Stock Market Wealth and Entrepreneurship*

Gabriel Chodorow-Reich[†] Plamen T. Nenov[‡] Vitor Santos[§] Alp Simsek[¶]

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Abstract

We study the effect of stock market wealth on entrepreneurship. Our research design isolates idiosyncratic variation in stock market returns using portfolio-level data from Norway. Higher stock market wealth increases the propensity to start a firm, with the response concentrated among households with moderate wealth experiencing positive idiosyncratic returns in years when the overall market does well. For these households, a gain of 40,000 NOK (around $6000) raises the likelihood of starting a firm by about 25% of the baseline rate. To estimate the causal effect of wealth on firm outcomes, we develop a selection correction that accounts for the endogenous entry into entrepreneurship. Higher wealth increases firm profitability, providing evidence that wealth affects entrepreneurship by relaxing financial constraints. Our empirical estimates suggest that aggregate stock market volatility can account for roughly one-third of the variation in the entrepreneurship rate among moderate-wealth stockholders in Norway.

JEL Classification: E22, E44, L26, G50

Keywords: entrepreneurship, financial frictions, selection correction

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[†]Harvard University and NBER. Email: chodorowreich@fas.harvard.edu

[‡]Norges Bank and Norwegian Business School (BI). Email: plamen.nenov@norges-bank.no

[§]Católica Lisbon School of Business and Economics (CLSBE). Email: vipereira@ucp.pt

[¶]Yale School of Management, NBER, and CEPR. Email: alp.simsek@yale.edu

1 Introduction

New business creation constitutes an integral part of economic growth and provides an important pathway to individual wealth accumulation (Buera et al., 2015; Smith et al., 2019; Bhandari et al., 2022). Does initial wealth affect who starts a firm or the type of business they build? In theory, higher wealth might increase business entry and profits by relaxing would-be entrepreneurs' financial constraints, enabling them to raise more capital and operate at a larger scale. Yet, establishing a causal effect of wealth on entry faces the challenge that high wealth individuals may have other traits that make them more likely to start businesses (Hurst and Lusardi, 2004). Even granting a causal effect, determining why wealth matters or the effect of wealth on business outcomes such as profitability faces the further difficulty that an entry effect causes non-random selection on talent across entrepreneurs with different initial wealth (Buera, 2009).

We make four contributions. First, we study the effect of *stock market wealth*, the most volatile component of household financial wealth but one that has received comparatively little attention in the literature on entrepreneurship. Second, we show a causal effect of stock market wealth on entry using a research design that compares individuals with the same *ex ante* stock portfolio characteristics but different *ex post* market returns arising from idiosyncratic holdings. Third, we isolate the causal effect of firm-owner wealth on business outcomes by demonstrating a rank preservation property in a simple but general model of entrepreneurial choice. Fourth, in our data higher stock market wealth causally increases key business variables, including firm profits and owners' equity, providing evidence that wealth matters to entrepreneurship by relaxing financial constraints.

To frame the empirical analysis, we start by describing the model and testable implications. Individuals differ in potential business productivity and in their portfolio returns, which generate differences in wealth. Since our empirical approach isolates random variation in portfolio returns, we assume that returns are conditionally independent of productivity. An individual starts a business only if her utility as an entrepreneur exceeds her utility from wage employment. Greater wealth can affect this trade-off either by allowing for higher business profits (e.g., because of financial constraints) or by increasing the utility from running a business (e.g., because entrepreneurship provides non-pecuniary benefits). Comparing individuals with high and low wealth correctly identifies the magnitude of this entry effect (see Proposition 1) but does not distinguish the reason for it. The causal effect of wealth on firm profits provides a key moment to distinguish financial constraints from a non-pecuniary benefits explanation of the wealth effect on entry, as only under the former does higher wealth relax financial constraints and result in higher profits.

The effect of wealth on business outcomes such as profits is however harder to identify because we observe firm outcomes *only for entrants*, and entrants with different wealth have non-random differences in productivity. While this insight follows directly from a standard model of entrepreneurial selection, simple comparisons of outcomes of high and low wealth entrepreneurs remain prevalent in empirical work. We show that, under a natural monotonicity assumption, the model satisfies a rank preservation property that enables us to match entrants by productivity and estimate the causal effect of wealth on firm-level outcomes (see Proposition 2). Intuitively, while we do not directly observe productivity, we observe firm size, which is a proxy for the firm's productivity rank when size increases with productivity. Using this proxy, we remove from the comparison the left tail of the productivity distribution of the firms created by high wealth entrepreneurs, as these firms would not have existed if the founder instead had low wealth. This correction for non-random entry enables us to identify the causal effect of founder wealth on business outcomes. Propensity score reweighting extends the result to the realistic case of independence between wealth and ability *conditional on observables* (see Proposition 3). We also extend the argument to allow firm size to depend on residual factors beyond productivity.

We bring the model's insights to the data using administrative records from Norway for both households and firms. We merge several administrative data sets, including a registry of security-level holdings of Norwegian stocks, total household financial wealth from tax records, labor market history from the employer-employee register, and firm balance sheet and income statements. In short, we observe household financial wealth, portfolio allocation at the individual stock level for stocks traded on the Norwegian stock exchange, business ownership, and firm-level outcomes. We follow Levine and Rubinstein (2017) and focus on incorporated business owners. Specifically, we define an entrepreneur as an individual who owns at least 1/3 of the book value of stocks in an incorporated non-financial firm, and where the firm has at most 3 stock owners (so the firm is a closely-held private firm). To remove shell companies we further require that the firm has at least one employee in the year of foundation or subsequent year and either holds no public equities or employs a worker who is not a member of the entrepreneur's household.

Our first main result compares entry into entrepreneurship across individuals with different stock market outcomes. To facilitate interpretation, we instrument for the buy-and-hold change in financial wealth in Norweigian Kroner (NOK) using the buy-and-hold return on total financial wealth induced by stock returns alone. There are two important threats to causal identification. First, realized stock market returns may correlate with other factors that affect the entrepreneurship decision. For example, home bias in portfolio choice could result in better returns in periods when the individual's industry or local area is booming.

We address this concern by including sector×time and geography×time fixed effects. Second, individuals more likely to become entrepreneurs might hold systematically different portfolios, for example if risk-tolerant individuals both hold riskier portfolios and are more likely to start firms. Following the results in Borusyak and Hull (2021), we address this concern by including flexible controls for *ex ante* portfolio characteristics such as the market beta. Our research design therefore isolates variation in returns that comes from random realizations of the idiosyncratic component of portfolio holdings across portfolios with the same *ex ante* characteristics. In our setting more than half of households with directly-held stocks have only one or two holdings, generating substantial idiosyncratic return variation.

We find strong evidence that greater stock market wealth increases entrepreneurship. Pooling across all observations, a gain of 40 thousand NOK (around 6 thousand USD) due to an idiosyncratic stock return raises entry into entrepreneurship by about 1/20th of the sample average rate. This overall effect masks important underlying heterogeneity: individuals with sufficiently high initial financial wealth exhibit essentially no effect of higher stock market wealth on entrepreneurship, while for lower financial wealth individuals the marginal effect increases five-fold, with a stock market gain of 40 thousand NOK raising the entry rate by about 25% of the sample average rate. We also find that the positive marginal effect comes only from positive returns or in years when the overall stock market does well. We demonstrate robustness along several dimensions, including controlling for initial financial wealth and labor income or for the sector of the individual's largest stock holding. The positive effect of stock wealth on entry also holds when restricting the sample to similarly under-diversified households that hold less than 3 stocks and whose main stock holding is among the 20 most popular companies among small investors traded on the Norwegian stock exchange. Placebo exercises demonstrate no response of entrepreneurship to future stock returns.

Our second set of results apply the model's selection correction to obtain the causal effect of firm-owner financial wealth on firm outcomes. We find sizable positive effects of increased stock market wealth on firm balance sheet and income statement outcomes, including total assets, sales, employment, value added, and profitability that persist for several years after the firm is founded. As shown in our model, the increase in profits indicates a role for financial constraints. Two additional results further support this interpretation: (i) a marginal increase in stock wealth results in a nearly one-to-one increase in owners' equity in the new firm, and (ii) entrepreneurs with higher returns finance their larger businesses from their liquid financial wealth, including via active liquidations of stocks.

Together, our findings provide evidence that higher stock market wealth increases entrepreneurship and results in higher owner equity that in turn implies more profitable firms at creation. This evidence complements research using other sources of windfall gains such as housing capital gains or lottery winnings. Beyond providing a new source of variation in wealth arising from idiosyncratic stock portfolios, analysis of the stock market matters because it accounts for a large share of total wealth fluctuations. This share reflects the high volatility of stocks relative to assets such as housing, which also may have distinct effects on entrepreneurship due for example to differences in liquidity characteristics. Consequently, our results open the possibility that aggregate stock market volatility can account for a sizable share of the variability in the entrepreneurship rate among households with moderate financial wealth. Indeed, a simple back-of-the-envelope calculation in Section 7 suggests that aggregate stock market volatility can account for roughly a third of the variation in the entrepreneurship rate among moderate-wealth stockholders in Norway.

The reach of this channel depends on stock market participation, which varies across countries and over time. In this regard, our findings complement Melcangi and Sterk (2024), who show that stock market participation is also an important determinant for the responsiveness of business investment to monetary policy via a portfolio rebalancing effect. Furthermore, our findings of a stock market wealth channel on entrepreneurship suggest that fluctuations in stock market wealth induced by monetary policy can have more long-lasting effects on economic growth by constraining or facilitating business creation.

Related literature. Our paper makes a direct contribution to the literature on wealth and entrepreneurship and in particular to the academic debate on the importance of liquidity constraints for business creation.[1] In two early seminal contributions, Evans and Jovanovic (1989) and Evans and Leighton (1989) find a positive association between individual wealth and the propensity to start a business using data from the National Longitudinal Survey of Youth. Using a structural approach, Evans and Jovanovic (1989) argue that this relationship is likely causal. Similar correlational findings have been reported in Blanchflower and Oswald (1998), Fairlie (1999), Quadrini (1999), and Gentry and Hubbard (2004) among others.

On the other hand, Hurst and Lusardi (2004) find a flat relationship in the Panel Study of Income Dynamics between wealth and entry into entrepreneurship for most of the wealth distribution and a strong positive relationship only at the top. In addition, they find no evidence that individual wealth matters more for entry in high starting-capital industries. More recently, Bhandari et al. (2022) use administrative data from the IRS and Social Se-

[1]Parker (2018) provides a comprehensive treatment of the economics of entrepreneurship including the link between wealth and entrepreneurship. See also Kerr and Nanda (2011). In addition to empirical studies, the idea of financial constraints impacting entry into entrepreneurship has also been explored theoretically and quantitatively in Banerjee and Newman (1993), Aghion and Bolton (1997), Piketty (1997), Cagetti and De Nardi (2006), Buera and Shin (2013), Moll (2014), and Morazzoni (2023), among others. See Buera et al. (2015) for a review of that literature.

curity Administration and find that entrants into self-employment have *lower* asset incomes prior to entry.

The lack of consensus on the relationship between wealth and entrepreneurship spurred a literature that looks for exogenous shocks to wealth. Several studies have found that individuals receiving an inheritance are more likely to become entrepreneurs (Holtz-Eakin et al. (1994), Lindh and Ohlsson (1996), Blanchflower and Oswald (1998), Andersen and Nielsen (2012), Fairlie and Krashinsky (2012)). Hurst and Lusardi (2004) challenge this approach by showing that both past and *future* inheritances predict entry into entrepreneurship, suggesting that inheritance may correlate with other factors such as risk tolerance or preferences that determine entry.

Another form of variation in wealth comes from lottery winnings or other cash windfalls. Lindh and Ohlsson (1996) report a positive correlation between lottery winnings and self-employment in Sweden, but cannot control for the amount spent on lottery tickets. In fact, Cesarini et al. (2017) find that among lottery players in Sweden, demographic variables such as age, education, and income predict the amount won. Similar to our controls for *ex ante* portfolio characteristics, Cesarini et al. (2017) address this problem by including fixed effects for cells of spending on lottery tickets. They find that lottery winnings reduce self-employment income. Cespedes et al. (2021) use variation in the lottery amount among retail businesses receiving a bonus payment for selling a winning jackpot ticket and find both an intensive and extensive (serial entrepreneurship) effect. Golosov et al. (2024) find lottery winners (compared to later winners) increase small ($< \$15,000$) self-employment income but do not transition to more substantial business activity. Bermejo et al. (2022) find a positive effect of winning the Spanish Christmas lottery on regional firm creation, which they argue is mediated via a credit constraint channel. Finally, Bellon et al. (2021) find a positive effect on incorporated business creation from cash windfalls due to shale oil exploration contracts in Texas.

The third wealth shock used in the literature is to housing wealth (Hurst and Lusardi (2004), Adelino et al. (2015), Corradin and Popov (2015), Schmalz et al. (2017), Harding and Rosenthal (2017), Jensen et al. (2022), Kerr et al. (2022)). With the prominent exception of Hurst and Lusardi (2004), most of this literature finds that housing wealth increases business creation. However, since variation in housing wealth is mostly regional there are inherent difficulties in establishing whether these effects are driven by local economic shocks, by higher wealth, or by higher collateral values. Schmalz et al. (2017) circumvent this difficulty by comparing local homeowners to renters and find that local homeowners are more likely to start a business compared to renters after a local house price appreciation. They also compare local homeowners with and without a mortgage on their house and show that the effects are present only for homeowners without a mortgage – a sign of higher housing wealth relaxing liquidity constraints, since in France homeowners with a mortgage cannot take on more mortgage debt.[2]

Relative to this large existing literature, and to the best of our knowledge, we are the first to propose and implement an empirical design featuring the impact of stock market wealth on business creation.[3] Among other differences, and unlike lottery winnings, our data contain both increases and decreases in wealth and thus allow us to test for non-linear effects of changes in wealth on entrepreneurship. Furthermore, our administrative data contain the near-universe of households and firms over a long time period with no top-coding, non-observability of assets, or self-reporting errors that have been an issue for much of the existing literature. Our main findings point to a robust causal and economically significant effect of stock market wealth on incorporated business creation.

We also depart from much of the previous literature by explicitly following Levine and Rubinstein (2017) and focusing on transitions to *incorporated* business ownership for our baseline entrepreneurship definition. In contrast (and with the notable exceptions of Hvide and Møen (2010) and Bellon et al. (2021)), the vast majority of empirical papers on the link between wealth and entrepreneurship focus either on self-employment income from tax returns (e.g. Cesarini et al. (2017)), which in most countries corresponds to income from *unincorporated* business ownership, or use answers from survey questions about "self-employment" or "starting a business", which combine both incorporated and unincorporated businesses.[4] Indeed, we find a *negative* effect of higher stock market wealth on unincorporated self-employment income, consistent with the evidence from lottery winnings in Cesarini et al. (2017). The discrepancy between the positive effect of stock market wealth on incorporated business ownership and the negative effect on unincorporated self-employment income supports the notion that entry into unincorporated and incorporated business ownership are two distinct types of entrepreneurship.

Several earlier papers also examine the effect of wealth on firm-level outcomes. Using data on start-ups from Norway, Hvide and Møen (2010) find a negative relationship between wealth and start-up profitability at the top of the wealth distribution. Similarly, Andersen and Nielsen (2012) find that on average the firms created with unexpected inheritances

[2] In addition to collateral shocks some papers have considered the effects of credit market shocks on entrepreneurship (Black and Strahan (2002), Kerr and Nanda (2009), Fracassi et al. (2013), among others).

[3] In contemporaneous and complementary work, Chetty et al. (in progress) show that early employees at firms undergoing an IPO have higher subsequent entrepreneurship rates. Our work differs in focusing on more "ordinary" stock market participants who have not necessarily already joined newly-formed firms.

[4] Golosov et al. (2024) also use self-employment income to measure entrepreneurship in the U.S., but in their tax data self-employment income contains both unincorporated business income as well as income from pass-through businesses such as partnerships or S-corporations.

have lower survival and profitability. Much of the rest of the literature reaches the opposite conclusion. Holtz-Eakin et al. (1994) show that firms whose owners receive inheritances tend to survive longer. Schmalz et al. (2017) find that firms created by homeowners in periods of rising house prices are significantly larger at the time of creation than those started by renters and that such firms tend to survive longer and are therefore not "riskier" in the sense of having a higher probability of failure. Jensen et al. (2022) also find higher survival rates among firms created with higher housing wealth. McKenzie (2017) uses the random allocation of grants to business start-ups in Nigeria to show that both potential and existing entrepreneurs that receive a grant are both more likely to operate a business three years after the grant allocation and more likely to operate firms with ten or more workers.[5] Bermejo et al. (2022) find a positive and significant effect on firm size and survival using the Spanish Christmas lottery.

