0164)	(0.00655)
I $\{Q_4\}$	0.328***	0.530***	0.582***	0.453***	0.577***	0.452***	0.608***	0.481***
	(0.00607)	(0.00601)	(0.00858)	(0.00882)	(0.00838)	(0.00960)	(0.0166)	(0.00733)
Observations	444,636	444,557	242,826	201,731	219,726	224,831	172,032	272,525
adjusted R-squared	0.671	0.712	0.710	0.747	0.724	0.727	0.683	0.715
Portfolio ratios; Definition 3								
I $\{Q_2\}$	0.164***	0.212***	0.215***	0.195***	0.219***	0.189***	0.160***	0.219***
	(0.00535)	(0.00500)	(0.00688)	(0.00764)	(0.00646)	(0.00868)	(0.0106)	(0.00609)
I $\{Q_3\}$	0.265***	0.373***	0.405***	0.328***	0.400***	0.323***	0.369***	0.360***
	(0.00565)	(0.00535)	(0.00745)	(0.00816)	(0.00706)	(0.00917)	(0.0107)	(0.00678)
I $\{Q_4\}$	0.380***	0.570***	0.626***	0.494***	0.629***	0.486***	0.619***	0.518***
	(0.00597)	(0.00580)	(0.00818)	(0.00880)	(0.00794)	(0.00964)	(0.0112)	(0.00753)
Observations	444,636	444,557	242,826	201,731	219,726	224,831	172,032	272,525
adjusted R-squared	0.672	0.714	0.712	0.748	0.727	0.728	0.688	0.716
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

NOTE: This table reports the results of regressing firm productivity on entrepreneurs' portfolio ratio using fixed effect model. In this table, the sample is restricted to either entrepreneurs with owner shares bigger than 33%, or entrepreneurs could have lower shares but stay the longest with the firm among all of the firm's entrepreneurs. "owner portfolio ratio" is measured with different definitions: (1) the owner' share firm equity (in book value) to the reported, total household-level gross wealth; (2) the owner' share firm equity to the reported, total household-level financial wealth (gross wealth net of the reported value of housing and other real estate); (3) the owner' share firm equity to the adjusted, total household-level gross wealth (housing values in the registry data before 2010 are adjusted upward by 30%). For each measure, we then find the 4 quartile values for the cross-sectional distribution, and use dummy variables to indicate respectively. "**Benchmark** " includes firm total assets (in logs) and household total wealth as controls; "**No size** " are without these controls. "**Young firms** " requires that firm age is less than 10, and "**Mature firms** " is for firm age greater than 10. "**Small firms** " requires that firm assets is less than the median value of the cross-sectional distribution, and "**Large firms** " is for those firms above the median. "**Top rich HH** " requires that entrepreneurs should have wealth greater than 90% of the households in the population; otherwise, entrepreneurs are labelled as "**Other HH** ".

Table 15: Risk-free assets share and Firm Productivity; Pooling OLS

Risk-free assets share	No size	Firm size	Young firms	Mature firms	Small shares	Large shares	Other HH	Top rich HH
Sample 1								
TFPQ, **in (logs)**	-0.0156***	-0.0164***	-0.00920***	-0.0239***	-0.0178***	-0.0152***	0.00736***	-0.00217*
	(0.00108)	(0.00106)	(0.00145)	(0.00157)	(0.00183)	(0.00132)	(0.00195)	(0.00129)
Observations	171,180	171,180	96,715	74,465	61,864	109,316	66,147	105,033
adjusted R-squared	0.0407	0.0550	0.0489	0.0648	0.0546	0.0519	0.0265	0.0667
Sample 2								
TFPQ, **in (logs)**	-0.0176***	-0.0157***	-0.0129***	-0.0182***	-0.0147***	-0.0146***	0.00667***	-0.00162*
	(0.000778)	(0.000769)	(0.00108)	(0.00110)	(0.00114)	(0.00106)	(0.00145)	(0.000920)
Observations	309,257	309,257	165,040	144,217	148,438	160,819	111,162	198,095
adjusted R-squared	0.0338	0.0499	0.0454	0.0555	0.0437	0.0505	0.0247	0.0564
Sample 3								
TFPQ, **in (logs)**	-0.0177***	-0.0167***	-0.0132***	-0.0197***	-0.0163***	-0.0158***	0.00695***	-0.00259***
	(0.000822)	(0.000812)	(0.00114)	(0.00117)	(0.00127)	(0.00107)	(0.00153)	(0.000977)
Observations	283,929	283,929	152,205	131,724	123,453	160,476	103,566	180,363
adjusted R-squared	0.0351	0.0514	0.0459	0.0593	0.0460	0.0508	0.0251	0.0601
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES	YES	YES	YES	YES
Firm age dummies	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

NOTE: This table reports the results of regressing entrepreneurs' *Riskfreeassetsshare* on firm productivity using simple OLS with pooled data. In this table, we have different sample selection requirements: (1) The sample is restricted to entrepreneurs with owner shares bigger than 51%; (2) The entrepreneurs' owner shares should be bigger than 33%; (3) The sample is restricted to either entrepreneurs with owner shares bigger than 33%, or entrepreneurs could have lower shares but stay the longest with the firm among all of the firm's entrepreneurs. "*Riskfreeassetsshare* " refers to the share of risk-free assets (cash and banking deposits) relative to total financial assets (including stocks and mutual fund shares). For the columns, "**No size** " are without controls on firm size in assets. "**Young firms** " requires that firm age is less than 10, and "**Mature firms** " is for firm age greater than 10. "**Small shares** " requires that owner's shares times firm equity/assets ratio is less than the median value of the cross-sectional distribution, and "**Large shares** " is for those above the median. "**Top rich HH** " requires that entrepreneurs should have wealth greater than 90% of the households in the population; otherwise, entrepreneurs are labelled as "**Other HH** ".

Table 16: Risk-free assets share and Wealth percentile

Risk-free assets share	(1)	**Productivity**	**Firm size**
Wealth, 10%-20%	-0.0579***	-0.0579***	-0.0590***
	(0.0150)	(0.0150)	(0.0151)
Wealth, 20%-30%	-0.183***	-0.184***	-0.188***
	(0.0137)	(0.0137)	(0.0138)
Wealth, 30%-40%	-0.249***	-0.249***	-0.253***
	(0.0127)	(0.0126)	(0.0127)
Wealth, 40%-50%	-0.300***	-0.301***	-0.304***
	(0.0121)	(0.0121)	(0.0121)
Wealth, 50%-60%	-0.332***	-0.334***	-0.337***
	(0.0117)	(0.0117)	(0.0118)
Wealth, 60%-70%	-0.356***	-0.358***	-0.361***
	(0.0115)	(0.0115)	(0.0116)
Wealth, 70%-80%	-0.388***	-0.391***	-0.393***
	(0.0114)	(0.0113)	(0.0114)
Wealth, 80%-90%	-0.427***	-0.431***	-0.432***
	(0.0113)	(0.0112)	(0.0113)
Wealth, 90%-95%	-0.461***	-0.466***	-0.465***
	(0.0113)	(0.0112)	(0.0113)
Wealth, 95%-99%	-0.502***	-0.510***	-0.503***
	(0.0113)	(0.0112)	(0.0113)
Wealth, 99%-99.9%	-0.570***	-0.582***	-0.565***
	(0.0113)	(0.0113)	(0.0113)
Wealth, 99.9%-100%	-0.679***	-0.694***	-0.665***
	(0.0116)	(0.0116)	(0.0117)
$TFPQ$**, in (logs)**		0.0149***	0.0125***
		(0.000831)	(0.000831)
Firm Assets, in (logs)			-0.0120***
			(0.000361)
Observations	283,868	283,868	283,868
adjusted R-squared	0.0941	0.0951	0.0987
Year dummies	YES	YES	YES
Industry dummies	YES	YES	YES
Firm age dummies	YES	YES	YES

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

NOTE: This table reports the results of regressing entrepreneurs' *Riskfreeassetsshare* on entrepreneurs' wealth percentile dummies, firm productivity and firm size, using simple OLS with pooled data. The sample is restricted to either entrepreneurs with owner shares bigger than 33%, or entrepreneurs could have lower shares but stay the longest with the firm among all of the firm's entrepreneurs.