None of these papers attempts to separate the causal effect of wealth on firm outcomes from the selection bias that arises because higher wealth changes the composition of entrants. Indeed, our selection model can help to reconcile the disparate findings across papers, since it implies that unconditional differences between firms started by high and low wealth entrepreneurs have theoretically ambiguous sign and could vary across institutional settings. Our selection correction echoes the structural approach in Evans and Jovanovic (1989), but provides a more direct mapping from data to results. After applying our selection correction, we find strong evidence that higher wealth causes better firm outcomes.

The literature has also debated whether to interpret a causal relationship between wealth changes and entrepreneurship as revealing financial constraints. Alternatively, there might be a *non-pecuniary benefit* from firm ownership that increases with wealth (Hurst and Pugsley, 2017). In this spirit, Hamilton (2000) finds a "self-employment" discount, showing that entrepreneurship tends to persist despite lower earnings growth compared to paid employment (see also Pugsley and Hurst (2011) and Catherine (2022)), although Bhandari et al. (2022) challenge this result using their administrative data.

Our model demonstrates that the causal effect of wealth on firm profits can help to distinguish among these channels. The finding of higher profits suggests wealth increases entrepreneurship at least in part by relaxing financial constraints. Consistent with this interpretation, we also find a near one-to-one pass-through from higher stock wealth to equity in the firm, partly via active liquidations of stocks, and that stock market wealth matters less for entrepreneurship decisions of high financial wealth households. Our model incorporates both leverage constraints and uninsurable business risk, along the lines of Leland and Pyle

[5]See also De Mel et al. (2008) who show that wealth shocks are important for the performance of microenterprises in Sri Lanka.

(1977); Ross (1977); Kihlstrom and Laffont (1979); Moskowitz and Vissing-Jørgensen (2002); Landier and Thesmar (2008); Hall and Woodward (2010); Nenov (2017), as complementary financial frictions, and we do not attempt to empirically distinguish their relative importance. Our finding that financial constraints matter in turn creates a possible role for development policies such as business subsidies that mitigate financial frictions (Itskhoki and Moll, 2019).

Our focus on the effect of stock market wealth for the real economy brings our paper close to recent work by Di Maggio et al. (2020), Chodorow-Reich et al. (2021), Andersen et al. (2021), and Ring (2022), among others. Unlike these papers, we consider the effects of stock market wealth for entrepreneurship and business creation rather than the effects on consumer spending (Di Maggio et al., 2020; Andersen et al., 2021; Chodorow-Reich et al., 2021) or the effects of wealth of existing firm owners on firm employment and investment during the 2008-2009 financial crisis (Ring (2022)). In independent work, Andersen et al. (2021) use a similar approach to isolating variation in returns by controlling for portfolio characteristics. We provide a formal justification for this approach by linking portfolio choice to the general problem of non-random exposure as in Borusyak and Hull (2021).

2 The Model and Testable Hypotheses

We start by developing the hypotheses that we test in our empirical analysis. Section 2.1 presents a simple static model of entrepreneurship choice as a function of wealth and business productivity. Section 2.2 formalizes the prediction that greater wealth increases entrepreneurship, which we test in Section 5. Section 2.3 introduces two microfoundations of why greater wealth increases entrepreneurship, one rooted in financial frictions and the other in non-pecuniary benefits of entrepreneurship, and shows that the causal effect of wealth on profits distinguishes them. Section 2.4 turns to how to estimate the causal effect of wealth on business outcomes such as profits. We show that endogenous entry into entrepreneurship generates selection on unobserved productivity even when wealth is randomly assigned and we develop a procedure to correct for this selection effect, which we implement in Section 6. Section 2.5 extends the basic model and the results in Section 2.4 to the important case where firm size depends on residual heterogeneity beyond productivity. Finally, Section 2.6 provides a dynamic extension in which positive portfolio returns increase entry, as in our empirical implementation.

2.1 Setup

The baseline model has a single period. There is a continuum of agents denoted by i with mass normalized to one. Agents have the same level of invested wealth, denoted by a_0. Agent i realizes an observable gross return on wealth, denoted by R. Thus, her wealth becomes $a_i = a_0 R$. The agent is also associated with unobservable log potential business productivity denoted by z_i and an observable vector of covariates denoted by x_i that might be correlated with productivity and portfolio return. We let $F_z(z_i|x_i)$ and $F_R(R_i|x_i)$ denote the conditional CDFs of productivity and returns, respectively, and F_x denote the marginal distribution of covariates.

In the empirical analysis, we will isolate quasi-random fluctuations in the portfolio return R by controlling for covariates such as *ex ante* portfolio characteristics. Therefore, in the model we impose the following conditional independence assumption:

Assumption (CIA). The portfolio return R is independent of business productivity z_i *conditional on the covariates* x_i.

An individual i chooses whether to enter into business, $E_i \in \{0, 1\}$. If she does not enter, $E_i = 0$, she earns the outside option (reservation wage) $w(z_i)$. The reservation wage can depend on business productivity z_i, but we require this dependence to be relatively small in a sense that we formalize in Assumption (M) below. In this case, the individual's (consumption-equivalent) utility is equal to her assets plus her wage

$$U(E_i = 0) = a_i + w(z_i).$$

If instead the individual enters, $E_i = 1$, she runs a business with log size $k_i = k(z_i, a_i)$ and earns profits $\pi_i = \Pi(k_i; z_i, a_i) = \pi(z_i, a_i)$. The individual's consumption-equivalent utility is

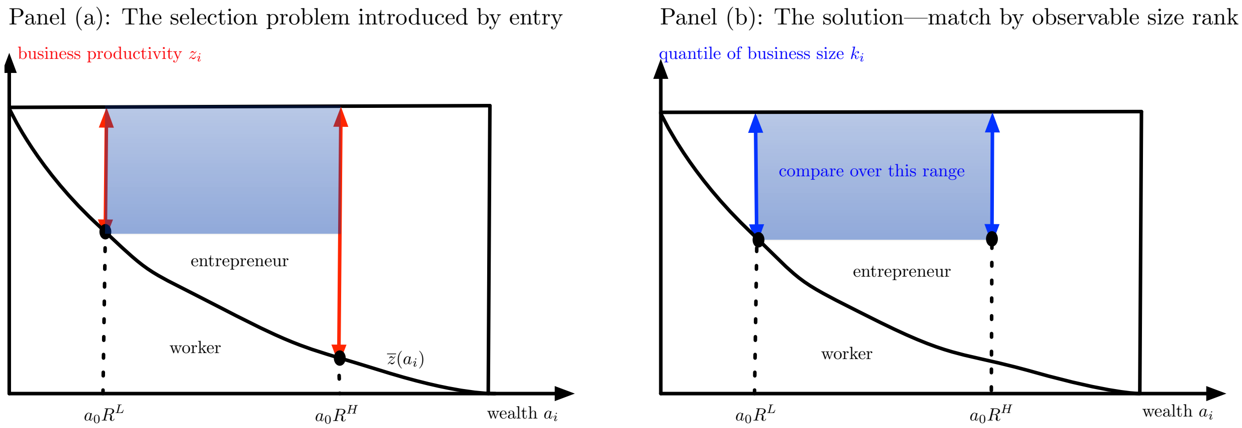
$$U(E_i = 1) = a_i + \pi(z_i, a_i) + u^e(z_i, a_i).$$

Here, the profit term captures the pecuniary benefit from entrepreneurship and the last term captures a possible non-pecuniary benefit—individuals might enjoy running their own business. An individual enters into business if her potential consumption-equivalent utility from entrepreneurship exceeds her potential wage $U(E_i = 1) \geq U(E_i = 0)$, that is:

$$\pi(z_i, a_i) + u^e(z_i, a_i) \geq w(z_i) \text{ where } a_i = a_0 R_i. \tag{1}$$

Observe that we assume the outside option w, entrepreneurship benefit u^e, profit π, and log size k depend *only* on log business productivity and wealth. Observed covariates x_i affect

Figure 1: Selection Correction



Notes: Panel (a) illustrates the selection problem: higher wealth lowers the entry threshold, so the high-wealth group includes additional low-productivity entrants (red arrow). Panel (b) illustrates the solution: because size is increasing in productivity, matching entrants by size quantile across wealth groups removes the marginal entrants, enabling comparison of firm outcomes for a common set of productivity types (shaded region).

these outcomes only through their impact on z_i, R_i and other unobserved variables do not affect these outcomes. These assumptions are restrictive but they help to illustrate our results while simplifying the notation. In Appendix B.2, we show that under additional assumptions our results extend to cases in which the outcomes w, u^e, π, k can be heterogeneous in other (observed or unobserved) dimensions. We discuss this extension in Section 2.5.

To characterize and estimate the effects of wealth on entrepreneurship, we impose mild monotonicity conditions on the profit, entrepreneurship benefit, and size functions.

Assumption (M). $\frac{\partial(\pi(z_i,a_i)+u^e(z_i,a_i))}{\partial a_i} \geq 0$ and $\frac{\partial(\pi(z_i,a_i)+u^e(z_i,a_i)-w(z_i))}{\partial z_i} > 0$, $\frac{\partial k(z_i,a_i)}{\partial z_i} > 0$.

The first condition captures the main effect we investigate: greater wealth increases the total utility from entrepreneurship. This could be either because greater wealth increases profits by relaxing financial constraints, or because greater wealth increases the non-pecuniary benefits from entrepreneurship. We will shortly show how to distinguish among these explanations. The second condition says that business productivity increases the total utility from entrepreneurship faster than it increases the reservation wage—so it increases the net gain from entry into business. The last condition enables us to address the selection effect induced by entry. It says that individuals with higher business productivity start larger businesses—this enables us to use size rank to control for unobserved productivity.

2.2 Effect of Wealth on Entry

Our first main result concerns how greater wealth—induced by a higher portfolio return—affects the entrepreneur's propensity to enter into business.

Proposition 1 (Causal effect of wealth on entry)**.** *Consider the entry model with Assumption (M). A higher portfolio return induces more entry into business: the fraction of entrants* $e(a_i|x_i) = \int_{z_i} E_i dF_z(z_i|x_i)$ *is weakly* increasing *in* $a_i = a_0 R$ *and therefore also in* R.

This is the first hypothesis that we test in our empirical analysis. To see why, note that Assumption (M) implies greater business productivity increases the net gain from entry into business. Therefore, conditional on assets a_i, there is a unique productivity level that satisfies the entry condition (1) as equality. We define the solution as $\overline{z}(a_i)$ and refer to it as the cutoff productivity for entry. Since Assumption (M) also implies that greater assets increase the total utility from entrepreneurship, $\overline{z}(a_i)$ is weakly *decreasing* in wealth a_i. This implies $e(a_i|x_i) = \int_{z_i \geq \overline{z}(a_i)} dF_z(z_i|x_i)$ is increasing in a_i. Figure 1(a) illustrates the cutoff productivity $\overline{z}(a_i)$ and the region of entry for lower and higher wealth levels.

2.3 Explicit Microfoundations and the Role of Profits

We now describe two example models that satisfy Assumption (M) and hence in which Proposition 1 holds (see Appendix B.1 for details). These models illustrate complementary mechanisms by which wealth might increase entrepreneurship, while making distinct predictions for how wealth affects profits, $\frac{\partial \pi(z_i,a_i)}{\partial a_i}$.

The first model features two complementary financial frictions—a borrowing constraint and uninsurable business risk—but does not have non-pecuniary benefits from entrepreneurship, $u^e(z_i, a_i) = 0$. We begin with the borrowing constraint in isolation, so that there is no risk. The entrepreneur produces with capital and labor, but capital must be financed up front against a borrowing constraint based on expected profitability. After optimally choosing labor, the profit is effectively linear in capital, so every productive entrepreneur operates at the maximum scale permitted by the constraint. Higher initial wealth relaxes this constraint, which in turn strictly raises firm size and profits. Firm size in levels, denoted by K, is a leveraged multiple of entrepreneur wealth, $K(z_i, a_i) = \Lambda(z_i) \cdot a_i$, where the leverage ratio $\Lambda(z_i)$ is strictly increasing in productivity—more productive entrepreneurs are more profitable, can pledge more to lenders, and therefore borrow more. This structure is related to models of financial frictions and misallocation such as Moll (2014). Since the leverage ratio is increasing in productivity, so is firm size, satisfying the last condition of Assumption (M).

We next introduce the second financial friction: *uninsurable risk*. In practice, entrepreneurship is associated with considerable risk that is difficult to share with outsiders due to a variety of information frictions. More concretely, entrepreneurs face steep equity issuance costs and need to borrow with (non-contingent) debt, which leaves them exposed to their business risks. The literature has long recognized this friction as a key impediment to business formation (see, e.g., Kihlstrom and Laffont (1979)). In our model, uninsurable risk provides a complementary channel by which wealth affects entrepreneurship. Because the entrepreneur cannot share her business risk with outside investors, she voluntarily limits her leverage even when the borrowing constraint does not bind. With CRRA preferences, the leverage ratio $\Lambda(z_i, \gamma)$ may depend on the risk aversion coefficient γ but it is independent of wealth. Thus, the firm size retains the form $K = \Lambda \cdot a_i$ regardless of whether the borrowing constraint binds. Uninsurable risk also reduces the certainty-equivalent return from entrepreneurship, raising the wealth threshold for entry. Under mild assumptions, the model still satisfies Assumption (M), so the key predictions are preserved.[6]

The second model features no financial frictions. Unlike the first model, where profit is linear in capital so entrepreneurs might operate at a corner, here we assume a strictly concave profit function $\Pi(K; z_i)$ with a unique interior profit-maximizing firm size K^*. Instead, wealth enters through non-pecuniary benefits from entrepreneurship given by a function $u^e = U^e(K, c; z_i, a_i)$ where K is firm size and $c = a_i + \Pi(K; z_i)$ is regular consumption. We assume $\frac{\partial U^e}{\partial c} > 0, \frac{\partial U^e}{\partial K} \geq 0, \frac{\partial^2 U^e}{\partial c \partial K} \geq 0$ (along with standard regularity conditions). These assumptions capture the idea that individuals enjoy running a (larger) business, and more so when their regular consumption is higher. Individuals choose their business size K to maximize $\Pi + U^e$. In this case, greater wealth increases the total utility from entrepreneurship as before, $\frac{\partial(\pi(z_i,a_i)+u^e(z_i,a_i))}{\partial a_i} \geq 0$, but the effect works through the non-pecuniary benefits $u^e(z_i, a_i)$. Crucially, unlike in the financial frictions model, greater wealth *decreases* profits, $\frac{\partial \pi(z_i,a_i)}{\partial a_i} \leq 0$. Intuitively, the non-pecuniary benefits induce a firm size beyond K^*, and greater wealth pushes size even further beyond K^*, reducing profits.

We next develop Propositions 2 and 3 to estimate the effect of wealth on profits $\frac{\partial \pi(z_i,a_i)}{\partial a_i}$ (and on other business outcomes), which we will use to differentiate between the two models.

[6] Assumption (M) holds for an arbitrary risk aversion coefficient γ except for the last condition $\frac{\partial k(z_i,a_i)}{\partial z_i} > 0$—which we need to address the selection effect induced by entry. This condition holds automatically when the borrowing constraint binds. When the constraint does not bind, we assume $\gamma \leq 1$ to ensure that the leverage ratio $\Lambda(z_i, \gamma)$ and thus business size is increasing in productivity z_i. In the appendix we discuss why $\gamma \leq 1$ is an appropriate assumption for this context.

2.4 Effect of Wealth on Business Characteristics

Identifying the effect of wealth on the intensive margin of business outcomes is more complicated than the extensive margin choice because entry into business induces selection on unobserved productivity. Comparing average firm outcomes across wealth levels does not identify the causal effect of wealth, because higher wealth also reduces the average productivity of entrants by lowering the entry threshold (see Figure 1(a)).

Since we do not directly observe productivity, we cannot address this selection problem by controlling for productivity z_i. Instead, we observe the return R_i (and thus the wealth a_0R_i) for all individuals and we observe firm size k_i for the individuals that enter. We next show how to use these *observed* outcomes to match individuals by productivity and estimate firm-level outcomes.