Table 17: Firm leverage choices

Firm leverage	(1)	(2)	(3)
$TFPQ$**, in (logs)**	0.0173***	0.0313***	0.0258***
	(0.000536)	(0.000567)	(0.000551)
Firm size, in (logs)	0.0106***	0.0166***	0.0139***
	(0.000218)	(0.000224)	(0.000224)
Wealth, 10%-20%		0.0170	
		(0.0118)	
Wealth, 20%-30%		0.0179*	
		(0.0106)	
Wealth, 30%-40%		0.0134	
		(0.0102)	
Wealth, 40%-50%		0.0155	
		(0.0100)	
Wealth, 50%-60%		0.00869	
		(0.00991)	
Wealth, 60%-70%		0.00698	
		(0.00985)	
Wealth, 70%-80%		-0.00627	
		(0.00982)	
Wealth, 80%-90%		-0.0247**	
		(0.00980)	
Wealth, 90%-95%		-0.0454***	
		(0.00980)	
Wealth, 95%-99%		-0.0726***	
		(0.00979)	
Wealth, 99%-99.9%		-0.104***	
		(0.00983)	
Wealth, 99.9%-100%		-0.118***	
		(0.0101)	
Top rich $\times$ Risk-free assets share			-0.0206***
			(0.00157)
Risk-free assets share			0.0176***
			(0.00275)
Observations	287,452	287,181	287,027
adjusted R-squared	0.152	0.176	0.169
Year dummies	YES	YES	YES
Industry dummies	YES	YES	YES
Firm age dummies	YES	YES	YES

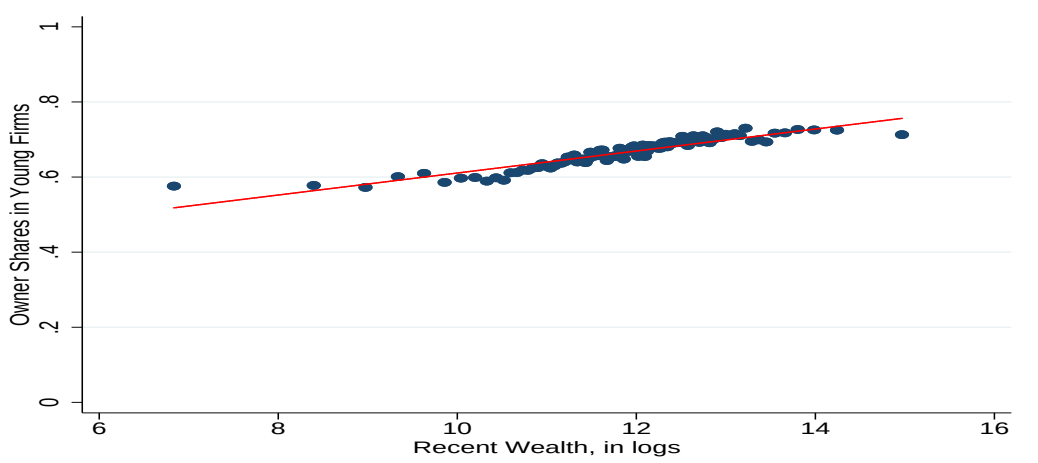
Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

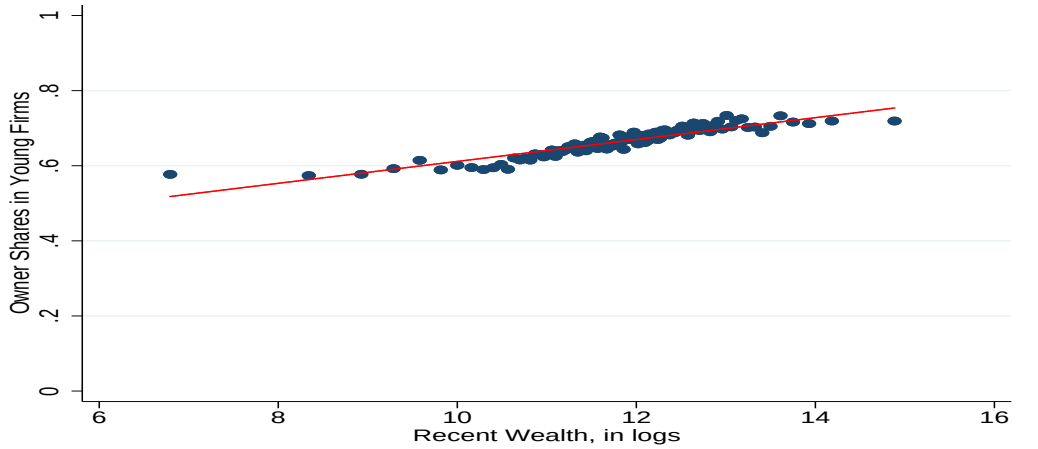
NOTE: This table reports the results of regressing firm leverages on firm productivity, firm size, and entrepreneurs' wealth percentile dummies, $Riskfreeassetsshare$, using simple OLS with pooled data. The sample is restricted to either entrepreneurs with owner shares bigger than 33%, or entrepreneurs could have lower shares but stay the longest with the firm among all of the firm's entrepreneurs.

5.4.2 Owner shares in New Firms

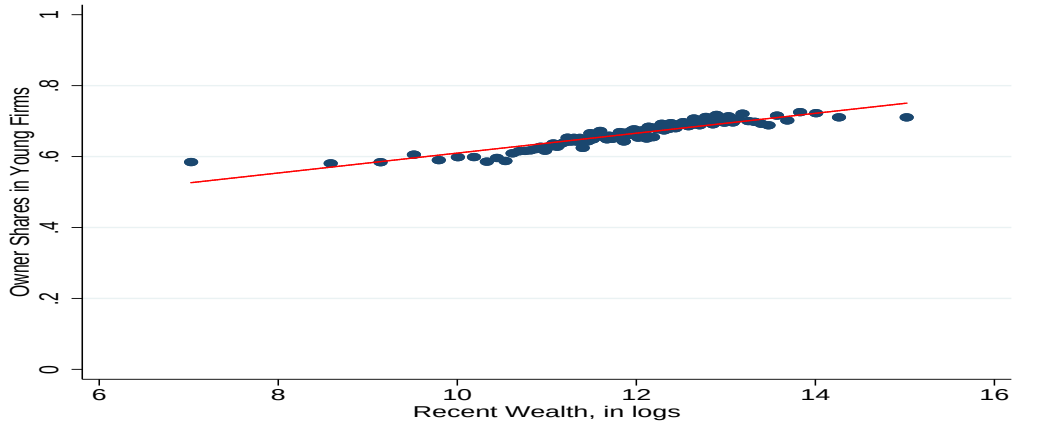
(a) Recent Wealth and Owner shares in New Firms



(b) Owner only has one firm



(c) Firm aged less than 3 years



NOTE: "Recent Wealth": We first use log of real, total HH gross wealth, net of year fixed effects, to obtain cleaned wealth; Then for each HH, we compute the averages of cleaned wealth in the past three years. We call this as "Recent Wealth". "New Firms" refers to entrepreneur firms aged less than 2 years. Upper panel plots Recent Wealth and Owner shares in New Firms for any owners; Middle panel plots that for owners who only have one firm; Bottom panel plots that for firms aged less than 3 years and is for any active owners.