The result relies on sorting the entrants by their size k_i—which is monotonically increasing with productivity in view of Assumption (M)—to control for unobserved productivity. To formalize this idea, we define additional notation. First, we define the cutoff size for entry as the size corresponding to the cutoff productivity, $\overline{k}(a_i) = k(\overline{z}(a_i), a_i)$. Second, given wealth level $a_i = a_0R$ and a size level above the cutoff $\overline{k} \geq \overline{k}(a_i)$, we denote the fraction of individuals who enter into business *and whose size exceeds* $\overline{k}$ with

$$e\left(\overline{k}, a_i|x_i\right) = \int_{z_i \geq \overline{z}(a_i), k(z_i,a_i) \geq \overline{k}} dF_z\left(z_i|x_i\right). \tag{2}$$

Third, consider a firm-level outcome that can be described as a function of productivity and wealth, $y(z_i, a_i)$, such as log size or profits. We denote the expected firm-level outcome for entrants whose size exceeds $\overline{k}$ with

$$\mathbf{y}\left(\overline{k}, a_i|x_i\right) = \frac{\int_{z_i \geq \overline{z}(a_i), k(z_i,a_i) \geq \overline{k}} y\left(z_i, a_i\right) dF_z\left(z_i|x_i\right)}{e\left(\overline{k}, a_i|x_i\right)}. \tag{3}$$

For fixed covariates x_i, we can calculate the empirical counterparts of the fractions $e(\cdot)$ and the expected outcomes $\mathbf{y}(\cdot)$ for different size and wealth levels $(\overline{k}, a_i = a_0R)$. Our result shows how to use these observable functions to control for unobserved productivity and calculate the causal effects of return on firm-level outcomes.

Proposition 2 (Rank preservation and the causal effect of wealth on firm outcomes)**.** *Fix covariates x_i, a return level R^L, and a log size level $\overline{k}^L \geq \overline{k}\left(a_0R^L\right)$. Let $R^H > R^L$ denote a higher return level and $\overline{k}^H \geq \overline{k}^L$ denote the unique log size that solves (see* (2)*)*

$$e\left(\overline{k}^H, a_0R^H|x_i\right) = e\left(\overline{k}^L, a_0R^L|x_i\right). \tag{4}$$

Let $\mathbf{y}^L = \mathbf{y}\left(\overline{k}^L, a_0R^L|x_i\right)$ denote the expected firm-level outcome among the low-return entrants with size above $\overline{k}^L$, and $\mathbf{y}^H = \mathbf{y}\left(\overline{k}^H, a_0R^H|x_i\right)$ denote the expected outcome among the high-return entrants with size above $\overline{k}^H$ (see (3)*). The difference $\mathbf{y}^H - \mathbf{y}^L$ identifies the average causal effect of wealth on the firm-level outcome for low-return entrants with size above $\overline{k}^L$:*

$$\mathbf{y}^H - \mathbf{y}^L = \frac{\int_{z_i \geq \overline{z}(a_0R^L), k(z_i, a_0R^L) \geq \overline{k}^L} \left[y\left(z_i, a_0R^H\right) - y\left(z_i, a_0R^L\right)\right] dF_z\left(z_i|x_i\right)}{e\left(\overline{k}^L, a_0R^L|x_i\right)}. \tag{5}$$

For intuition, consider the log-size functions with the higher return $k\left(z_i, a_0R^H\right)$ and the lower return $k\left(z_i, a_0R^L\right)$. Since both functions are strictly increasing in z_i, they satisfy $k\left(z_i, a_0R^H\right) = g\left(k\left(z_i, a_0R^L\right)\right)$ where $g(\cdot)$ is a strictly increasing function. Put differently, *changing the return induces a rank preserving mapping of size*: agents that have a higher size level with low return—driven by their higher productivity—are mapped into a higher size level when they have a higher return. In view of this property, matching the high-return and low-return agents by their size rank, as we do with (2), controls for their unobserved productivity. This in turn enables us to estimate the causal effect of wealth on firm-level outcomes such as profits or size. Eq. (5) shows how to calculate the average causal effects for low-return entrants larger than a fixed size level $\overline{k}^L$.

While we can in principle compute the fractions $e\left(\overline{k}, a_0R|x_i\right)$ and implement Proposition 2 separately for each x_i, in practice this computation is not feasible because even large population data sets, such as the one we use, have a much smaller number of entrepreneurs. Therefore, we also develop a version of the proposition that uses *unconditional* fractions along with propensity score reweighting to control for the covariates x_i.

To state the result, consider the fraction of entrepreneurs with wealth $a_i = a_0R$ and minimum size $\overline{k} \geq \overline{k}(a_0R)$ *aggregated over all covariates* (cf. (2))

$$e\left(\overline{k}, a_0R\right) = \int_{x_i} \int_{z_i \geq \overline{z}(a_0R), k(z_i, a_0R) \geq \overline{k}} dF_z\left(z_i|x_i\right) dF_x\left(x_i|R\right). \tag{6}$$

Likewise, consider the expected firm-level outcome aggregated over covariates (cf. (3))

$$\mathbf{y}\left(\overline{k}, a_0R\right) = \frac{\int_{x_i} \int_{z_i \geq \overline{z}(a_0R), k(z_i, a_0R) \geq \overline{k}} y\left(z_i, a_0R\right) dF_z\left(z_i|x_i\right) dF_x\left(x_i|R\right)}{e\left(\overline{k}, a_0R\right)}. \tag{7}$$

Without further adjustment, matching on these unconditional fractions does not control for productivity, because agents with different return levels may differ in their distribution of covariates. We correct for this by reweighting the marginal distributions $dF_x(x_i|R)$, following the large literature on propensity score reweighting (see, e.g., Rosenbaum and Rubin (1983); DiNardo et al. (1996); Heckman et al. (1998); Hirano et al. (2003)).

Formally, for the lower return level R^L we define the *propensity score reweighted* fraction of entrepreneurs:

$$\begin{aligned} e^*\left(\overline{k}, a_0 R^L\right) &= \int_{x_i} \int_{z_i \geq \overline{z}(a_0 R^L), k(z_i, a_0 R^L) \geq \overline{k}} dF_z\left(z_i|x_i\right) \omega\left(x_i\right) dF_x\left(x_i|R^L\right) \\ \text{where } \omega\left(x_i\right) &= \frac{dF_x\left(x_i|R^H\right)}{dF_x\left(x_i|R^L\right)} = \frac{dF_R\left(R^H|x_i\right)}{dF_R\left(R^L|x_i\right)} \frac{dF_R\left(R^L\right)}{dF_R\left(R^H\right)}. \end{aligned} \tag{8}$$

Likewise, we define the *propensity score reweighted* expected outcome for entrants whose size exceeds $\overline{k}$:

$$\mathbf{y}^*\left(\overline{k}, a_0 R^L\right) = \frac{\int_{x_i} \int_{z_i \geq \overline{z}(a_0 R^L), k(z_i, a_0 R^L) \geq \overline{k}} y\left(z_i, a_0 R^L\right) dF_z\left(z_i|x_i\right) \omega\left(x_i\right) dF_x\left(x_i|R^L\right)}{e^*\left(\overline{k}, a_0 R^L\right)}. \tag{9}$$

The second line in (8) defines the propensity weights $\omega(x_i)$ and applies Bayes rule. These weights can be estimated from data since they rely *only* on observable variables and are defined over the full set of agents. Intuitively, the fraction $e^*\left(\overline{k}, a_0 R^L\right)$ overweights (resp. underweights) the agents with covariates x_i that are relatively more common (resp. less common) among agents with higher return R^H. This reweighting makes the sample with return R^L comparable to the sample with return R^H in terms of the distribution of covariates. Consequently, a version of Proposition 2 applies with the reweighted distribution.

Proposition 3 (Rank preservation with propensity score reweighting)**.** *Fix a return level R^L and a log size level $\overline{k}^L \geq \overline{k}\left(a_0 R^L\right)$. Let $R^H > R^L$ denote a higher return level and $\overline{k}^H \geq \overline{k}^L$ denote the unique log size that solves (see* (6) *and* (8)*):*

$$e\left(\overline{k}^H, a_0 R^H\right) = e^*\left(\overline{k}^L, a_0 R^L\right). \tag{10}$$

Let $\mathbf{y}^{*L} = \mathbf{y}^*\left(\overline{k}^L, a_0 R^L\right)$ denote the propensity score reweighted expected firm-level outcome among the low-return entrants with size above $\overline{k}^L$, and $\mathbf{y}^H = \mathbf{y}\left(\overline{k}^H, a_0 R^H\right)$ denote the expected firm-level outcome among the high-return entrants with size above $\overline{k}^H$ (see (7) *and* (9)*). The difference $\mathbf{y}^H - \mathbf{y}^{*L}$ identifies the average causal effect of wealth on the firm-level* *outcome for the propensity score reweighted low-return entrants with size above* $\overline{k}^L$*:*

$$\mathbf{y}^H - \mathbf{y}^{*L} = \frac{\int_{x_i} \int_{z_i \geq \overline{z}(a_0 R^L), k(z_i, a_0 R^L) \geq \overline{k}^L} \begin{bmatrix} y\left(z_i, a_0 R^H\right) \\ -y\left(z_i, a_0 R^L\right) \end{bmatrix} dF_z\left(z_i | x_i\right) \omega\left(x_i\right) dF_x\left(x_i | R^L\right)}{e^*\left(\overline{k}^L, a_0 R^L\right)}. \quad (11)$$

This proposition shows how to estimate the average causal effect for particular entrants with size above an arbitrary level $\overline{k}^L \geq \overline{k}\left(a_0 R^L\right)$. In the empirical analysis, we set $\overline{k}^L = \overline{k}\left(a_0 R^L\right)$ so that we estimate the average causal effect over all low-wealth entrants. Figure 1(b) illustrates this approach.

2.5 Residual Heterogeneity

Underlying the rank preservation condition in Propositions 2 and 3 is an inversion of the ranking of observed business size k_i to infer the ranking of unobserved productivity z_i. This inversion relies on two properties of the monotonicity condition $\frac{\partial k(z_i, a_i)}{\partial z_i} > 0$ in Assumption (M). First, because size is increasing in productivity, agents with higher size have higher productivity—so size rank is a proxy for productivity rank. Second, agents above a given size cutoff all have productivity above the corresponding entry threshold and therefore all choose to enter. This ensures that the *observed* size distribution above the cutoff coincides with the *potential* size distribution, avoiding selection problems near the entry margin.

In the baseline model, these properties hold because size depends only on z_i and wealth $a_i = a_0 R$. In practice, size can also depend on residual factors. Ex ante, individuals may differ in industry-specific skills or leverage costs that affect their prospective firm's size. Ex post, individuals may be subject to productivity shocks or make mistakes relative to the optimal choice. Likewise, profits, outside options, or non-pecuniary benefits may feature residual heterogeneity not fully captured by productivity.

In Appendix B.2, we show that our rank preservation approach is robust to allowing for ex-ante and ex-post residual heterogeneity—denoted by $\boldsymbol{\delta}_i$ and $\boldsymbol{\varepsilon}_i$, respectively—under three additional conditions. First, we strengthen Assumption (CIA) to require the return R to be independent of *both the residual variables and productivity* conditional on the observed covariates x_i. This is the natural extension of (CIA) to the richer environment and remains mild since we focus on quasi-random fluctuations in the portfolio return R conditional on covariates. Importantly, we do *not* require residual heterogeneity to be independent of business productivity z_i—arbitrary correlation between the two is permitted.

The second condition, which we state formally as Assumption (S), requires that log size takes the form $k = G(k_0(z_i, \boldsymbol{\delta}_i, \boldsymbol{\varepsilon}_i), a_i)$, where G is strictly increasing in its first argument and k_0 aggregates all heterogeneity in productivity and residuals into a single index. The key implication is that changing wealth induces a rank-preserving transformation of the size distribution: two agents are ranked in the same order by size with high and low return, regardless of their particular productivity-residual configurations. Controlling for size rank therefore controls for the *joint* distribution of productivity and residuals—generalizing the identification argument in the baseline model to the setup with residuals.

Assumption (S) holds naturally in models where entrepreneurs face financial frictions and firm size is determined by a leverage multiple of entrepreneurial wealth, $K = \Lambda(z_i, \boldsymbol{\delta}_i, \boldsymbol{\varepsilon}_i) \cdot a_i$. In such models, productivity and residual heterogeneity operate through the leverage ratio Λ while wealth enters multiplicatively and separately. This structure obtains both in the baseline model without risk—where the borrowing constraint binds and Λ is determined by the entrepreneur's borrowing capacity—and in the extension with uninsurable risk, where Λ may also depend on the risk aversion coefficient γ and the degree of idiosyncratic risk (see Appendix B.1.1). In either case, the leverage ratio is independent of wealth under CRRA preferences, preserving the separable structure. In Appendix B.2 we further show that the structure extends to settings with fixed entry costs.

Finally, as a third condition, we need to focus on size levels that exceed the entry cutoff by a sufficient margin. This helps to address a selection issue near the entry margin. As in the baseline model, we maintain that size is increasing in productivity. However, this is no longer sufficient to avoid selection effects, because size also depends on the residual variables $\boldsymbol{\delta}_i$ and $\boldsymbol{\varepsilon}_i$. An agent with high residuals but low productivity can have a large potential size yet choose not to enter—her productivity is below the entry threshold. Near the entry cutoff, such agents distort the observed size distribution relative to the underlying distribution of all potential entrants. We address this by focusing on entrants with interior size levels that exceed the entry cutoff by a sufficient margin. This margin is increasing in the degree of residual heterogeneity, as we show in a calibrated numerical example in Appendix B.2. The calibration also provides a diagnostic: if the estimates stabilize as we increase the trimming margin, this indicates that the margin is sufficiently large. In our empirical analysis, we apply this diagnostic and find that the estimates vary little even with a trimming margin of 10% (see Section 6.3). This suggests that in our empirical setting the bias is negligible.

2.6 Dynamic Extension and the Role of Portfolio Returns

So far we have worked with a static model to highlight the main predictions and to show how to correct for the selection on unobserved productivity on firm outcomes. In Appendix B.3 we develop a multi-period extension that more directly motivates our empirical framework. The dynamic model is deliberately parsimonious—focusing on the case with financial frictions and assuming constant wages and business productivity over time—in order to derive qualitative insights that we expect to hold more broadly. We characterize the dynamic decisions of a worker and an entrepreneur separately, and then derive the implications of the entry choice for our empirical specification.

The individual enters into business when her wealth starts below a cutoff but then crosses it. The threshold $\overline{a}(z)$ is decreasing in business productivity as in the static model. The difference is that the individual's wealth evolves endogenously driven by her savings and portfolio decisions. Under simplifying assumptions, if the individual chooses to work, then her wealth evolves according to (see Eq. $(B.45)$):

$$a_{t+1} = \left(\beta a_t + w\left(\frac{\beta - 1/R^f}{1 - 1/R^f}\right)\right) R_{t+1}.$$

Here, β denotes the discount factor that captures the individual's propensity to save, R^f is the gross risk-free return, and R_{t+1} is the individual's (endogenous) gross portfolio return. Letting $r_{t+1} = R_{t+1} - 1$ denote the corresponding *net* portfolio return, we obtain the following condition for entry in period t (see Eq. $(B.46)$):

$$\begin{aligned} a_t &< \overline{a}(z) \text{ and} \\ a_{t+1} &\geq \overline{a}(z) \iff a_t\, r_{t+1} \geq a_t \left[\frac{\overline{a}(z)}{\beta a_t + w\left(\frac{\beta - 1/R^f}{1-1/R^f}\right)} - 1\right]. \end{aligned}$$

The second condition says that the agent becomes an entrepreneur when the return component of wealth change $a_t\, r_{t+1}$ exceeds a cutoff that depends on productivity and lagged wealth. This directly motivates our empirical specification, in which the key regressor is the stock return component of wealth change.

The first condition $a_t < \overline{a}(z)$ says that entrants have wealth below their cutoff value in the last period and experience an *increase* in their wealth when they enter. Intuitively, would-be entrants with a higher wealth had already entered in past periods. This condition suggests that the portfolio return is likely to have an asymmetric effect on entry, with positive returns generating stronger effects than negative returns (see Appendix B.3 for a formalization). We find evidence consistent with this type of asymmetry in our empirical analysis.