Table 18: Owner shares in New Firms: regression analysis for different samples

	(1)	(2)	(3)	(4)
Owner shares		**+controlling TFPQ**	**+controlling Firm size**	**+controlling Firm leverages**
Active owner:				
Recent Wealth	0.0318***	0.0346***	0.0368***	0.0356***
	(0.000859)	(0.000871)	(0.000888)	(0.000889)
Observations	65,860	65,860	65,860	65,860
adjusted R-squared	0.0578	0.0639	0.0673	0.0706
Year dummies	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES
Firm age dummies	YES	YES	YES	YES
Owners who only have one firm:				
Recent Wealth	0.0320***	0.0345***	0.0365***	0.0353***
	(0.000890)	(0.000902)	(0.000917)	(0.000918)
Observations	61,671	61,671	61,671	61,671
adjusted R-squared	0.0596	0.0649	0.0680	0.0712
Owner shares bigger than 50%:				
Recent Wealth	0.0241***	0.0259***	0.0270***	0.0258***
	(0.000908)	(0.000925)	(0.000945)	(0.000946)
Observations	52,163	52,163	52,163	52,163
adjusted R-squared	0.0490	0.0515	0.0522	0.0553
Owners with wealth in top 90%:				
Recent Wealth	0.0176***	0.0185***	0.0212***	0.0180***
	(0.00308)	(0.00309)	(0.00314)	(0.00313)
Observations	17,707	17,707	17,707	17,707
adjusted R-squared	0.0581	0.0598	0.0613	0.0719
Owners with wealth below top 90%:				
Recent Wealth	0.0313***	0.0336***	0.0349***	0.0346***
	(0.00115)	(0.00115)	(0.00116)	(0.00116)
Observations	48,153	48,153	48,153	48,153
adjusted R-squared	0.0515	0.0612	0.0659	0.0670

NOTE: This table reports the results of regressing entrepreneurs' owner shares on "Recent Wealth" and control for firm productivity, firm size, and firm leverages, using simple OLS with pooled data. The sample is restricted to entrepreneur firms aged less than 2 years "Recent Wealth": We first use log of real, total HH gross wealth, net of year fixed effects, to obtain cleaned wealth; Then for each HH, we compute the averages of cleaned wealth in the past three years. We call this as "Recent Wealth". "**owners with wealth in top 90%** " requires that entrepreneurs should have wealth greater than 90% of the households in the population (the current period); otherwise, entrepreneurs are labelled as "**owners with wealth below top 90%**". For all regressions, we always control Year dummies, Industry dummies and Firm age dummies. Collum 1 does not have nay firm-level variables in controls; Collum 2 adds TFPQ as control; Collum 3 further adds Firm size and Collum 4 further adds Firm leverages as control variables.

Table 19: Distribution of Owner shares

	# of Obs.	Mean	S.D.	10th	25th	50th	75th	90th
Young Firms								
Wealth: $< 25\%$	32806	0.629	0.254	0.333	0.500	0.500	1.000	1.000
Wealth: $> 25\%, < 50\%$	17666	0.676	0.261	0.338	0.500	0.500	1.000	1.000
Wealth: $> 50\%, < 75\%$	11096	0.701	0.260	0.357	0.500	0.600	1.000	1.000
Wealth: $> 75\%, < 90\%$	4299	0.703	0.259	0.375	0.500	0.600	1.000	1.000
Wealth: $> 90\%$	24926	0.622	0.248	0.337	0.444	0.500	0.998	1.000
All	90793	0.648	0.257	0.333	0.500	0.500	1.000	1.000
Old Firms								
Wealth: $< 25\%$	87511	0.619	0.250	0.333	0.450	0.500	1.000	1.000
Wealth: $> 25\%, < 50\%$	102648	0.650	0.255	0.340	0.490	0.500	1.000	1.000
Wealth: $> 50\%, < 75\%$	109219	0.666	0.255	0.340	0.500	0.533	1.000	1.000
Wealth: $> 75\%, < 90\%$	67889	0.678	0.252	0.353	0.500	0.600	1.000	1.000
Wealth: $> 90\%$	140401	0.646	0.250	0.343	0.453	0.511	1.000	1.000

Table 20: Owner shares: the distribution of changes

	# of Obs.	Mean	S.D.	10th	25th	50th	75th	90th
Young Firms								
Wealth: $< 25\%$	18301	0.003	0.075	0.000	0.000	0.000	0.000	0.000
Wealth: $> 25\%, < 50\%$	10239	0.002	0.075	0.000	0.000	0.000	0.000	0.000
Wealth: $> 50\%, < 75\%$	6144	0.001	0.074	0.000	0.000	0.000	0.000	0.000
Wealth: $> 75\%, < 90\%$	2252	-0.001	0.075	0.000	0.000	0.000	0.000	0.000
Wealth: $> 90\%$	12992	-0.002	0.082	0.000	0.000	0.000	0.000	0.000
All	49928	0.001	0.077	0.000	0.000	0.000	0.000	0.000
Old Firms								
Wealth: $< 25\%$	77023	0.006	0.071	0.000	0.000	0.000	0.000	0.000
Wealth: $> 25\%, < 50\%$	91174	0.005	0.068	0.000	0.000	0.000	0.000	0.000
Wealth: $> 50\%, < 75\%$	95406	0.004	0.065	0.000	0.000	0.000	0.000	0.000
Wealth: $> 75\%, < 90\%$	57815	0.003	0.064	0.000	0.000	0.000	0.000	0.000
Wealth: $> 90\%$	116919	0.001	0.072	0.000	0.000	0.000	0.000	0.000

NOTE: In this table and Table 19, we report the summary statistics for the distribution of owner share and its changes (from year before). The sample is limited to owners of any entrepreneur firms. "Recent Wealth" is as previously defined and consequently the wealth percentiles are also computed based on "Recent Wealth". Young firms are firms aged less than 2 years.

Table 21: Distribution of Owner shares (definition 2)

	# of Obs.	Mean	S.D.	10th	25th	50th	75th	90th
Young Firms								
Wealth: $< 25\%$	32806	0.165	0.137	0.035	0.068	0.127	0.217	0.351
Wealth: $> 25\%, < 50\%$	17666	0.188	0.158	0.039	0.072	0.138	0.254	0.421
Wealth: $> 50\%, < 75\%$	11096	0.197	0.172	0.040	0.073	0.139	0.268	0.451
Wealth: $> 75\%, < 90\%$	4299	0.203	0.182	0.039	0.072	0.140	0.276	0.460
Wealth: $> 90\%$	24926	0.142	0.140	0.027	0.051	0.100	0.181	0.311
All	90793	0.169	0.151	0.034	0.064	0.122	0.222	0.374
Old Firms								
Wealth: $< 25\%$	87511	0.172	0.142	0.038	0.071	0.133	0.228	0.359
Wealth: $> 25\%, < 50\%$	102648	0.202	0.163	0.049	0.085	0.155	0.268	0.430
Wealth: $> 50\%, < 75\%$	109219	0.218	0.177	0.050	0.091	0.165	0.291	0.472
Wealth: $> 75\%, < 90\%$	67889	0.225	0.184	0.051	0.094	0.166	0.305	0.490
Wealth: $> 90\%$	140401	0.199	0.169	0.048	0.081	0.146	0.262	0.423

Table 22: Owner shares (definition 2): the distribution of changes

	# of Obs.	Mean	S.D.	10th	25th	50th	75th	90th
Young Firms								
Wealth: $< 25\%$	18301	0.012	0.133	-0.104	-0.037	0.008	0.056	0.127
Wealth: $> 25\%, < 50\%$	10239	0.016	0.141	-0.105	-0.030	0.012	0.065	0.144
Wealth: $> 50\%, < 75\%$	6143	0.024	0.135	-0.093	-0.025	0.015	0.070	0.151
Wealth: $> 75\%, < 90\%$	2252	0.029	0.191	-0.081	-0.018	0.016	0.074	0.159
Wealth: $> 90\%$	12991	0.018	0.827	-0.085	-0.024	0.007	0.049	0.115
All	49926	0.017	0.439	-0.098	-0.030	0.009	0.058	0.133
Old Firms								
Wealth: $< 25\%$	77022	0.027	0.243	-0.069	-0.019	0.012	0.054	0.125
Wealth: $> 25\%, < 50\%$	91173	0.019	0.130	-0.072	-0.020	0.010	0.050	0.115
Wealth: $> 50\%, < 75\%$	95403	0.018	0.180	-0.070	-0.018	0.010	0.049	0.112
Wealth: $> 75\%, < 90\%$	57815	0.017	0.118	-0.070	-0.017	0.008	0.047	0.113
Wealth: $> 90\%$	116918	0.015	0.194	-0.065	-0.018	0.007	0.042	0.100

NOTE: In this table and Table 21, we report the summary statistics for the distribution of owner share and its changes. "owner share" is defined differently from the previous version: here we consider the faction of owner equity relative to the firm's total book value of assets (not the firm's total equity). The sample is limited to owners of any entrepreneur firms. "Recent Wealth" is as previously defined and consequently the wealth percentiles are also computed based on "Recent Wealth". Young firms are firms aged less than 2 years.

5.5 Empirical Analysis with owner death

Table 23: Characteristics for firms with premature owner death

Year	%	Owner Age	%	Initial Wealth	%	Initial Firm Assets	%
2004	12.8	$<= 50$	23.1	$[0\%, 50\%]$	3.6	$[0\%, 10\%]$	8.3
2005	2.5	51	3.5	$(50\%, 60\%]$	3.2	$(10\%, 20\%]$	8.9
2006	17.5	52	3.4	$(60\%, 70\%]$	4.2	$(20\%, 30\%]$	10.1
2007	5.9	53	3.4	$(70\%, 80\%]$	8.4	$(30\%, 40\%]$	9.2
2008	9.8	54	3.5	$(80\%, 90\%]$	13.9	$(40\%, 50\%]$	10.6
2009	10.4	55	4.7	$(90\%, 95\%]$	13.9	$(50\%, 60\%]$	11.5
2010	11.2	56	4.7	$(95\%, 99\%]$	27.9	$(60\%, 70\%]$	11.8
2011	11.5	57	4.7	$(99\%, 99.9\%]$	20.3	$(70\%, 80\%]$	10.8
2012	18.5	58	5.4	$(99.9\%, 100\%]$	4.8	$(80\%, 90\%]$	10.4
		59	7.0			$(90\%, 95\%]$	4.6
		60	5.7			$(95\%, 100\%]$	3.8
		61	6.7				
		62	6.0				
		63	5.8				
		64	5.9				
		65	6.4				
Total	100.0		100.0		100.0		100.0
Total Num.	2,343						

NOTE: This table shows the distribution for the firms with premature owner death at the event year from different dimensions. For the details of the definition of "premature owner death" please see the body text. "Owner Age" measures the deceased owner's age at the event year. "Initial Wealth" measures the deceased owner's wealth percentile 3 years before the event year. "Initial Firm Assets" measures the treated firm's assets 3 years before the event year.

Table 24: Dynamics for firms with premature owner death

Year	$t_0 - 2$	$t_0 - 1$	t_0	$t_0 + 1$	$t_0 + 2$	$t_0 + 3$	$t_0 + 4$
Conditional Survival Prob.	99.63 %	99.78 %	92.11 %	85.09 %	84.93 %	90.71 %	92.04 %
Growth rates: Firm Assets	0.78 %	1.26 %	-2.02 %	-5.88 %	-9.63 %	-5.64 %	-3.67 %
Growth rates: Firm Revenue	-2.56 %	3.92 %	-3.02 %	-29.66 %	-52.39 %	-16.18 %	-13.22 %
Growth rates: Firm Employee	2.26 %	2.28 %	-0.59 %	-4.41 %	-11.03 %	-1.60 %	1.19 %

NOTE: This table shows the dynamics for the firms with premature owner death from different dimensions. For the details of the definition of "premature owner death" please see the body text. "t_0" denotes the event year. "Conditional Survival Prob." documents the average probability that firms can survive this year conditional on survived the year before (we call a firm survive in a year if it has registry data and not being associated with any bankruptcy, insolvency, liquidation, and other merger and acquisition activities.) Other rows report the average year-over-year growth rates for real assets, firm revenue and full-time equivalent number of employees, respectively.

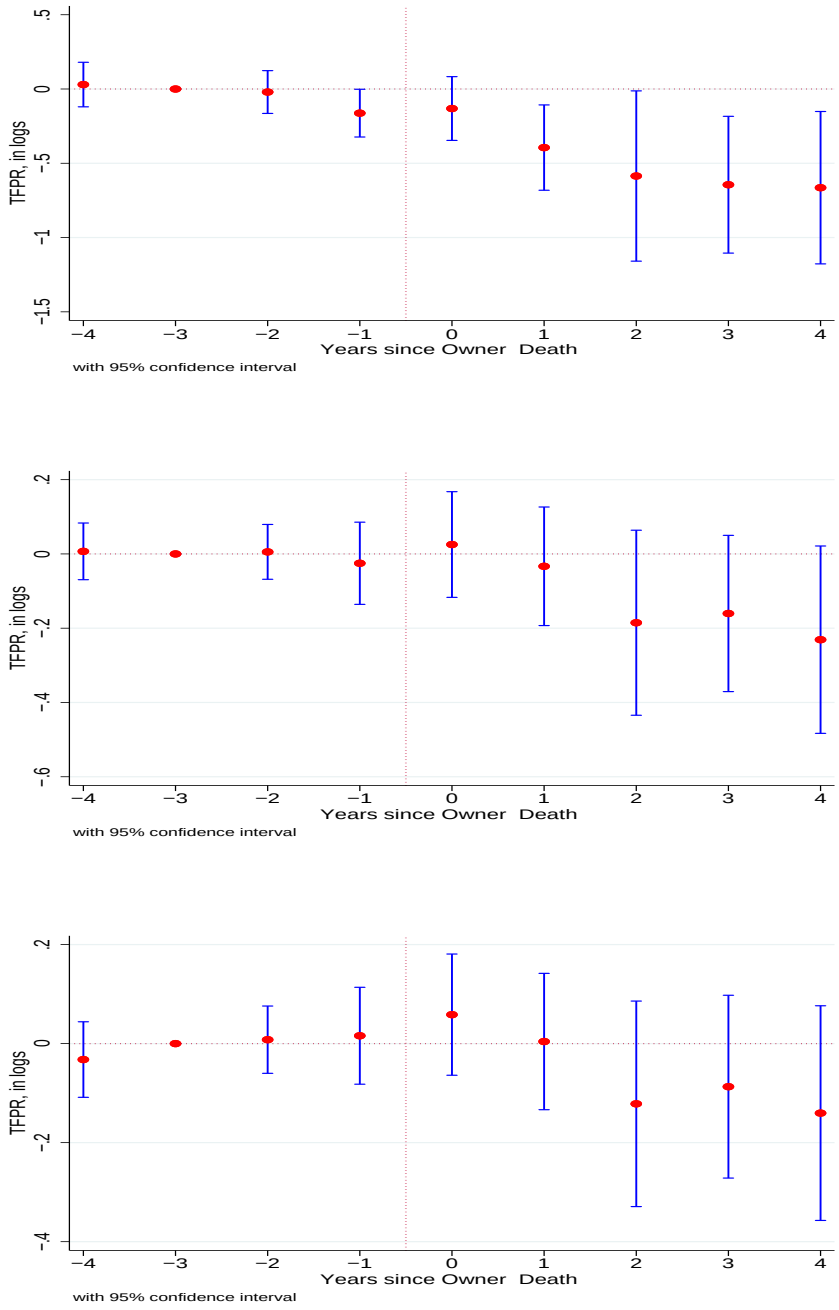


Figure 23: Firm Productivity (measured by TFPR, in logs) since Owner death: by Initial wealth (1% in Top panel, 5% in Middle panel, 10% in Lower panel)

NOTE: This figure shows the dynamics for firm productivity by using TFPR, for the firms with premature owner death. For the details of the definition of "premature owner death" please see the body text. We require that firms have should observations at least 3 years before and after the event to conduct the analysis. The top panel is for the treated firms with owners who are in the top 1% of wealth distribution; the middle panel is for the top 5% owners and the lower panel for top 10%.