3 Data and Definitions

We combine a number of administrative data sets from Norway using unique personal and firm identification numbers, as well as the unique ISINs of publicly traded shares. The unit of analysis is a household. Our data set construction shares similarities with Fagereng et al. (2020) and Ring (2022).

3.1 Data

We obtain information on the composition of stock portfolios and business ownership from the shareholder register ("Aksjonærregisteret"). This data set records information on ownership of shares in Norwegian limited liability firms, both publicly traded and privately held, and the book value of those shares at the end of each calendar year starting in 2004. The information is collected by the Norwegian tax authority and is third-party reported by financial intermediaries and includes stocks held in individual retirement accounts.[7] Using the security-level ISIN numbers for publicly traded stocks, we merge the stock ownership data with prices and returns for all publicly traded stocks on the Oslo stock exchange (OSE). These returns account for stock splits and other similar events.[8] We use the shareholder register information on shares in privately held companies to determine entry into entrepreneurship, as discussed further below.

We obtain household balance sheet and income information from tax records ("Inntekt" register). The household balance sheet information includes total gross financial wealth subject to the Norwegian wealth tax and asset holdings for broad asset classes such as deposits, publicly-traded Norwegian stocks, stock and bond mutual funds, bonds, and foreign assets. It also comes from third-party reporting to the Norwegian tax authority (except ownership of foreign assets). We do not know the details of specific asset holdings within broad asset classes of financial wealth outside of directly-held publicly-traded Norwegian stocks, so the variation in portfolio returns will come only from that component. However, being able to quantify the "known unknown" in financial wealth, including overall holdings

[7]Most directly-held stock wealth in Norway is held outside of individual retirement accounts, as such accounts were not particularly wide-spread for most of our sample. Smogeli and Halvorsen (2019) report that in 2017 the aggregate value of "Individuell Pensjonssparing" (IPS) accounts was around 37 billion NOK, or 0.7% of total retirement wealth in Norway. Around 353 thousand people aged 17 and over had such retirement accounts, with a median balance of 48 thousand NOK. The vast majority of retirement wealth is in the national social insurance fund, with a smaller amount managed by occupational pensions.

[8]See Ødegaard (2013) for details of the OSE data.

of mutual funds and non-Norweigian stocks, will prove important in our research design.

The Norwegian register data also provide a number of variables used as covariates in the analysis, including education and age of the household members, family status, and municipality of residence ("Befolkning" and "Utdanning" registers). We obtain the NACE sector of primary employment of the highest earning individual in the household ("household head") by merging the tax records to the employer-employee register ("Aa-registeret").

Our firm-level data start with information from the "Aksjonærregisteret" on all limited liability firms in Norway, including the exact foundation date, closing date (if the firm is dissolved), primary sector, the total number of shareholders for different classes of shares, and the book value of outstanding shares for each firm. We combine with information on employment from the employer-employee register, as well as annual firm balance sheets and income statements from tax records ("Regnskapsdata").[9] We use the employment in the subsequent year in the cases when employment in year of foundation is missing.

We restrict attention to households with a household head between 20 and 65 years old. We drop household-year observations with no earnings and zero financial asset holdings, as well as observations with (lagged) real gross financial assets below 50 thousand and above 5 million Norwegian kroner.[10] We also drop observations of direct stock owners with less than 1% (lagged) exposure to domestic publicly traded stocks. Furthermore, for our regression analysis we drop households after they become entrepreneurs. Our final sample covers the period 2004-2019.

3.2 Entrepreneur Definition

We follow the entrepreneur definition advocated by Levine and Rubinstein (2017) and focus on owners of incorporated firms.[11] As shown by Levine and Rubinstein (2017) for the US, owners of incorporated firms and recipients of self-employment income from unincorporated businesses tend to be quite different, and their firms also tend to perform very differently.[12] Specifically, we define an entrepreneur as an individual who owns at least 1/3 of the book value of stocks in an incorporated non-financial firm, and where the firm has at most 3 stock owners and at least one employee in the year of foundation or subsequent year. We further require that either the newly-created firm does not own publicly traded domestic stocks in

[9] We deflate all nominal values and returns to 2010 Norwegian kroner. Throughout our sample period the dollar-kroner exchange rate fluctuates between 4.9 and 9.3, with a mean of 6.8.

[10] Below we refer to the household's gross financial asset holdings as the household's financial wealth. Financial wealth is a subset of total wealth, which also includes real assets like real estate and vehicles. As such, our focus is slightly different than, for example, Fagereng et al. (2020), who focus on total wealth in their analysis of Norwegian household balance sheets.

[11] See Table 5 for results using recipients of self-employment income.

[12] See also Berglann et al. (2011) for a similar delineation for Norway.

the year of foundation or that it has employees that are not members of the entrepreneur's household. A transition to entrepreneurship requires both a newly-created firm and that the household not have owned stocks in any private firm in the past. Upon transitioning to entrepreneurship, a household exits our sample.

These restrictions collectively focus attention on first-time active owners of new firms.[13] In particular, the limit on number of owners helps to exclude passive investment positions in private firms (e.g. angel investing), the employment restriction ensures the new firm is economically active, and the requirement that either the firm have employees unrelated to the entrepreneur or that the firm holds no public equity filters out inactive "family investment firms" created to store unrealized capital gains or losses for tax simplification purposes.

To put our entrepreneurship definition into perspective, Table 1 reports shares of business ownership and transitions to different types of business ownership both among the owners of publicly traded Norwegian stocks ("Stock owners"), as well as for our whole sample ("Population"). The first row includes both owners of at least 1/3 of the book value of any incorporated firm, as well as households that receive unincorporated business or farm income. We then progressively tighten the definition until we arrive at the definition of entrepreneurship we use.[14]

In addition to this table, Appendix Table A.6 includes additional descriptive statistics for the groups of entrepreneurs and non-entrepreneurs, as well as the groups of direct owners of Norwegian public stocks and the rest. Entrepreneurs tend to be younger, with slightly higher earnings but slightly lower financial wealth and lower holdings of publicly traded domestic stocks compared to non-entrepreneurs. Direct owners of domestic publicly traded stocks constitute around 12.6% of our sample. These households tend to be older, have higher earnings and higher level of financial wealth than the rest of our sample. The fact that entrepreneurs have higher earnings upon transitioning compared to non-entrepreneurs but lower direct holdings of domestic publicly traded stocks is broadly in line with the findings of Bhandari et al. (2022) using data from the U.S.

[13] See Brandt et al. (2022) for an analysis of the differences between serial and non-serial entrepreneurs using detailed firm-level data from China.

[14] Strictly speaking our baseline definition for entrepreneurs includes those in (VII) but for whom the transition happens for the first time. Therefore, in principle the definition in (VII) and our baseline definition of entrepreneurship do not overlap exactly because of the possibility of serial entrepreneurship with breaks. In practice, however, the difference is negligible as a share of the population, and so the shares in row (VII) essentially overlap with the shares of entrepreneurs according to our definition.

Table 1: Business Owners Descriptive Statistics

	Stock owner (in %)	Population (in %)
(I) owns $\geq \frac{1}{3}$ book value (BV) of an incorporated firm or receives business/farm/forestry income	22.64	20.63
(II) owns $\geq \frac{1}{3}$ BV of an incorporated firm ("owns a business")	10.17	8.35
(III) owns a business with ≤ 3 shareholders	9.44	7.84
(IV) AND is non-financial firm	8.34	7.16
(V) AND has employees	4.30	4.19
(VI) transitions to a business such as in (V)	0.38	0.38
(VII) transitions to a business such as in (V) that is newly created and not "family investment firm"	0.18	0.21

Notes: The table reports shares of business ownership and transitions to different types of business ownership both among the owners of publicly traded Norwegian stocks ("Stock owners") as well as for our whole sample ("Population"). The first row includes both owners of at least 1/3 of the book value of any incorporated firm as well as households that receive unincorporated business or farm income. Subsequent rows progressively narrow this group as described in the first column of the table.

4 Econometric Methodology

This section presents our baseline specification and explains how we isolate quasi-random variation in stock market wealth.

4.1 Econometric Design

Let $E_{i,t}$ denote an indicator for individual i becoming an entrepreneur in year t. Following our dynamic model in Section 2.6 , we consider $E_{i,t}$ as a function of the return component of wealth change, $a_{i,t} - a_{i,t-1} - y_{i,t-1,t}$. Here, $a_{i,t}$ denotes financial wealth at date t and $y_{i,t-1,t}$ net contributions between $t-1$ and t. We also allow $E_{i,t}$ to depend on other *ex ante* observed characteristics $X_{i,t-1}$ and unobserved characteristics $\epsilon_{i,t}$. The terms $X_{i,t-1}$ and $\epsilon_{i,t}$ include determinants discussed in Section 2, such as the wage if remaining in paid employment and entrepreneurial ability, as well as other factors, such as preferences.

We do not observe all transactions and their value during the year and hence cannot construct the total return component of wealth change. Instead, we focus on the (kroner) change in financial wealth due to stock market returns. Thus, define the return on financial wealth $r_{i,t}$ associated with stocks held at $t-1$ as:

$$r_{i,t} = r_t^f + \omega_{i,t-1}\mathbf{s}'_{i,t-1}\mathbf{r}_t,$$

where r_t^f is the risk-free return, $\omega_{i,t-1}$ denotes the share of financial wealth held in domestic stocks at the end of year $t-1$, $\mathbf{s}_{i,t-1}$ the weight in the domestic stock portfolio of each stock, and $\mathbf{r}_t$ the vector of realized excess returns of domestic stocks in year t. The buy-and-hold change in wealth due to stock returns (hereafter "kroner change" for short), $a_{i,t-1}r_{i,t}$, differs from the total return component of wealth change, due to excess returns on other (e.g. non-domestic equity) risky financial assets as well as the excess returns from the trading of stocks in year t. Nonetheless, if we can isolate quasi-random variation in $r_{i,t}$, then the variation identifying the effect of the buy-and-hold kroner change is orthogonal to the difference between the buy-and-hold change and total return component. Therefore, our focus on the buy-and-hold kroner change $a_{i,t-1}r_{i,t}$ also recovers the effect of the total return component.[15]

How do we isolate quasi-random variation in the stock return? To frame the problem, it helps to decompose the excess return from stocks into systematic and idiosyncratic components: $\mathbf{s}'_{i,t-1}\mathbf{r}_t = \beta_{i,t-1} \times r_t^m + \nu_{i,t}$, where r_t^m is the market excess return in year t, $\beta_{i,t-1}$ is the portfolio "beta" for stock holdings at the end of $t-1$, and $Var(\nu_{i,t}) = \sigma^2_{i,t-1}$.[16] A first issue arises because the *realized* idiosyncratic component $\nu_{i,t}$ may be correlated with unobserved determinants of entrepreneurship $\epsilon_{i,t}$. For example, home bias in portfolio choice (Coval and Moskowitz, 1999) could result in households experiencing better stock market returns in periods when their current industry or local area is booming. We address such concerns by including sector×time and municipality×time fixed effects in all specifications.

The second main concern is that *expected* returns may vary across households in a manner correlated with the entrepreneurship decision. For example, a more risk-tolerant individual might choose a stock portfolio with a higher market beta, implying higher expected returns, and risk tolerant individuals might also be more likely to transition to entrepreneurship for other reasons. Or individuals likely to become entrepreneurs might hold more or less of their wealth in domestic stocks. Borusyak and Hull (2021) term this "non-random exposure" and show that in linear regression it suffices to control for the *ex ante* expected realization. In our setting, variation in exposure comes from portfolio characteristics. Specifically, the expected buy-and-hold return is $\mathbb{E}_{t-1}r_{i,t} = \mathbb{E}_{t-1}r_t^f + \omega_{i,t-1} \times \beta_{i,t-1} \times \mathbb{E}_{t-1}r_t^m$.

We control flexibly for different expected buy-and-hold returns by creating bins of $\omega_{i,t-1}, \beta_{i,t-1}$, and $\sigma_{i,t-1}$ and including interactions of these bins and time fixed effects, where

[15]The relationship between the buy-and-hold change and total return component is stronger when individuals' stock portfolios are more persistent over time. Empirically, we find stock portfolios are quite persistent, with a large share of stock holders not adjusting their portfolio over a one year horizon (see Table A.3).

[16]We use this timing notation because we hold fixed the characteristics $\beta_{i,t-1}$ and $\sigma^2_{i,t-1}$ at their values from the previous year. We omit expected excess returns ("alpha") from the return representation because we find that the idiosyncratic component of returns has close to zero serial correlation in our data.

the interactions with time accommodate unrestricted time-variation in the risk-free rate or expected market return. The non-parametric controls for portfolio characteristics and inclusion of the return variance $\sigma_{i,t-1}$ is necessary for the non-parametric and non-linear specifications reported below.[17] Effectively, we compare entrepreneurship rates across two individuals in the same year with the same allocation to domestic stocks and the same portfolio beta but different realized excess returns. The variation in $r_{i,t}$ thus comes from random realizations on portfolios with the same *ex ante* characteristics, where the randomness arises as the result of the idiosyncratic component of the portfolio holdings $\nu_{i,t}$ purged of industry or location characteristics.

Why do such idiosyncratic returns arise? Table A.3 reports statistics from the distribution of household portfolio characteristics. Portfolios of domestic stocks exhibit high concentration, with the median stock owner holding just two stocks. Such high concentration implies an absence of diversification, making possible sizable idiosyncratic differences in returns. Direct stock owners also tend to have a relatively limited investment in other risky assets such as stock mutual funds, with the remaining share of financial wealth held in deposits.

To further validate our identifying assumption of conditional random assignment in buy-and-hold returns, we follow the approach from Cesarini et al. (2017) and perform a test for violation of conditional random assignment. Specifically, Table A.9 reports results from regressing the buy-and-hold return $r_{i,t}$ on a set of household-level variables, including indicators for secondary and tertiary education, log lagged earnings and log lagged financial wealth, without and with our non-parametric controls for portfolio characteristics. Once we control for the portfolio characteristics, the demographic variables have no predictive power for the return. Additionally, Figure A.5 in the Appendix shows changes in household balance sheet items in response to a stock-owning household receiving a large stock return (defined as an excess buy-and-hold return of 20% or more), compared to a household that receives a small stock return. Prior to the year with the large stock return, households appear to be on parallel trends in terms of non-business liquid financial wealth (defined as total financial wealth net of Norwegian private business equity) and active changes in stock holdings (defined as the annual change in the value of the portfolio of directly-held stocks, holding stock prices fixed throughout the year). These parallel pre-trends are consistent with conditional random assignment of buy-and-hold returns.

Finally, even if the buy-and-hold return $r_{i,t}$ is conditionally randomly assigned, the level of initial financial wealth $a_{i,t-1}$ correlates with $\epsilon_{i,t}$ if wealthier households are more likely to enter into business for other reasons (Hurst and Lusardi, 2004). Put differently, using the

[17] The bins for ω, β, and σ should have relatively low within-bin dispersion. We therefore truncate their distributions at the 2nd and 98th percentiles and report robustness in Section 5.2 to not truncating.

buy-and-hold kroner change $a_{i,t-1}r_{i,t}$ as a regressor leads to an omitted variable bias even if $r_{i,t}$ is random. We address this challenge by instrumenting for the kroner change $a_{i,t-1}r_{i,t}$ using just the return component $r_{i,t}$.

To summarize, our baseline specification for the effect of the stock market on transitioning to entrepreneurship takes the form:

$$E_{i,t} = b \times a_{i,t-1}r_{i,t} + \alpha_{\text{sector}\times t}(i) + \alpha_{\text{munic.}\times t}(i) + \alpha_{\beta\times\sigma\times\omega\times t}(i) + \epsilon_{i,t}, \tag{12}$$

where $\alpha_{y\times z}(i)$ denotes a fixed effect for observation i belonging to group $y \times z$. We estimate this equation by 2SLS, instrumenting for $a_{i,t-1}r_{i,t}$ with $r_{i,t}$. In some specifications we also control for additional covariates. These covariates absorb residual variation in the likelihood of becoming an entrepreneur and relax specific assumptions in our baseline implementation.