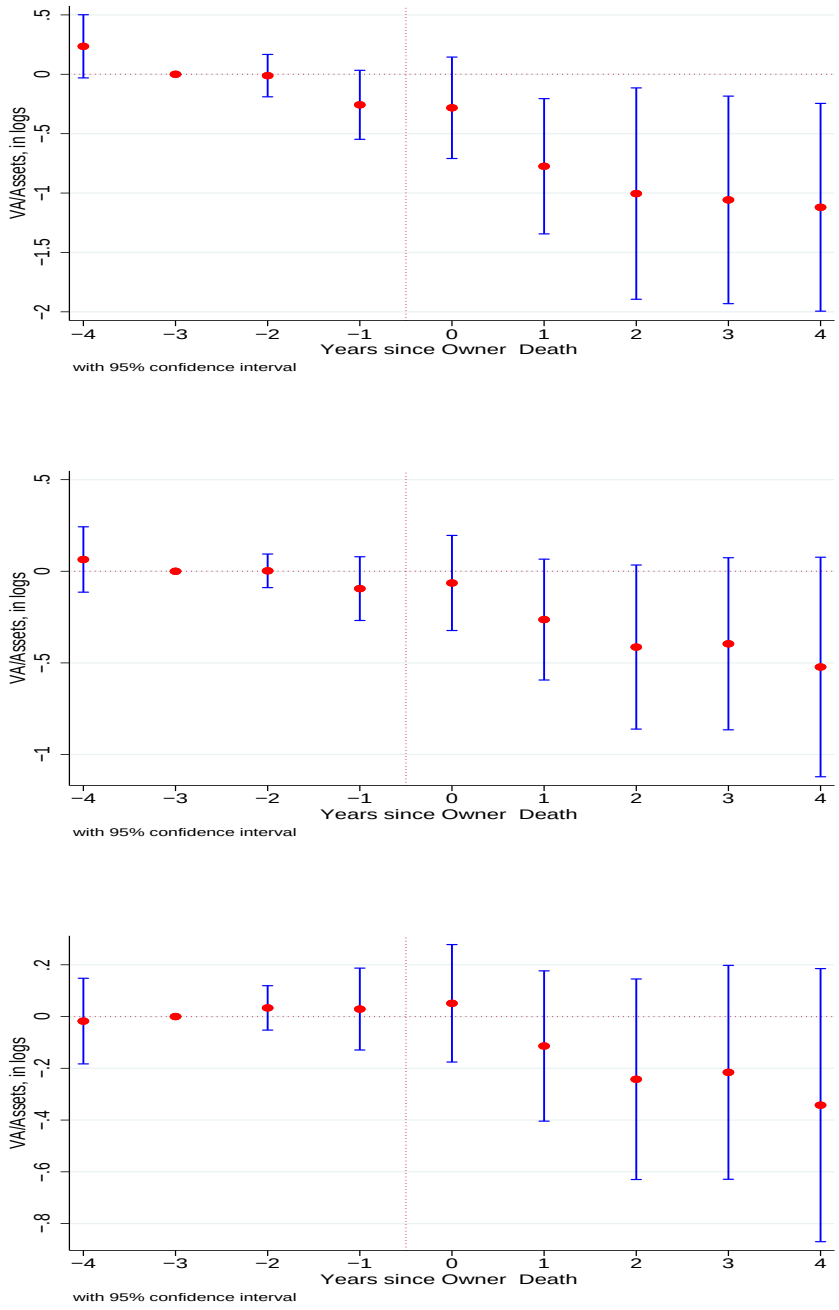


Figure 24: Firm Productivity (measured by Value Added/Assets, in logs) since Owner death: by Initial wealth (1% in Top panel, 5% in Middle panel, 10% in Lower panel)

NOTE: This figure shows the dynamics for firm productivity by using Value Added/Assets (in logs), for the firms with premature owner death. For the details of the definition of "premature owner death" please see the body text. We require that firms have should observations at least 3 years before and after the event to conduct the analysis. The top panel is for the treated firms with owners who are in the top 1% of wealth distribution; the middle panel is for the top 5% owners and the lower panel for top 10%.

5.5.1 Empirical Analysis with owner death: with firm survival prob. correction

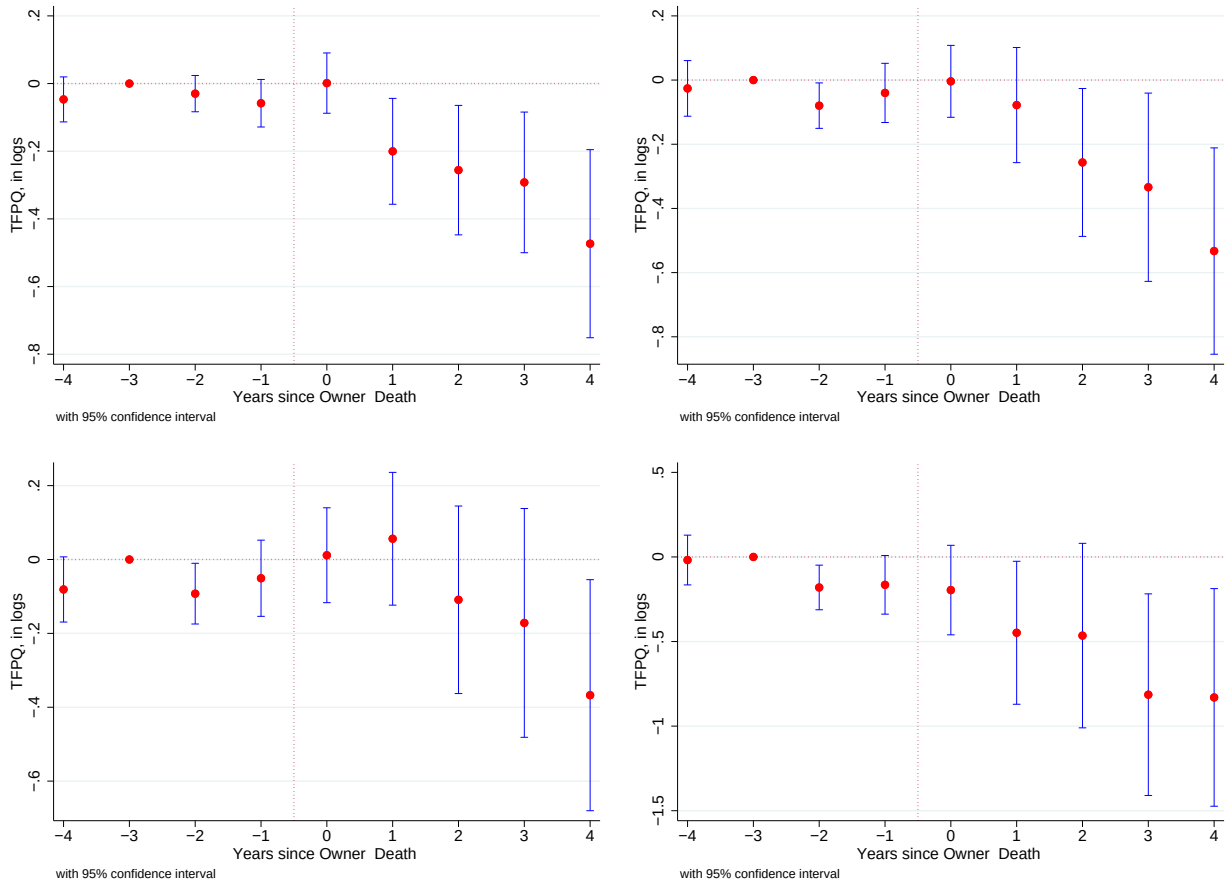


Figure 25: TFPQ dynamics after Owner death: (All firms in Top left; 10% in Top right; 5% in Bottom left; 1% in Bottom right)

NOTE: This figure shows the dynamics for firm productivity by using TFPQ (in logs), for the firms with premature owner death. For the details of the definition of "premature owner death" please see the body text. We require that treated firms have should observations at least 3 years before and after the event to conduct the analysis. Productivity is measured relative to the control group firms. We correct for the firm survival bias by using inverse mills ratios, which is obtained first by running a Probit model of firm survival on several pre-event firm characteristics; for details, please see the text.

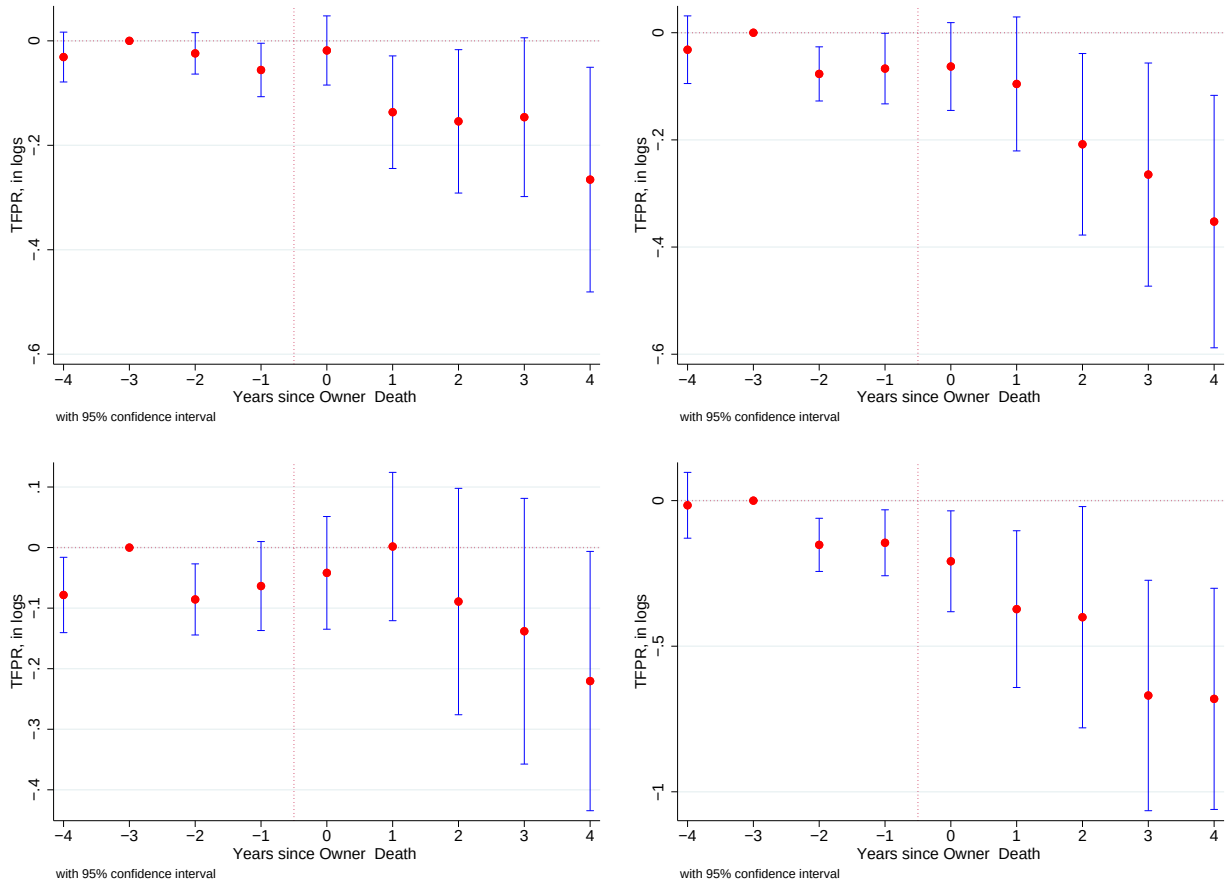


Figure 26: TFPR dynamics after Owner death: (All firms in Top left; 10% in Top right; 5% in Bottom left; 1% in Bottom right)

NOTE: This figure shows the dynamics for firm productivity by using TFPR (in logs), for the firms with premature owner death. For the details of the definition of "premature owner death" please see the body text. We require that treated firms have should observations at least 3 years before and after the event to conduct the analysis. Productivity is measured relative to the control group firms. We correct for the firm survival bias by using inverse mills ratios, which is obtained first by running a Probit model of firm survival on several pre-event firm characteristics; for details, please see the text.

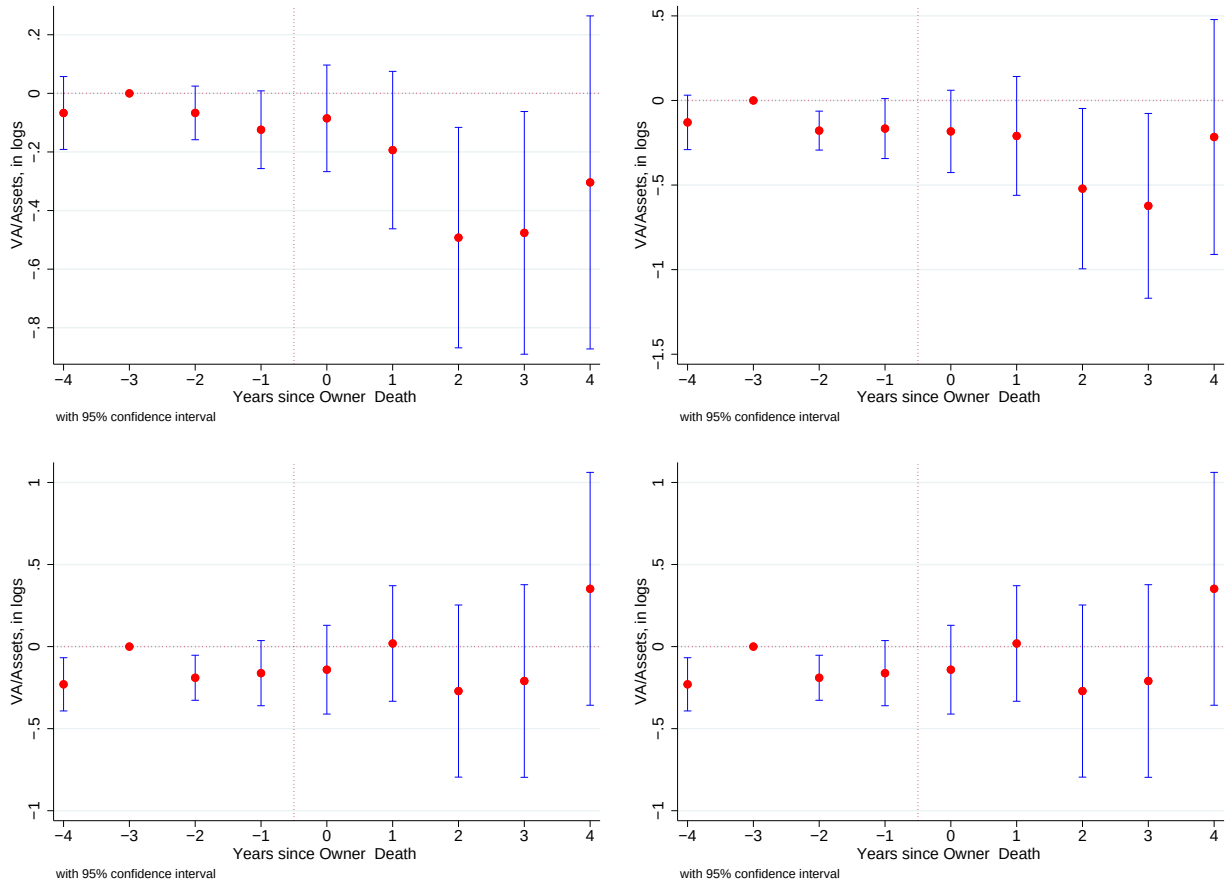


Figure 27: Value Added/Assets dynamics after Owner death: (All firms in Top left; 10% in Top right; 5% in Bottom left; 1% in Bottom right)

NOTE: This figure shows the dynamics for firm productivity by using Value Added/Assets (in logs), for the firms with premature owner death. For the details of the definition of "premature owner death" please see the body text. We require that treated firms have should observations at least 3 years before and after the event to conduct the analysis. Productivity is measured relative to the control group firms. We correct for the firm survival bias by using inverse mills ratios, which is obtained first by running a Probit model of firm survival on several pre-event firm characteristics; for details, please see the text.