4.2 Implementation

We measure the portfolio characteristics $\beta_{i,t-1}$ and $\sigma_{i,t-1}$ using daily returns over the year $t-1$. Specifically, for each observation we form the time series of daily returns $\mathbf{s}_{i,t-1}\mathbf{r}_{t-1+\Delta}$, where $\mathbf{r}_{t-1+\Delta}$ gives the vector of individual stock returns on day $t-1+\Delta$, and we fix the weights at their value at the end of the year.[18] We obtain $\beta_{i,t-1}$ as the OLS regression coefficient from a regression of $\mathbf{s}_{i,t-1}\mathbf{r}_{t-1+\Delta}$ on $r^m_{t-1+\Delta}$ (which we equate with the OSEAX stock market index – a full-market value-weighted index) and $\sigma_{i,t-1}$ as the variance of $\mathbf{s}_{i,t-1}\mathbf{r}_{t-1+\Delta}$.[19]

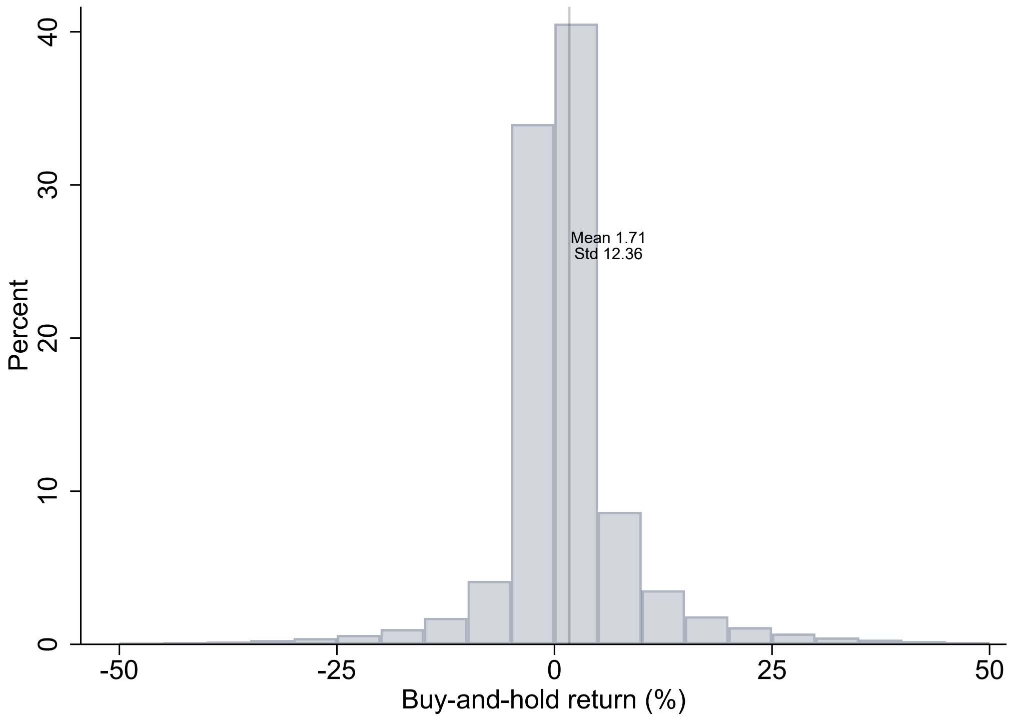
Figure 2 plots the unconditional distribution of buy-and-hold returns on financial wealth in our sample.[20] Portfolio returns tend to be small on average but with a substantial standard deviation of around 12% and non-zero mass of relatively large return realizations of above 25%. The distribution of returns is also right-skewed, reflecting the in-sample positive mean return on the aggregate stock market, which we decompose in Figure 3 by splitting buy-and-hold portfolio returns in two groups based on whether the average return on the OSEAX stock market index is above or below the 2004-2019 median. In our empirical analysis we will examine the heterogeneous effects of higher returns in years with above or below median aggregate stock market returns, which we will refer to as "good" and "bad" stock market years.

[18]We use price returns to focus on the unexpected component of the stock return but our results are little changed if we use total returns instead.

[19]Section 5.2 reports robustness to allowing for up to three portfolio factors or to replacing the OSEAX with the U.S. CRSP value-weighted index, as well as several other robustness exercises that try to account for possible additional differences in portfolio characteristics that correlate with the propensity to start a firm. Figures A.1-A.3 in the Appendix plot the distributions of β, σ and ω.

[20]Households who are not direct owners will be treated as a separate category in our regressions.

Figure 2: Portfolio Return Distribution



Notes: Buy-and-hold returns $r_{i,t}$ are defined as $r_{i,t} = r_t^f + \omega_{i,t-1}\mathbf{s}'_{i,t-1}\mathbf{r}_t$, where r_t^f is the risk-free return in year t, $\omega_{i,t-1}$ denotes the share of financial wealth held in domestic stocks at the end of year $t-1$, $\mathbf{s}_{i,t-1}$ the weight in the stock portfolio of each domestic stock, and $\mathbf{r}_t$ the vector of realized excess returns of domestic stocks in year t.

5 Results on the Propensity to Start a Business

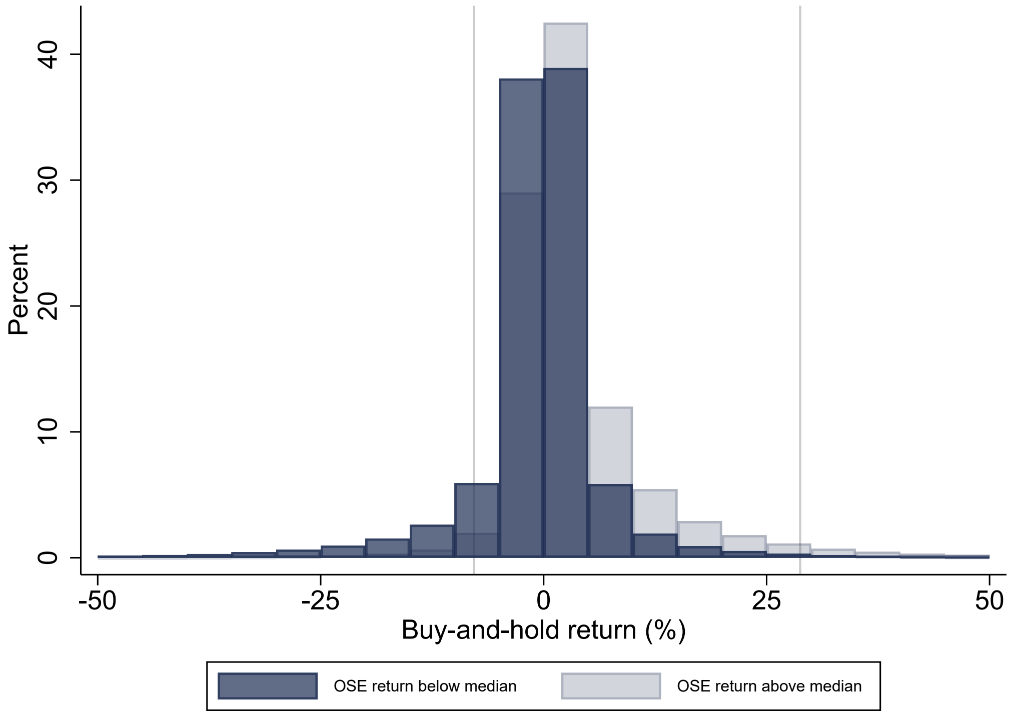
In this section we present results on the effects of stock market wealth on the propensity to start a business.

5.1 Baseline Results

We start with a non-parametric approach. We partition the space of financial wealth and buy-and-hold portfolio returns into several bins and estimate the average effect from being in a particular bin on the propensity to start a business relative to a specific base bin. Our specification includes the fixed effect controls described in Section 4. We split financial wealth in two groups: below 600k ("moderate wealth") and above 600k ("high wealth"). For buy-and-hold returns we have 7 bins with the return bin of (0%, 5%] serving as base.

Figure 4 presents the estimated relative effects for each wealth bin. There is a notable positive effect of having a relatively high return of 25% or above for the moderate wealth

Figure 3: Portfolio Return Distribution: Good vs. Bad Stock Market Years



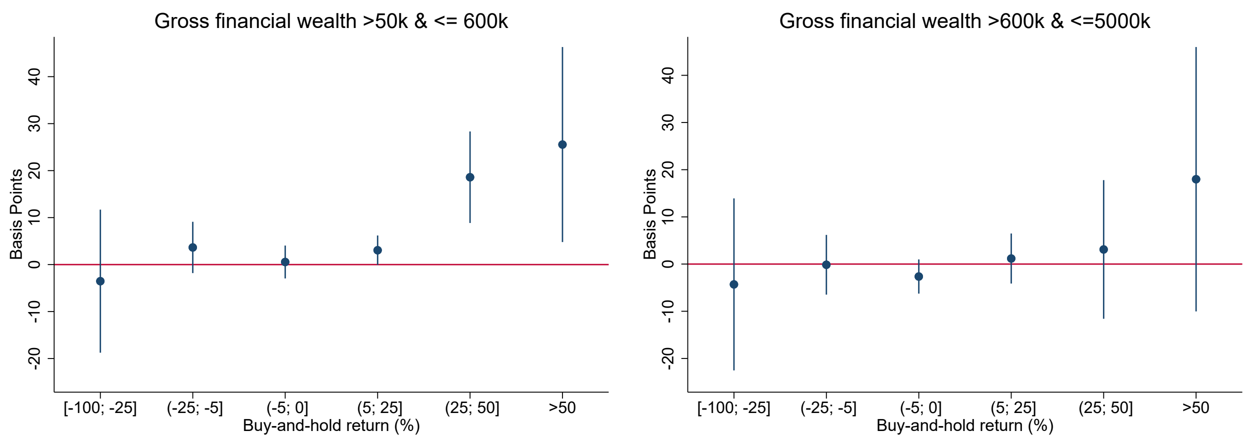
Notes: Buy-and-hold returns $r_{i,t}$ are defined as $r_{i,t} = r_t^f + \omega_{i,t-1}\mathbf{s}'_{i,t-1}\mathbf{r}_t$, where r_t^f is the risk-free return in year t, $\omega_{i,t-1}$ denotes the share of financial wealth held in domestic stocks at the end of year $t-1$, $\mathbf{s}_{i,t-1}$ the weight in the stock portfolio of each domestic stock, and $\mathbf{r}_t$ the vector of realized excess returns of domestic stocks in year t. The figure plots the distributions of buy-and-hold returns for two groups of years: years in which the aggregate OSEAX return is above the median value in the period 2004-2019 and years in which the OSEAX return is below the median value.

group. In contrast the effects for high wealth are much smaller. The effect also appears to be asymmetric in the sign of buy-and-hold returns with only significant effects observed for sufficiently high positive returns. This asymmetry is consistent with only positive returns moving individuals above their wealth cutoff for starting a business, as in the dynamic extension discussed in Section 2.6.

Table 2 reports regression coefficients from IV regressions, in which the buy-and-hold kroner change is instrumented by buy-and-hold returns as discussed in Section 4.[21] The buy-and-hold kroner changes are in 10,000 NOK, while the coefficient estimates are in basis points. Column (1) pools the full sample and all years. The coefficient of 0.23 implies that a gain of 10,000 NOK due to stock returns raises the entry rate by 0.23 basis points. For comparison, the raw correlation between directly-held stock wealth and entrepreneurship implies that 10,000 NOK higher stock wealth is associated with a 0.30 basis point higher

[21] Table A.10 in the Appendix presents the reduced-form estimates with excess buy-and-hold returns as regressor.

Figure 4: Non-parametric Entry Results



Notes: We define an entrepreneur as a household that owns at least 1/3 of the book value of stocks in an incorporated non-financial firm with at most 3 stock owners which employs at least one worker. When considering the transition to entrepreneurship we only consider newly-created firms and households who have not owned stocks in any private firm in the past. In addition we require that the newly-created firm does not own publicly traded domestic stocks in the year of foundation unless it has employees that are not members of the entrepreneur's household. Furthermore, upon transitioning to entrepreneurship a household is dropped from our sample. Effects in each return bin are relative to a base buy-and-hold portfolio return between 0% and 5%. Controls include age group indicators (for 3 age groups of the household head: 20-34 years, 35-49 years and 50-65 years), municipality-by-year fixed effects, primary employment sector-by-year fixed effects, and a set flexible controls given by a four-way interactions between interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the portfolio, 7 bins of volatility for the observed part of the portfolio and year. Buy-and-hold returns $r_{i,t}$ are defined as $r_{i,t} = r_t^f + \omega_{i,t-1}\mathbf{s}'_{i,t-1}\mathbf{r}_t$, where r_t^f is the risk-free return in year t, $\omega_{i,t-1}$ denotes the share of financial wealth held in domestic stocks at the end of year $t-1$, $\mathbf{s}_{i,t-1}$ the weight in the stock portfolio of each domestic stock, and $\mathbf{r}_t$ the vector of realized excess returns of domestic stocks in year t. The bars represent 95% confidence intervals computed with clustering on the level of the municipality.

propensity to be an entrepreneur, so our causal estimate is about three-quarters of this reduced-form correlation.

Motivated by the evidence in Figure 4, columns (2) and (3) split the sample into households with less than 600k NOK or more than 600k NOK in initial financial wealth, respectively. The coefficient estimate is substantially larger for the sample with moderate initial financial wealth. In particular, one can reject equality of the coefficients for moderate versus high wealth households at a significance level of 1%. Furthermore, column (4) shows that the effects are significantly larger for good stock market years compared to bad stock market years among the moderate wealth group. A two-sided t-test rejects equality of the coefficients for a good versus bad stock market year in column (4) at a significance level of 1%. Finally, column (5) displays the asymmetric effects of positive versus negative buy-and-hold kroner changes on the propensity to start a business, A two-sided t-tests rejects equality of the two coefficients at a significance level of 10%.

To put these magnitudes in context, the estimated effect in column (2) implies that a 40k

NOK (around 6k USD based on the sample average exchange rate) increase in (one year) stock market wealth increases the propensity to start a business by around 4.5 basis points, which is around 25% of the baseline entrepreneurship rate.[22]

[22]For further context, Norway has a minimum startup equity threshold that fell from 100k NOK to 30k NOK in 2012. We do not have power to detect different marginal responses before and after. See Bacher et al. (2024) for analysis of the effects of the threshold change on overall entrepreneurship rates.

Table 2: Baseline Entry Results

	Dep. var.: becomes entrepreneur ($E_{i,t}$)				
	(1)	(2)	(3)	(4)	(5)
Kroner change	0.233*	1.121**	0.012		
	(0.099)	(0.389)	(0.053)		
Kroner change, $r_{OSEAX,t} \leq r_{OSEAX,median}$				−0.241	
				(0.527)	
Kroner change, $r_{OSEAX,t} > r_{OSEAX,median}$				1.643**	
				(0.476)	
Kroner change, $r_{i,t} \leq 0$					−0.590
					(0.974)
Kroner change, $r_{i,t} > 0$					1.408**
					(0.493)
Sample	All	$\leq 600k$	$> 600k$	$\leq 600k$	$\leq 600k$
Age group FE	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes
Primary sector-year FE	Yes	Yes	Yes	Yes	Yes
Portfolio-year FE	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ
Clusters	422	422	422	422	422
Observations	13,027,888	10,444,167	2,583,400	10,444,167	10,444,167
F-stat	776.7	4251	1340.7	4576	6304.6
Median fin. wealth	255.9	175.7	1111.6	175.7	175.7

Notes: 2SLS estimates with buy-and-hold kroner change in financial wealth due to stock returns instrumented with the buy-and-hold return. The buy-and-hold kroner change in t is defined as the product of buy-and-hold returns $r_{i,t}$ and lagged financial wealth. For easier interpretation the coefficient estimates reflect the effect of a 10,000 NOK kroner change on the propensity to become an entrepreneur in basis points. All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years and 50-65 years. The flexible controls in all specifications include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the stock portfolio, 7 bins of volatility for the observed part of the stock portfolio and year. Specifications (2) and (3) are restricted to gross financial wealth of up to 600k NOK and more than 600k NOK in 2010 prices, respectively. An entrepreneur is defined as a household that owns at least 1/3 of the book value of stocks in an incorporated non-financial firm with at most 3 stock owners which employs at least one worker. For transition to entrepreneurship we only consider newly-created firms and households who have not owned stocks in any private firm in the past. In addition, we require that the newly-created firm does not own publicly traded domestic stocks in the year of foundation unless it has employees that are not members of the entrepreneur's household. Furthermore, upon transitioning to entrepreneurship a household is dropped from our regression sample. Standard errors in parentheses are clustered at the municipality level with a total of 422 clusters in each specification. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

5.2 Robustness

We perform a number of robustness exercises and specification tests. In all of our robustness exercises we focus on the specification in column (2) of Table 2 as the baseline for concreteness.[23] Table 3 presents robustness to changing the set of covariates. Column (1) adds 6 bins of financial wealth interacted with year to absorb any correlation between *ex ante* wealth and the propensity to start a firm. Column (2) controls for lagged log labor earnings, since as shown in Section 2 labor market earnings serve as an opportunity cost in the business creation decision of a potential entrepreneur. Column (3) includes a richer set of portfolio controls based on the Fama and French (1993) three factor model: a 6-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of market betas from a Fama-French 3-factor model, 7 bins of volatility for the observed part of the portfolio, 2 bins for loading on the SMB (small minus big) factor, 2 bins for loading on the HML (high minus low) factor and year. Column (4) controls for the interaction between the NACE sector of a stock-owner's highest returning holding and year to account for stock-owners loading on industries that they believe would do well and subsequently starting firms in those industries. The main regression coefficient changes little with any of these additional covariates. Column (5) considers a specification that controls for portfolio composition by including a three-way interaction of bins of the share of financial wealth invested in domestic stock mutual funds, bins of the exposure to directly-held domestic stocks and year. In this way we account for possible systematic differences in portfolio composition and the propensity to enter into business.[24] In particular, this flexible control can help account for systematic differences in financial literacy, which lead to households holding undiversified portfolios of stocks versus more diversified mutual fund holdings. These controls turn out to matter little for our coefficient estimate. Finally, column (6) illustrates the importance of the flexible controls for *ex ante* portfolio heterogeneity by removing them altogether. The estimated coefficient is now substantially reduced and less significant. This points to *ex ante* portfolio heterogeneity being an important confounder for the link between stock returns and entrepreneurship.