Table 25: Firm Productivity since Owner Death

	(1) Benchmark	(2) Matched #: 1	(3) Matched #: 2	(4) Matched #: 3	(5) Matched #: 5	(6) Matched #: 10	(7) Age $\leq$55	(8) Age 55$\sim$65	(9) Male	(10) Female	(11) HS	(12) College
All sample												
TFPQ, inlogs												
I(Post Owner Death)	-0.150	-0.151	-0.200	-0.198	-0.159	-0.164	-0.0438	-0.138	-0.181*	-0.202	-0.338***	1.224**
	(0.100)	(0.194)	(0.162)	(0.141)	(0.125)	(0.109)	(0.142)	(0.147)	(0.105)	(0.331)	(0.104)	(0.501)
Observations	20,411	2,689	4,699	6,494	9,310	14,366	10,194	10,217	18,205	2,206	17,705	2,706
adjusted R-squared	0.0569	0.0643	0.0622	0.0612	0.0589	0.0575	0.109	0.0824	0.0585	0.211	0.0591	0.170
I(Post Owner Death)	-0.0761	-0.141	-0.117	-0.121	-0.0914	-0.0897	-0.0235	-0.0320	-0.0880	-0.410**	-0.200**	0.872**
	(0.0740)	(0.149)	(0.122)	(0.105)	(0.0924)	(0.0803)	(0.100)	(0.116)	(0.0784)	(0.189)	(0.0805)	(0.345)
Observations	20,411	2,689	4,699	6,494	9,310	14,366	10,194	10,217	18,205	2,206	17,705	2,706
adjusted R-squared	0.0547	0.0573	0.0577	0.0590	0.0561	0.0535	0.0987	0.0873	0.0563	0.238	0.0540	0.172
Initial Wealth Top 1%												
TFPQ, inlogs												
I(Post Owner Death)	-0.305*	-0.120	-0.153	-0.239	-0.241	-0.276	-0.107	-0.242	-0.515***	1.497***	-0.467**	-0.458
	(0.176)	(0.355)	(0.279)	(0.231)	(0.205)	(0.181)	(0.327)	(0.244)	(0.185)	(0.407)	(0.198)	(0.466)
Observations	3,972	732	1,263	1,655	2,187	3,161	1,414	2,558	3,678	294	2,945	1,027
adjusted R-squared	0.190	0.211	0.225	0.203	0.196	0.198	0.197	0.213	0.177	0.317	0.194	0.235
TFPR, inlogs												
I(Post Owner Death)	-0.270**	-0.334	-0.251	-0.292*	-0.262*	-0.261**	-0.391**	-0.220	-0.376***	0.797***	-0.462***	-0.0564
	(0.122)	(0.242)	(0.190)	(0.157)	(0.142)	(0.125)	(0.182)	(0.191)	(0.136)	(0.222)	(0.133)	(0.384)
Observations	3,972	732	1,263	1,655	2,187	3,161	1,414	2,558	3,678	294	2,945	1,027
adjusted R-squared	0.220	0.235	0.265	0.244	0.222	0.222	0.211	0.235	0.210	0.399	0.234	0.273
Initial Wealth Top 5%												
TFPQ, inlogs												
I(Post Owner Death)	-0.243**	-0.130	-0.156	-0.202	-0.210	-0.225*	-0.393**	-0.0836	-0.329***	0.493	-0.445***	0.341
	(0.110)	(0.223)	(0.179)	(0.150)	(0.132)	(0.116)	(0.171)	(0.156)	(0.114)	(0.440)	(0.129)	(0.477)
Observations	9,919	1,442	2,627	3,638	5,009	7,547	4,920	4,999	9,246	673	8,636	1,283
adjusted R-squared	0.116	0.135	0.132	0.119	0.120	0.116	0.189	0.154	0.110	0.315	0.123	0.186
TFPR, inlogs												
I(Post Owner Death)	-0.150*	-0.170	-0.124	-0.140	-0.137	-0.142*	-0.287**	-0.0334	-0.181**	-0.0830	-0.316***	0.349
	(0.0782)	(0.154)	(0.125)	(0.106)	(0.0933)	(0.0823)	(0.112)	(0.119)	(0.0846)	(0.237)	(0.0922)	(0.344)
Observations	9,919	1,442	2,627	3,638	5,009	7,547	4,920	4,999	9,246	673	8,636	1,283
adjusted R-squared	0.118	0.128	0.136	0.125	0.122	0.116	0.184	0.164	0.115	0.373	0.126	0.219
Initial Wealth Top 10%												
TFPQ, inlogs												
I(Post Owner Death)	-0.279***	-0.0844	-0.154	-0.184	-0.222*	-0.260**	-0.405**	-0.0323	-0.346***	0.0785	-0.405***	-0.0723
	(0.102)	(0.209)	(0.168)	(0.142)	(0.125)	(0.109)	(0.170)	(0.138)	(0.103)	(0.367)	(0.122)	(0.424)
Observations	12,574	1,772	3,146	4,345	6,028	9,210	5,757	6,817	11,163	1,411	10,795	1,779
adjusted R-squared	0.0964	0.115	0.104	0.0970	0.0970	0.0960	0.180	0.132	0.0991	0.195	0.105	0.187
TFPR, inlogs												
I(Post Owner Death)	-0.200***	-0.139	-0.139	-0.153	-0.170*	-0.189**	-0.322***	0.0127	-0.223***	-0.353*	-0.315***	-0.0161
	(0.0752)	(0.153)	(0.123)	(0.105)	(0.0918)	(0.0802)	(0.113)	(0.109)	(0.0773)	(0.209)	(0.0916)	(0.304)
Observations	12,574	1,772	3,146	4,345	6,028	9,210	5,757	6,817	11,163	1,411	10,795	1,779
adjusted R-squared	0.0892	0.0902	0.0931	0.0892	0.0882	0.0860	0.168	0.135	0.0974	0.191	0.100	0.187
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

NOTE: This table shows the dynamics for firm productivity by using TFPQ and TFPR(in logs), for the firms with premature owner death. For the details of the definition of "premature owner death" please see the body text. We require that firms have should observations at least 3 years before and after the event to conduct the analysis. We also correct for the firm survival probability. "**Benchmark**" refers to the benchmark regression where we use all matched pairs and all groups; "**Matched #: 1 to #: 10**" refer to the cases where we limit the maximal possible number of matches to 1,2,3,5,10, respectively. We also use the deceased owner's demographic information and divide the treated firms into different groups, as in "**Age $\leq$55** " vs. "**Age 55$\sim$65** ", "**Male** " vs. "**Female** ", and "**Male** " vs. "**high school educated**" vs. "**College educated**".