[23]See Tables A.13-A.15 in the Appendix for robustness exercises based on the full sample.

[24]In our measure of portfolio composition we focus only on stock mutual fund and domestic stock ownership, since other holdings of asset classes, such as bond mutual funds, bonds, or international financial assets are much more concentrated in Norway – see Table A.7.

Table 3: Robustness to Additional Covariates

	Dep. var.: becomes entrepreneur ($E_{i,t}$)					
	(1)	(2)	(3)	(4)	(5)	(6)
kroner change	1.131**	1.097**	1.182**	1.106**	1.074*	0.424+
	(0.389)	(0.410)	(0.410)	(0.402)	(0.455)	(0.243)
Age group FE	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Primary sector-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Financial wealth-year FE	Yes	No	No	No	No	No
Portfolio-year FE	ω-β-σ	ω-β-σ	3-factor model	ω-β-σ	ω-β-σ	None
Clusters	422	422	422	422	422	422
F-stat	4276.8	4002.1	3163.4	4055.8	3250.8	8786.1
Observations	10,444,167	9,723,908	10,416,289	10,442,921	7,558,169	10,444,332
Description	Wealth bins	Labor income control	3-factor model	Addn'l. sectoral controls	Portfolio composition	No portfolio characteristics

Notes: 2SLS estimates with buy-and-hold kroner change in financial wealth due to stock returns instrumented with the buy-and-hold return. The buy-and-hold kroner change in t is defined as the product of buy-and-hold returns $r_{i,t}$ and lagged financial wealth. For easier interpretation the coefficient estimates reflect the effect of a 10,000 NOK kroner change on the propensity to become an entrepreneur in basis points All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years and 50-65 years. Flexible controls in specifications (1), (2), (4) and (5) include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the portfolio, 7 bins of volatility for the observed part of the portfolio and year. Flexible controls in specification (3) include a 6-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of market betas from a Fama-French 3-factor model (Fama and French, 1993) for the observed part of the portfolio, 7 bins of volatility for the observed part of the portfolio, 2 bins for exposure to the SMB factor, 2 bins for exposure to the HML factor and year. Additional controls in specification (1) include 6 bins of financial wealth times year. Additional controls in specification (2) include lagged labor market income. Additional controls in specification (4) include an interaction between the level 1 NACE sector of the highest returning holding and year. Specification (5) includes a three-way interaction of 8 bins of share of financial wealth invested in directly-held domestic stocks, 5 bins of share of financial wealth held in domestic mutual funds and year. Note that for specification (5) we drop observations after 2015. We define an entrepreneur as a household that owns at least 1/3 of the book value of stocks in an incorporated non-financial firm with at most 3 stock owners which employs at least one worker. When considering the transition to entrepreneurship we only consider newly-created firms and households who have not owned stocks in any private firm in the past. In addition we require that the newly-created firm does not own publicly traded domestic stocks in the year of foundation unless it has employees that are not members of the entrepreneur's household. Furthermore, upon transitioning to entrepreneurship a household is dropped from our sample. All specifications are restricted to gross financial wealth of up to 600k 2010 NOK. Standard errors in parentheses are clustered at the municipality level with a total of 422 clusters in each specification. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 4: Robustness to Alternative Return Definitions

	Dep. var.: becomes entrepreneur ($E_{i,t}$)				
	(1)	(2)	(3)	(4)	(5)
kroner change	1.233*	1.641*	1.082**	1.015**	
	(0.495)	(0.819)	(0.385)	(0.354)	
placebo kroner change					0.246
					(0.273)
Age group FE	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes
Sector-year FE	Yes	Yes	Yes	Yes	Yes
Portfolio-year FE	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ
Clusters	422	422	422	422	422
F-stat	2763.5	2457.9	3767.2	25830.3	6730
Observations	10,276,460	10,082,807	10,444,167	10,444,151	10,399,696
Description	< 3 stock owner	< 3 stock owner (top 20 stocks)	Own employer stock	Heterogeneous risk-free rate	Placebo returns

Notes: 2SLS estimates with buy-and-hold kroner change in financial wealth due to stock returns instrumented with the buy-and-hold return. The buy-and-hold kroner change in t is defined as the product of buy-and-hold returns $r_{i,t}$ and lagged financial wealth. For easier interpretation the coefficient estimates reflect the effect of a 10,000 NOK kroner change on the propensity to become an entrepreneur in basis points All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years and 50-65 years. Flexible controls in all specifications include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the portfolio, 7 bins of volatility for the observed part of the portfolio and year. Column (1) restricts the sample to households with less than 3 directly-held stocks and (2) further requires the highest returning stock holding to be among the top 20 most popular traded Norwegian companies. In Column (3) we replace in the excess buy-and-hold portfolio return the return of the firm which the household head is employed in with the OSEAX return for that year. In column (4) we allow for household-level heterogeneity in the risk-free rate. The heterogeneous risk-free rate is based on Fagereng et al. (2020) and is computed as the ratio of interest income over the sum of deposit holdings in $t-1$ and one-half of the change in deposit holdings from year $t-1$ to t net of interest income. In (5) we construct a placebo kroner change at $t+1$ based on a period $t+1$ return, defined as $r_{i,t+1} = r^f_{t+1} + \omega_{i,t-1}\mathbf{s}'_{i,t-1}\mathbf{r}_{t+1}$, where r^f_{t+1} is the risk-free return in year $t+1$, $\omega_{i,t-1}$ denotes the share of financial wealth held in domestic stocks at the end of year $t-1$, $\mathbf{s}_{i,t-1}$ the weight in the stock portfolio of each domestic stock, and $\mathbf{r}_{t+1}$ the vector of realized returns of domestic stocks in year $t+1$, which we also use as an instrument for the placebo kroner change at $t+1$. We define an entrepreneur as a household that owns at least 1/3 of the book value of stocks in an incorporated non-financial firm with at most 3 stock owners which employs at least one worker. When considering the transition to entrepreneurship we only consider newly-created firms and households who have not owned stocks in any private firm in the past. In addition we require that the newly-created firm does not own publicly traded domestic stocks in the year of foundation unless it has employees that are not members of the entrepreneur's household. Furthermore, upon transitioning to entrepreneurship a household is dropped from our sample. All specifications are restricted to gross financial wealth of up to 600k 2010 NOK. Standard errors in parentheses are clustered at the municipality level with a total of 422 clusters in each specification. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table 4 explores changes to the return definition or restricting variation in returns. Column (1) narrows the stock portfolio variation to just households that hold directly less than 3 stocks. The coefficient estimate is largely unchanged, reflecting the fact that most of the variation in domestic stock portfolios in the data comes from owners of less than 3 stocks (see Table A.3). Column (2) further requires the highest returning stock holding of such households to be among the 20 most popular companies traded by small investors on the

Norwegian stock exchange, to help rule out undiversified investments in "exotic" single stocks due to private information or superior stock picking-skill correlated with the propensity to start a firm.[25] In column (3) we account for stock owners holding stocks in their employer by replacing the firm-specific return for the firm where the household head is employed with the OSEAX return. This accounts for positive employer-specific returns due to innovative activity by the employer that may in turn trigger an idea spillover and spur additional business creation by employees (Babina and Howell, 2022; Chetty et al., in progress). In column (4) we allow for household level heterogeneity in the risk-free rate, computed as in Fagereng et al. (2020). This lowers our estimates slightly but they remain economically and statistically significant. Finally, column (5) performs a placebo exercise using the kroner change in $t+1$ instrumented with the portfolio return in year $t+1$ (based on the portfolio shares at the end of $t-1$). The estimated coefficient is closer to zero and insignificant in that case, bolstering the causal interpretation of our main effect.

Table A.11 in the Appendix reports results from additional robustness exercises. First, rather than computing the market beta using the domestic OSEAX index, which may be tilted towards energy stocks, we use the CRSP value-weighted index. Second, we consider the effects of trimming our baseline sample for extreme realizations of exposure and stock portfolio characteristics. The estimates are slightly lower but still highly significant. Third, we restrict the sample only to households that do not receive business income in year $t-1$ to rule out possible changes in legal form of unincorporated businesses as opposed to new business creation. Fourth, in column (4) we modify the entrepreneurship definition by also considering existing firms that start hiring employees in addition to newly-created firms, as in row (VI) of Table 1. We find positive and statistically significant effects of returns on entrepreneurship for this alternative definition as well. Fifth, to account for stock wealth held in non-taxable retirement accounts in the measure of gross financial wealth, we replace in the denominator of r the value of stock wealth held in Norwegian public stocks on tax returns with the value of the domestic stock portfolio from the stock register, with little change. Sixth, we lower the lower bound on financial wealth down to 10,000 NOK from 50,000 NOK. We estimate slightly larger effects, consistent with the effects being monotone decreasing in initial wealth. Finally, we exclude the 2008-2010 Great financial crisis period and estimate slightly larger effects for the remaining sample.

We also consider the robustness of our wealth heterogeneity effects. We first vary the cutoff for moderate wealth from 300k NOK up to 900k NOK in increments of 100k NOK. Figure A.4 in the Appendix presents the estimated effects for the resulting two subsamples for the different cutoffs. Overall the effect on the moderate wealth group is monotone decreasing

[25]See Table A.8 in the Appendix for a list of these stocks.

in the cutoff used with the largest estimated effect for the lowest cutoff of 300k NOK. In contrast the effect on the high wealth group is always consistently close to 0. We can also reject equality of the two coefficients at conventional levels of significance for all cutoffs. Second, Table A.12 in the Appendix reports estimates for a modification of our baseline specification that allows for an interaction effect between (log) initial financial wealth and the buy-and-hold kroner change in stock wealth. We estimate a negative interaction effect both for log and level of gross financial wealth, consistent with a decreasing treatment effect in initial financial wealth. Specifically, relative to a household with the average financial wealth of our baseline moderate wealth group, for whom an additional 10,000 NOK of stock wealth increases the propensity to enter into business by around 1.26 basis points, a doubling of financial wealth decreases that effect by around 0.34 basis points.

5.3 Additional Outcomes

Table 5 reports the effects of higher stock wealth on other household-level outcomes. The first several columns examine various definitions of self-employment or business income. In Norway, self-employment income on household tax returns includes unincorporated business income and farm and forestry income. This definition is the same in Sweden, facilitating comparison to Cesarini et al. (2017), who study the effect of lottery winnings on self-employment income.[26] Column (1) of Table 5 reports the effects on self-employment income, computed as the average for years 1 through 5 after the stock market return, in line with Cesarini et al. (2017). Our estimates are fully consistent with theirs, with an effect of 1 million kroner gain relative to the mean of around -8.6% for our specification versus around -7.7% in Cesarini et al. (2017) (see Table 3, column (3) in their paper). Column (2) reports the effects of an indicator for self-employment income above 25,000 NOK (around 25,000 SEK during our sample period, which is the cutoff used in Cesarini et al. (2017)). The estimated coefficient has the same sign as in Cesarini et al. (2017) (Table 4, column (3)) but is larger in absolute value, with an effect relative to the mean of -10.6%, compared to -2.6% in Cesarini et al. (2017).

Column (3) shows that there is instead a positive effect on dividend income from incorporated private business ownership, which we denote as "incorporated business income". This result is consistent with our baseline results on entry into business. Column (4) shows a positive and significant effect on labor income. However, this positive effect could be in part due to business income being classified as labor income by start-up entrepreneurs for tax op-

[26] In the appendix we discuss how our results compare to the findings in Golosov et al. (2024). Since in the U.S. self-employment income on tax returns combines both unincorporated business income and income from S-corporations, it is not possible to make an exact comparison to their findings.

timization purposes (see Jasinski et al. (2025) for details). We find no statistically-significant effect on debt in column (5).

Table 5: Effect of Stock Wealth on Household Outcomes

	Dep. var.: Household Outcomes				
	Self-emp. income	Self-emp. income >25k NOK	Incorp. bus. income	Labor income	Debt
Kroner change (100 NOK)	-0.388		0.402^{+}	1.969^{*}	0.436
	(0.359)		(0.219)	(0.834)	(2.135)
Kroner gain (1 million NOK)		-1.168^{**}			
		(0.364)			
Mean (NOK)	44656.8	11	9937.4	646256.8	1423332.2
Effect/mean (%)	-8.6	-10.6	40.4	3	.4
Age group FE	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes
Primary sector-year FE	Yes	Yes	Yes	Yes	Yes
Portfolio-year FE	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ
Clusters	422	422	422	422	422
Observations	16,447,702	14,491,309	16,447,702	16,447,702	16,447,702
F-stat	1230.2	1176.6	1230.2	1230.2	1230.2

Notes: 2SLS estimates with buy-and-hold kroner change in financial wealth due to stock returns instrumented with the buy-and-hold return. The buy-and-hold kroner change in t is defined as the product of buy-and-hold returns $r_{i,t}$ and lagged financial wealth. For easier interpretation the coefficient estimates reflect the effect of a 100 NOK kroner change. The dependent variables in columns (1), (3), (4) and (5) are measured in Norwegian kroner as is the the dependent variable mean. The dependent variable in column (2) is an indicator that takes the value of 1 if self-employment income is greater than 25,000 NOK."Effect/mean" reports the effect of a 1 million kroner change relative to the mean of the dependent variable (in percent). "Self-empl. income" denotes unincorporated business income as well as farm and forestry income on household tax returns. "Incorp. bus. income" denotes dividend income from incorporated private businesses received by the household in one year. The outcomes in columns (1)-(3) are computed as 5-year averages for years 1 through 5 after the stock market return. All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years, and 50-65 years. The flexible controls in all specifications include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the stock portfolio, 7 bins of volatility for the observed part of the stock portfolio and year. Standard errors in parentheses are clustered at the municipality level with a total of 422 clusters in each specification. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

6 Results on Firm-level Outcomes

Next, we investigate how the entrepreneur's stock market wealth affects the characteristics of the new firm, using Proposition 3. In addition to being of interest in their own right, these results help to distinguish financial frictions from other explanations for the effect on firm entry.

6.1 Implementation Details

We implement the selection correction as follows. We extend the exposition in Section 2, which focused on two wealth levels, to incorporate multiple wealth levels. In addition, since entry in the model depends on the wealth *level* rather than on the return itself, we perform the selection correction for entrants with similar initial wealth but different returns. Specifically, we partition initial financial wealth into $N = 3$ wealth bins: (50k, 400k], (400k, 800k], (800k, 5000k], and excess buy-and-hold returns into $M = 5$ return bins: (-10%,0%], (0%, 10%], (10%, 20%], (20%, 40%], and over 40%. Denote the financial wealth bins $n \in \{1, 2, 3\}$ and the return bins by $r_m, m \in \{1, 2, 3, 4, 5\}$.

As a first step, we compute propensity score weights that will allow us to account for returns being orthogonal only conditional on controls. For each return bin below the highest, $r_m,\ m \in \{1, 2, 3, 4\}$, denote by $p_{r_m}(x_i)$ the probability that the return is in the highest return bin, rather than bin m, conditional on the covariates x_i. We estimate $p_{r_m}(x_i)$ using the sample of stock owners in return bin m and in return bin 5, controlling for the covariates from our baseline specification.[27] We then obtain the propensity score weight $\omega(x_i)$ for each observation by applying the formula

$$\omega\left(x_i\right) \equiv \frac{dF_x\left(x_i|r_5\right)}{dF_x\left(x_i|r_m\right)} = \frac{dF_r\left(r_5|x_i\right)}{dF_r\left(r_m|x_i\right)}\frac{dF_r\left(r_m\right)}{dF_r\left(r_5\right)} = \frac{p_{r_m}\left(x_i\right)}{1-p_{r_m}\left(x_i\right)}\frac{dF_r\left(r_m\right)}{dF_r\left(r_5\right)}, \tag{13}$$

where the first equality follows from Bayes' rule and $dF_r\left(r_m\right)/dF_r\left(r_5\right)$ equals the relative share of the population in each return bin.[28]

Next, we follow Eq. (8) and use the propensity score weights to calculate the reweighted probability $e^*_{n,m}$ of becoming an entrepreneur for each financial wealth bin n and return bin r_m. Following Proposition 3, we then truncate the propensity-score reweighted distribution

[27] Due to computational costs associated with using a non-linear model on our large population and given the multiple fixed effects, we estimate these propensities using a linear probability model. Since the linear probability model may give propensities close to or above unity, which implies an undefined or very large value for the propensity score weight, we drop observations with estimated propensities above 90%. We also drop observations with estimated negative propensities.

[28] We additionally force the propensity score weights to average to unity, as advocated by Busso et al. (2009) to improve the performance of the propensity score reweighting procedure.

of total assets of newly-started firms in financial wealth bin n and return bin m at the $(1 - e^*_{n,1}/e^*_{n,m}) \times 100$-th percentile. This step is the adjustment for selection into entrepreneurship.

Finally, we compute the propensity-score weighted average kroner changes in stock wealth for each financial wealth by return bin (in thousands of 2010 NOK) and use it to estimate the effects of a higher kroner change in stock wealth in the truncated sample via a weighted regression that uses the propensity score weights. Since different levels of financial wealth lead to potentially different intercepts, we also include financial wealth bin fixed effects. We look at both firm and entrepreneur outcomes. For the firm outcomes, we examine income and balance-sheet statement outcomes both in the year of foundation as well as in subsequent years. We report bootstrap standard errors that account for the estimated propensity score weights and the selection correction.[29]

6.2 Baseline Results

Table 6 reports the results for firm income statement (top panel), balance sheet (middle panel) and household-level (bottom panel) outcomes in the year of foundation. The outcomes (except employment and the pre-entry log earnings) are in thousands of 2010 NOK. The income statement outcomes (except employment) are also annualized to adjust for differences in foundation dates.

The results show that higher stock wealth implies sizable positive effects for sales, the wage bill, employment, and value added. In terms of magnitudes, a buy-and-hold kroner change in stock wealth of 1000 NOK increases sales by around 5,400 NOK, the wage bill by around 1,000 NOK and value added by around 3,500 NOK. Crucially, higher wealth also increases total earnings (EBITDA), consistent with a financial frictions channel but not a pure non-pecuniary benefit channel. In contrast, and consistent with our theoretical framework underpinning the selection correction procedure, there is a much smaller effect on firm earnings without implementing the selection correction – see Table A.16 in the Appendix.

Turning to the firm balance sheet and household outcomes, total assets as well as working capital also increase, as does owners' equity, which funds about one third of the increase in total assets, with the rest funded by an increase in liabilities. Also, a higher kroner change in stock wealth implies that the firm tends to be started in sectors with a higher value of median total assets at start-up. This finding provides additional support for the role of

[29]Specifically, for each bootstrap iteration, we generate weights from a $\Gamma(1, 1)$ distribution, fixing the weight over time for each household. We then estimate propensity score weights on the bootstrap-weighted sample and implement the selection correction and firm or entrepreneur-level regression using the estimated propensity score weights and store the regression coefficients.

Table 6: Firm and Entrepreneur Outcomes

	Sales	Wage bill	Empl.	Value Added	VA/worker	EBITDA
Kroner change	5.400**	1.381**	0.003*	3.513**	1.066*	1.134**
	(1.439)	(0.376)	(0.001)	(1.086)	(0.516)	(0.359)
N	1,165	1,165	1,165	1,165	1,165	1,165
Mean	1706.9	536.4	2.1	1120	647.2	174.8
Median	1307.8	366.1	1	820.4	495.3	52.6

	Total assets	Fixed assets	Working capital	Equity	Total liabilities	Sector median assets
Kroner change	2.128**	0.199	0.679**	0.663**	1.169**	1.294**
	(0.620)	(0.159)	(0.233)	(0.197)	(0.415)	(0.459)
N	1,165	1,165	1,165	1,165	1,165	805
Mean	696.1	144.4	155.6	160.3	511.6	515.3
Median	458	36.1	112.9	118.6	318.8	437.5

	Private firm equity	Log of pre-entry earnings
Kroner change	1.067**	-0.001+
	(0.413)	(0.001)
N	1,165	1,101
Mean	148.96	13.27
Median	60.49	13.52

Notes: All regressions are propensity score weighted and include 3 financial wealth bin fixed effects. All monetary values are in 2010 NOK. Firm-level outcomes are winsorized at the 5th and 95th percentiles. Working capital is defined as the difference between current assets and current liabilities. "Sector median assets" denotes the median total assets of newly created firms in the NACE rev 2 2-digit sector that the firm is started in. "Private firm equity" denotes the book value of a household's holdings of the firm's equity. "Log of pre-entry earnings" is the log of previous year's labor market earnings. The sample is based on the selection correction procedure described in Section 6. Bootstrapped standard errors in parentheses. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

financial constraints at start-up, since these would bind more for sectors with higher start-up capital needs.[30]

The coefficient on private firm equity of the household implies a near one-to-one increase in firm equity for every NOK increase in stock wealth. The near one-to-one pass-through of marginal stock market wealth into firm equity further suggest the importance of liquidity constraints and owner equity as a key friction making owner (stock) wealth relevant for

[30]Table A.5 in the Appendix reports the variation in median assets in the year of foundation by NACE sector. Most sectors have broadly similar initial sizes with assets in the range of 400-800k NOK.

business creation.[31]

Table 6 shows the firm outcomes only in the year of foundation. Figures A.8 and A.9 in the Appendix trace the dynamic effects for the firm outcomes from higher stock market wealth up to 3 years after founding. All of the effects persist over this period, apart from value added per worker, which tends to quickly become insignificant from zero, consistent with a competitive labor market with a short-run labor adjustment friction. Finally, there is a positive but insignificant effect on firm survival probabilities.

6.3 Robustness

Proposition 3 requires that the entry and asset choice decisions depend only on wealth a and business productivity z. Section 2.5 extends these results to *ex ante* and *ex post* residual heterogeneity in size or profits that is independent from wealth a, up to a potential bias close to the entry cutoff. In that case, trimming firms close to the entry cutoff mitigates the potential bias and also provides a diagnostic tool for the size of that potential bias. We make this logic quantitative in Appendix B.2.2 in a stylized financial frictions model calibrated to match key empirical moments, including the effect of wealth on entry. This exercise shows that even modest trimming can have a meaningful effect if residual heterogeneity is important. Table A.17 in the Appendix implements this recommendation by excluding the bottom 10% of firms in each return bin by size after the selection correction procedure. In fact, the coefficients change little, suggesting that residual heterogeneity does not meaningfully contaminate the baseline firm-level outcomes.

Finally, we include a robustness exercise that address a specific source of residual heterogeneity. One concern is that individuals might vary in their outside option of labor income relative to business productivity. This heterogeneity can imply that some individuals with high labor income and relatively lower productivity enter only if they have higher initial wealth. This violation has a testable implication, since if the conditions in our model hold, then the distributions of z and the wage if work $w(z)$ should not vary with wealth after applying Proposition 3. Accordingly, the final regression reported in Table 6 has the pre-entry wage as the dependent variable. Consistent with the model's assumptions, we find no

[31] We provide additional evidence consistent with entrepreneurs injecting increases in liquid financial wealth into their firms in Appendix figures A.6 and A.7. Figure A.6 shows that households that start businesses accumulate liquid financial wealth prior to the entry year, after which they actively decrease their stock holdings and decumulate non-business financial wealth. Figure A.7 splits figure A.5, which showed changes in non-business financial wealth and active changes in stock holdings following a large stock return, between households that start a business and those that do not. The households that start a business do not exhibit any statistically significant increase in non-business financial wealth, consistent with putting all of the additional wealth into the business. Importantly, figures A.6 and A.7 do not account for selection into entrepreneurship, so we treat them as supportive rather than conclusive evidence.

evidence of an economically meaningful difference in pre-entry wage by wealth.

7 Discussion: Stock Market Fluctuations Matter for Business Creation

In our paper we use idiosyncratic variation in stock portfolios to estimate the causal effect of changes in stock wealth on business creation. As discussed in the related literature, these quasi-random fluctuations in stock wealth in the cross-section of households allow us to estimate the causal effect of financial wealth changes on business creation, much like the random wealth fluctuations induced by lotteries, inheritances, or house prices. However, our analysis of stock market wealth matters beyond providing a new source of idiosyncratic variation in wealth, since the stock market accounts for a large share of total wealth fluctuations. This share reflects the high volatility of stock market valuations relative to other assets. Consequently, our empirical results open the possibility that aggregate stock market volatility can account for a sizable share of the variability in the entrepreneurship rate among households with moderate financial wealth.

To highlight this further, we use our causal estimates of the effect of stock market wealth on business creation in a simple back of the envelope calculation, linking aggregate stock market wealth fluctuations and fluctuations in the entrepreneurship rate. We focus on the population with moderate initial financial wealth of up to $600k$ NOK that own public stocks (either directly or indirectly via mutual funds). We combine the respective coefficient estimate for that group from our baseline results on propensity to start a business (column (2) of Table 2), together with the average stock market wealth for that group in the period 2005-2018 (around 53,000 NOK) and the volatility of the excess return on the OSEAX index (27.1%).[32] The resulting value of around 1.6 basis points is around 31% of the standard deviation of the entrepreneurship rate for that group in the period 2005-2018 (5.2 basis points).

The results from this simple back-of-the-envelope calculation imply a sizable influence of stock wealth on the variability in entrepreneurship rates among stock owners. Interpreting this calculation a bit more broadly, the stock market wealth channel of entrepreneurship would be even more important for inducing variation in entrepreneurship in countries and time periods where households are more exposed to the stock market. For example, as we show in Table A.4, according to data from the U.S. Survey of Consumer Finances, the share

[32] For this exercise, we compute the average stock wealth using total stock market wealth, computed as the value of directly-held Norwegian public stocks, stock mutual funds, and stock saving funds.

invested in directly-held public stocks outside of retirement accounts for the median stock-holding US household is around 28% compared to 10% for the median Norwegian household (c.f. Table A.3). This suggests that stock market wealth fluctuations may be even more important for entrepreneurship in the U.S. compared to Norway.[33]

8 Conclusion

In this paper we provide evidence that more stock market wealth causally increases business creation. The effects concentrate among moderate financial wealth individuals and in years when aggregate stock returns are high, consistent with financial constraints as the key mechanism. A back-of-the-envelope calculation suggests that aggregate stock market volatility can account for roughly a third of the variation in the entrepreneurship rate among moderate-wealth stockholders in Norway, with potentially larger effects in countries with greater stock market participation.

Determining the effect of wealth on firm outcomes requires accounting for selection into entrepreneurship. Applying our model-motivated selection correction, we find that wealthier entrepreneurs start larger, more profitable firms. The positive effect on profits points to financial frictions as a key mechanism. Two additional findings reinforce this interpretation: the absence of marginal effects among very high wealth households, and the near one-to-one pass-through of marginal stock market wealth into firm equity.

Finally, our firm-level findings show that financial constraints shape not just whether firms are created but how large and profitable they are at birth. Since initial firm size is a key determinant of long-run performance (Sedláček and Sterk (2017), Sterk et al. (2021)), these effects may persist well beyond the founding year, suggesting a channel through which stock market fluctuations affect long-run economic growth.

[33] A comparison of the other portfolio characteristics of Norwegian and U.S. households in Tables A.3 and A.4 shows that the typical U.S. household that invests directly in public stocks is also heavily under-diversified, with a median number of stocks held equal to 3 and a median daily volatility of 2%, according to the brokerage data used in Odean (1998) and Barber and Odean (2000), among others. Household stock portfolios also typically tend to be sticky, similar to those of Norwegian households. These observations resonate with findings by Calvet et al. (2007) and Calvet et al. (2009) for Swedish households. Therefore, the portfolio stickiness observed for Norwegian households is likely not due to higher transaction costs, which according to Klova and Ødegaard (2019) are comparable in the Oslo Stock Exchange and New York Stock Exchange, conditional on market capitalization, but rather to deeper behavioral portfolio adjustment frictions. All of these observations lend support for the external validity of our findings beyond the Norwegian context.

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Stock Market Wealth and Entrepreneurship

Online Appendix

Gabriel Chodorow-Reich   Plamen Nenov   Vitor Santos   Alp Simsek

A Data Appendix

A.1 Comparison with the results in Golosov et al. (2024)

In this section we report results for a number of additional outcomes, which allow us to make a comparison with the findings in Golosov et al. (2024) for self-employment income and entrepreneurship. Golosov et al. (2024) do not explicitly report an intensive margin effect of lottery winnings on self-employment income. However, since self-employment income in their paper is defined as the difference between total labor income and wage income, using their Table 2 one can take the difference between rows 3 and 2 to get that per \$100 of lottery winning the effect on per adult self-employment income is \$-0.315. Therefore, consistent with Cesarini et al. (2017) and our effect on self-employment income (column (1) of Table 5), there is a negative effect of lottery winnings on self-employment income in Golosov et al. (2024). Nevertheless, in the U.S., unlike Norway, self-employment income also contains income from S-corporations, while in Norway all incorporated business income comes in as dividend income for the firm owner. Therefore, to be closer to the measure of self-employment income used in Golosov et al. (2024), column (1) of Table A.1 reports a measure that combines self-employment income from individual tax returns with all dividend income paid out to the household by private incorporated Norwegian firms (the incorporated business income from column (2) of Table 5). We call this combined measure "business income". Note that this measure does not align fully with the self-employment income measure in Golosov et al. (2024) for at least two reasons. First, in the U.S. income from closely-held C-corporations is paid out as dividend income. Second, if there are differential tax incentives for a business owner to classify self-employment income as wage income in the two countries, then that would create an additional discrepancy. Since, in Norway such incentives are stronger at lower levels of business income (see Jasinski et al. (2025)), this discrepancy may be particularly large for new business owners.

Column (1) of Table A.1 reports a small positive and insignificant effect. This near-zero effect can be rationalized by the nearly offsetting effects of self-employment income and incorporated business income, reported in Table 5. In terns of an extensive margin comparison to Golosov et al. (2024), we estimate a negative effect for receiving more than 100k NOK. This cutoff is equal to around USD 15,000 during our sample period, which is the cutoff used in Golosov et al. (2024)). Golosov et al. (2024) report a smaller negative and insignificant effect. Overall, our estimated effects are somewhat different from the estimates in Golosov et al. (2024) but we would like to caution that part of the difference likely comes from the different taxation rules for business income in the U.S. and the special role played by S-corporations.