Table 26: Firm Productivity since Owner Death: Initial Firm Characteristics

	(1) Benchmark	(2) Young	(3) Mature	(4) Firm Assets: $\leq$90%	(5) Firm Assets: >90%	(6) Manufacturing	(7) Retail/Whole sale	(8) Service
All sample								
TFPQ, inlogs								
I(Post Owner Death)	-0.150	0.265	-0.439***	-0.128	-0.0752	-0.542	-0.343**	-0.134
	(0.100)	(0.196)	(0.121)	(0.102)	(0.372)	(0.714)	(0.162)	(0.574)
Observations	20,411	6,299	14,112	19,023	1,388	610	9,798	2,308
adjusted R-squared	0.0569	0.114	0.0815	0.0543	0.135	0.0816	0.0790	0.132
TFPR, inlogs								
I(Post Owner Death)	-0.0761	0.122	-0.274***	-0.0592	0.102	-0.542	-0.212*	-0.120
	(0.0740)	(0.128)	(0.0970)	(0.0752)	(0.276)	(0.480)	(0.126)	(0.422)
Observations	20,411	6,299	14,112	19,023	1,388	610	9,798	2,308
adjusted R-squared	0.0547	0.136	0.0718	0.0405	0.228	0.0816	0.0536	0.125
Initial Wealth Top 1%								
TFPQ, inlogs								
I(Post Owner Death)	-0.305*	0.568	-0.645***	-0.294*	-0.443	1.190	-0.517*	-6.561***
	(0.176)	(0.386)	(0.211)	(0.169)	(0.520)	(1.311)	(0.301)	(1.067)
Observations	3,972	1,056	2,916	2,758	1,214	147	1,667	154
adjusted R-squared	0.190	0.304	0.177	0.215	0.187	0.292	0.217	0.522
TFPR, inlogs								
I(Post Owner Death)	-0.270**	0.289	-0.520***	-0.258**	-0.399	0.180	-0.525**	-5.748***
	(0.122)	(0.224)	(0.140)	(0.127)	(0.328)	(0.738)	(0.215)	(0.746)
Observations	3,972	1,056	2,916	2,758	1,214	147	1,667	154
adjusted R-squared	0.220	0.355	0.187	0.191	0.306	0.289	0.236	0.582
Initial Wealth Top 5%								
TFPQ, inlogs								
I(Post Owner Death)	-0.243**	0.136	-0.444***	-0.262**	-0.196	0.372	-0.469**	-0.156
	(0.110)	(0.190)	(0.121)	(0.119)	(0.374)	(1.507)	(0.206)	(0.599)
Observations	9,919	2,727	7,192	8,551	1,368	245	4,826	708
adjusted R-squared	0.116	0.191	0.143	0.123	0.140	0.362	0.128	0.133
TFPR, inlogs								
I(Post Owner Death)	-0.150*	0.0435	-0.241***	-0.165*	-0.0372	-0.0386	-0.298*	-0.106
	(0.0782)	(0.121)	(0.0912)	(0.0847)	(0.256)	(1.048)	(0.153)	(0.507)
Observations	9,919	2,727	7,192	8,551	1,368	245	4,826	708
adjusted R-squared	0.118	0.227	0.125	0.0988	0.241	0.326	0.100	0.121
Initial Wealth Top 10%								
TFPQ, inlogs								
I(Post Owner Death)	-0.279***	-0.122	-0.422***	-0.322***	-0.0752	-0.320	-0.299	-1.171**
	(0.102)	(0.202)	(0.114)	(0.106)	(0.372)	(1.429)	(0.182)	(0.521)
Observations	12,574	3,299	9,275	11,186	1,388	356	6,551	964
adjusted R-squared	0.0964	0.170	0.140	0.100	0.135	0.180	0.125	0.133
TFPR, inlogs								
I(Post Owner Death)	-0.200***	-0.153	-0.279***	-0.249***	0.102	-0.657	-0.236*	-0.812*
	(0.0752)	(0.133)	(0.0861)	(0.0761)	(0.276)	(0.905)	(0.139)	(0.418)
Observations	12,574	3,299	9,275	11,186	1,388	356	6,551	964
adjusted R-squared	0.0892	0.192	0.113	0.0723	0.228	0.152	0.0940	0.104
Year dummies	YES	YES	YES	YES	YES	YES	YES	YES
Industry dummies	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

NOTE: This table shows the dynamics for firm productivity by different firm characteristics. Firm productivity is measured by using TFPQ, TFPR, and Value Added/Assets (in logs), for the firms with premature owner death. For the details of the definition of "premature owner death" please see the body text. We require that firms have should observations at least 3 years before and after the event to conduct the analysis. "**Young**" refers to the case where the firm is aged less than 11 years in the year of event. We also divide firms by Firm Assets: **Firm Assets: >90%** refers to the case where the treated firm has assets in the top 10% in the event year. Finally, we divide treated firms into different sectors in the event year.

6 Appendix for Numerical Computation

6.1 More on computation

- First, we can solve for $V^O(a, \eta)$ using the standard endogenous grid method and taking into account of the possible credit market constraint $a_{t+1} \geq \bar{m}$. For example, denote the Lagrangian multiplier for the budget constraint as μ_t and the multiplier for $a_{t+1} - \bar{m} \geq 0$ as γ_t, we have:

$$u'(c_t) = \gamma_t + \beta R^m u'(c_{t+1}).$$

  Specifically, first, we guess the value function $V^{O,(n-1)}$ and the consumption function $C^{O,(n-1)}$ in the n-th round. For tomorrow's assets at each grid point of $\{a'_1, ..., a'_N\}$ in the space of a, using the unconstrained Euler equation, we can find today's consumption c_t. After doing this, there will be a set of implied endogenous grids for today's assets: $\{\hat{a}_1, ..., \hat{a}_N\}$ and the associated consumption and value function. To obtain $V^{O,(n)}$ and $C^{O,(n)}$ on the grids, we can use interpolation. For $a < \hat{a}_1$,we know the agent is constrained and his saving is simply $a_{t+1} = \bar{m}$.

- Second, for $V^S(a_t, z_t, k_t, \alpha_t, \eta)$: once we solved for $V^O(a_t, \eta)$, we can find V^S based the first-order condition.

- Next, for V^E an V^C: note that $V^E = \max\{V^C, V^S\}$ and V^S is already obtained. Since the value function V^E is associated with discrete choices, we can use a method combining value function iteration and golden-section search to find V^C convergence (It's also possible to use a method combining value function iteration and Euler equation iteration).

- Once we solved for V^E, the value function $V^{Start}(a_t, \eta)$ can be solved using first-order conditions, or simply using grid search method since we do not have value function iteration for this problem:

$$\begin{aligned}
m_{t+1} \quad &: \quad u'(c_t) = \gamma_t + \beta R^m EI_{\{V^C \geq V^S\}} u'(c_{t+1}) + I_{\{V^C < V^S\}} u'(c_{t+1}). \\
k_{t+1} \quad &: \quad u'(c_t)\left[1 - \alpha_{t+1} + \varphi(\alpha_{t+1})\right] \\
&= \quad \beta R^m EI_{\{V^C \geq V^S\}} u'(c_{t+1}) \times (1 - \alpha_{t+1}) \frac{\partial F(k_{t+1}, \Psi(z_{t+1}, \eta))}{\partial k_{t+1}} \\
&\quad\quad + \beta R^m EI_{\{V^C < V^S\}} u'(c_{t+1}) \times (1 - \alpha_{t+1}) \frac{\partial P(k_{t+1}, z_{t+1})}{\partial k_{t+1}} \\
\alpha_{t+1} \quad &: \quad u'(c_t)\left[1 - \alpha_{t+1} + \varphi(\alpha_{t+1})\right] \\
&= \quad \beta R^m EI_{\{V^C \geq V^S\}} u'(c_{t+1}) \times F(k_{t+1}, \Psi(z_{t+1}, \eta)) \\
&\quad\quad + \beta R^m EI_{\{V^C < V^S\}} u'(c_{t+1}) \times P(k_{t+1}, z_{t+1})
\end{aligned}$$

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