Table A.1: Effect of Stock Wealth on Additional Household Outcomes

	Dep. var.: Household Outcomes		
	Business income	Self. empl. income >100k	Bus. income >100k
Kroner change i, t (100 NOK)	0.014		
	(0.430)		
Kroner change i, t (1 million NOK)		-0.749^{*}	-0.543
		(0.345)	(0.338)
Mean	54594	8.4	10.2
Effect/mean (%)	.2	-9	-5.2
Age group FE	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes
Primary sector-year FE	Yes	Yes	Yes
Portfolio-year FE	ω-β-σ	ω-β-σ	ω-β-σ
Clusters	422	422	422
Observations	16,447,702	14,491,309	14,491,309
F-stat	1230.2	1176.6	1176.6

Notes: 2SLS estimates with buy-and-hold kroner change in financial wealth due to stock returns instrumented with the buy-and-hold return. The buy-and-hold kroner change in t is defined as the product of buy-and-hold returns $r_{i,t}$ and lagged financial wealth. For easier interpretation the coefficient estimates reflect the effect of a 1 million NOK kroner change on each propensity measure in percentage points. "Effect/mean" reports the effect of a 1 million kroner change relative to the mean of the dependent variable (in percent). "Self-empl. income" denotes unincorporated business income as well as farm and forestry income on household tax returns. "Business income" denotes the sum of self-employment income and incorporated private business income. All of outcomes are computed as 5-year averages for years 1 through 5 after the stock market return. All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years, and 50-65 years. The flexible controls in all specifications include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the stock portfolio, 7 bins of volatility for the observed part of the stock portfolio and year. Standard errors in parentheses are clustered at the municipality level with a total of 422 clusters in each specification. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

A.2 Omitted tables and figures from the main text

Table A.2: Summary Statistics of New Firms (thousands of 2010 NOK)

	All years		**Low return years**		**High return years**	
	Mean	Median	Mean	Median	Mean	Median
Total Assets	885.3	471.4	869.7	469.7	904.6	473.2
Sales	1805.8	822.3	1733.1	812.1	1896.0	832.8
Wage Bill	548.2	321.6	540.7	316.9	557.4	327.3
Employment	3.1	2.0	3.1	2.0	3.2	2.0
Value added	987.5	589.0	983.7	585.3	992.3	595.0
Value added / worker	430.7	290.6	437.5	289.3	422.3	291.9
Current Assets	622.8	333.0	615.2	332.4	632.3	333.6
Current Liabilities	510.6	262.6	501.5	257.9	521.8	268.0
Working Capital	112.3	65.2	113.7	70.0	110.5	60.5
Fixed Assets	262.5	46.1	254.5	47.0	272.4	45.4
Tangibles	201.9	24.9	198.5	24.5	206.0	25.0
Equity	178.4	101.0	181.5	104.1	174.4	97.3

Table A.3: Distribution of Portfolio Characteristics for Stock Holders in Norway

Percentile	β	ω	σ	**Herfindahl index**	**Number of stocks**	**Change in stock holdings (in %)**	**Share stock mutual funds**	**Share deposits**
10th	0.45	0.02	0.01	0.34	1	-100.00	0	0.16
20th	0.63	0.03	0.01	0.47	1	-33.17	0	0.29
30th	0.75	0.05	0.01	0.56	1	0	0	0.40
40th	0.87	0.07	0.02	0.76	1	0	0	0.51
50th	0.96	0.10	0.02	0.99	2	0	0.02	0.60
60th	1.00	0.14	0.02	1.00	2	0	0.06	0.69
70th	1.04	0.20	0.02	1.00	3	2.82	0.10	0.77
80th	1.16	0.29	0.03	1.00	3	23.20	0.18	0.85
90th	1.32	0.44	0.03	1.00	5	72.73	0.31	0.92

Notes: ω is the share of directly-held domestic stocks out of total financial wealth. "Share stock mutual funds" is the portfolio share invested in domestic stock mutual funds and exchange-traded funds. "Share deposits" is the share of financial wealth held in deposits. Note that the stock mutual fund shares are for the period 2004-2015. "Change in stock holdings" is the change in the value of the portfolio of directly-held stocks given constant stock prices between $t-1$ and t relative to lagged gross financial wealth.

Table A.4: Distribution of Portfolio Characteristics for Stock Holders in the U.S.

Percentile	β*	ω	σ*	**Herfindahl index***	**Number of stocks**	**Change in stock holdings (in %)***	**Share stock mutual funds**	**Share deposits**
10th	0.62	0.03	0.01	0.20	1	-100.00	0	0.03
20th	0.78	0.06	0.01	0.30	1	-100.00	0	0.08
30th	0.89	0.12	0.01	0.40	1	-50.00	0	0.13
40th	0.98	0.19	0.02	0.51	2	-7.90	0	0.22
50th	1.06	0.28	0.02	0.60	3	0	0	0.30
60th	1.13	0.38	0.02	0.86	4	0	0	0.42
70th	1.23	0.51	0.02	1.00	5	8.17	0	0.55
80th	1.34	0.66	0.03	1.00	8	42.82	0.18	0.70
90th	1.55	0.83	0.04	1.00	15	117.10	0.40	0.86

Notes: Data is from the Survey of Consumer Finances (SCF), 2004-2016 waves, as well as portfolio data from a large discount broker in the U.S. over the period 1991-1996 for variables marked with an asterisk. See Barber and Odean (2000) and Barber and Odean (2001) for a more detailed description of the portfolio-level data, as well as Graham and Kumar (2006) for comparison of that data against the SCF. To align with the Norwegian administrative data, for wealth share calculations, we exclude financial wealth held in retirement accounts. ω is the share of directly-held stocks out of financial wealth. ”Share stock mutual funds” is the portfolio share invested in stock mutual funds according to the SCF. ”Share deposits” is the share of financial wealth held in deposits. “Change in stock holdings” is the change in the value of the portfolio of directly-held stocks given constant stock prices between $t-1$ and t relative to the lagged portfolio value.

Table A.5: Industry Distribution of New Firms, 2009-2019.

Industry	Share (%)	Median total assets (1000 NOK)
Construction	23.12	466.2
Wholesale and retail trade and repair of motor vehicles	20.56	775.0
Professional, scientific and technical activities	16.10	398.4
Administrative and support service activities	6.73	374.6
Information and communication	5.93	395.0
Human health and social work activities	5.65	473.2
Manufacturing	4.49	763.8
Transportation and storage	4.38	662.5
Other service activities	3.59	293.3
Real estate activities	3.03	1290.3
Education	1.89	278.9
Arts, entertainment and recreation	1.80	393.6
Agriculture, forestry and fishing	1.35	1101.6
Financial and insurance activities	0.72	3571.9
Mining and quarrying	0.27	870.1
Water supply, sewerage, waste management	0.22	1378.4
Electricity, gas, steam and air conditioning supply	0.16	13443.0

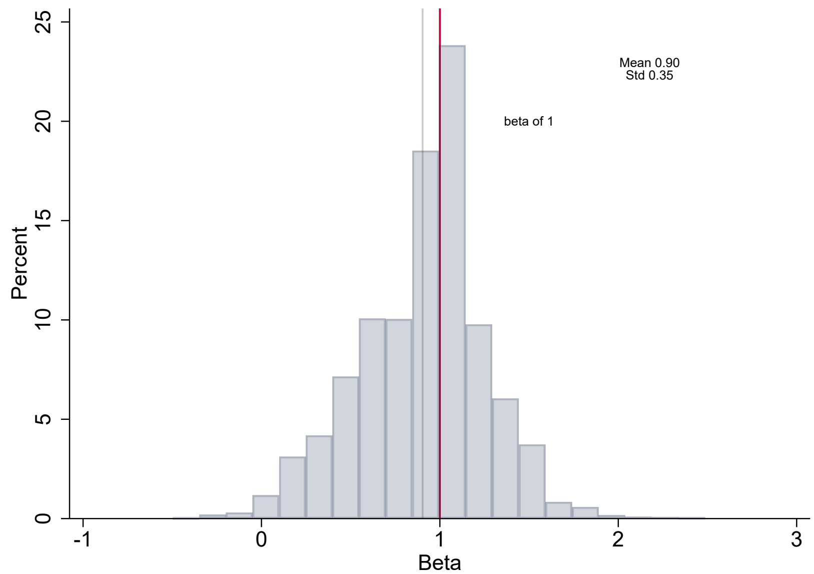
Notes: Only newly created firms with positive employment int he year of founding or the subsequent year are included. Monetary amounts are in 1000s of 2010 Norwegian kroner.

Table A.6: Sample Descriptive Statistics.

	Non-Entrepreneur					**Entrepreneur**				
	Mean	**p25**	**p50**	**p75**	**Share**	**Mean**	**p25**	**p50**	**p75**	**Share**
Age	44.5	35	45	55	.	39.8	32	39	47	.
Earnings	648.5	335.4	591.5	914.4	.	655.1	359.8	606.8	876.5	.
Financial Wealth	591.2	121.0	273.6	653.7	.	533.2	143.9	293.9	612.1	.
Directly held stocks	135.6	9.9	40.9	128.4	.	102.7	3.1	25.2	88.1	.
Share	–	–	–	–	**99.79**	–	–	–	–	**.21**
	(Direct) Stock owner					**Other**				
	Mean	**p25**	**p50**	**p75**	**Mean**	**p25**	**p50**	**p75**	**Share**	
Age	46.8	38	48	56	.	44.2	34	44	54	.
Earnings	881.2	489.7	832.3	1174.2	.	614.1	317.5	559.8	875.7	.
Financial Wealth	1041.7	275.9	604.7	1311.4	.	524.4	111.1	244.2	568.7	.
Directly held stocks	150.4	16.7	51.3	146.5	.	0.0	0.0	0.0	0.0	.
Share	–	–	–	–	**12.88**	–	–	–	–	**87.12**
	Moderate Wealth (<600K)					**High Wealth (>600K)**				
	Mean	**p25**	**p50**	**p75**	**Share**	**Mean**	**p25**	**p50**	**p75**	**Share**
Age	42.9	33	43	53	.	49.3	41	51	59	.
Earnings	605.8	324.0	559.6	864.9	.	775.1	375.1	710.2	1080.9	.
Financial Wealth	273.8	96.2	187.9	347.9	.	1530.1	747.4	1126.7	1879.7	.
Directly held stock	55.4	4.7	21.6	64.1	.	232.2	27.9	89.0	255.7	.
Share	–	–	–	–	**74.75**	–	–	–	–	**25.25**

Notes: Monetary amounts are in 1000s of 2010 Norwegian kroner.

Figure A.1: Beta of Portfolio of Directly-held Domestic Stocks

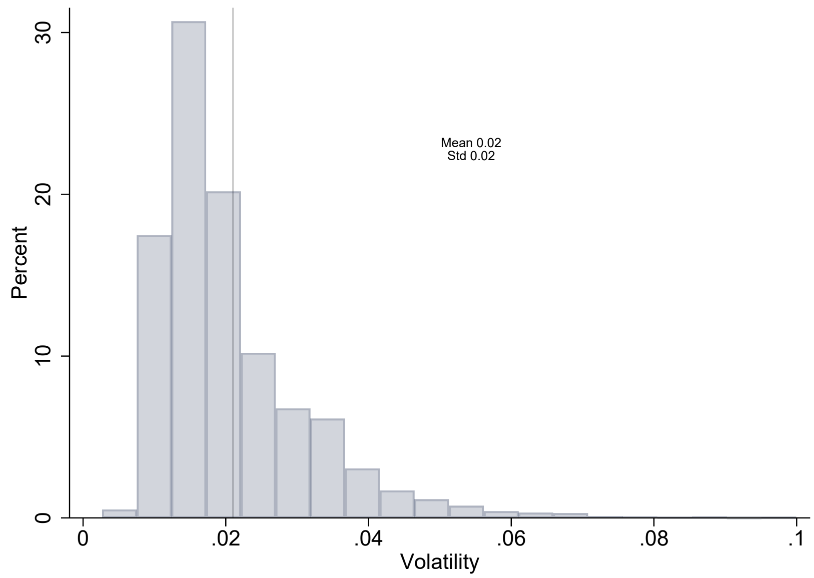


Notes: We measure the portfolio characteristics $\beta_{i,t-1}$ and $\sigma_{i,t-1}$ using daily returns over the year $t-1$. Specifically, for each observation we form the time series of daily returns $\tilde{r}_{i,t-1+\Delta} = \omega_{i,t-1}^{-1} \mathbf{s}_{i,t-1} \mathbf{r}_{t-1+\Delta}$, where $\tilde{r}_{i,t-1+\Delta}$ gives the return on day $t-1+\Delta$ of a portfolio with weights fixed at their value at the end of the year. We obtain $\beta_{i,t-1}$ as the OLS regression coefficient from a regression of $\tilde{r}_{i,t-1+\Delta}$ on $r^m_{t-1+\Delta}$ less the risk-free rate and $\sigma_{i,t-1}$ as the variance of $\tilde{r}_{i,t-1+\Delta}$.

Table A.7: Shares of the Population by Asset Holdings (2004-2015).

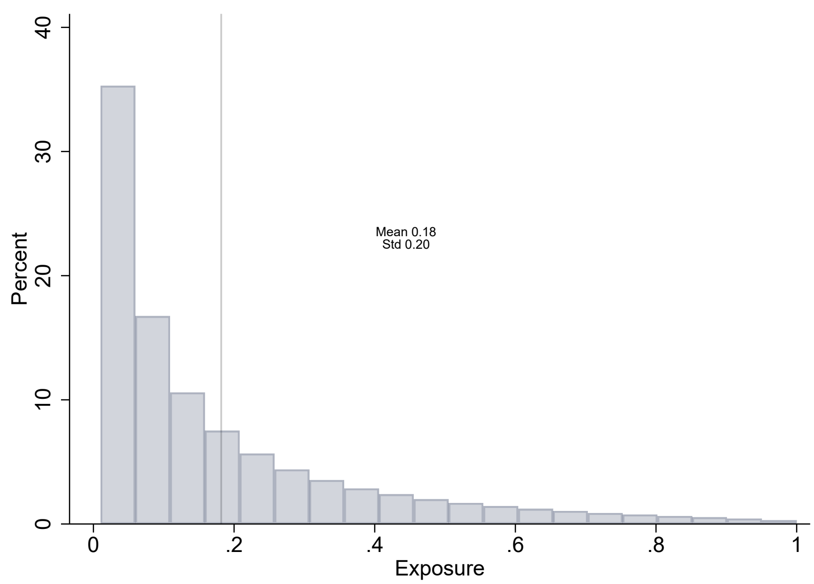
	Population	Moderate Wealth ($\leq 600K$)	High wealth ($> 600K$)
1. Direct owner domestic stock	0.135	0.097	0.254
Of which: < 3 stocks	0.095	0.077	0.151
Of which: among top 20	0.058	0.045	0.098
2. Domestic stock mutual fund owner	0.409	0.365	0.548
3. Direct or mutual fund owner	0.460	0.410	0.621
4. Direct and mutual fund owner	0.084	0.053	0.182
Of which: < 3 stocks	0.056	0.041	0.103
Of which: among top 20	0.034	0.024	0.068
5. Domestic bond mutual fund owner	0.091	0.079	0.130
6. Domestic bond owner	0.012	0.006	0.031
7. Foreign assets owner	0.055	0.036	0.116

Figure A.2: Volatility of Portfolio of Directly-held Domestic Stocks



Notes: We measure the portfolio characteristics $\beta_{i,t-1}$ and $\sigma_{i,t-1}$ using daily returns over the year $t-1$. Specifically, for each observation we form the time series of daily returns $\tilde{r}_{i,t-1+\Delta} = \omega_{i,t-1}^{-1} \mathbf{s}_{i,t-1} \mathbf{r}_{t-1+\Delta}$, where $\tilde{r}_{i,t-1+\Delta}$ gives the return on day $t-1+\Delta$ of a portfolio with weights fixed at their value at the end of the year. We obtain $\beta_{i,t-1}$ as the OLS regression coefficient from a regression of $\tilde{r}_{i,t-1+\Delta}$ on $r^m_{t-1+\Delta}$ less the risk-free rate and $\sigma_{i,t-1}$ as the variance of $\tilde{r}_{i,t-1+\Delta}$.

Figure A.3: Exposure to Domestic Stocks



Notes: $\omega_{i,t}$ denotes the share of financial wealth held in domestic stocks at the end of year t.

Table A.8: List of the 20 Most Popular Publicly Traded Companies Held by Direct Owners of Less Than 3 Domestic Stocks

5-digit NACE sector	**Average Mkt. Cap.**	**Average Number**	**Fraction shareholders**	**Ownership share**	**Share wealth invested**
Extraction of crude petroleum	1083.2	35.5	0.34	0.01	0.21
Wireless telecommunication activities	1053.0	18.2	0.33	0.01	0.07
Manufacturing of prepared meals and dishes	143.0	15.1	0.30	0.02	0.10
Non-life insurance	109.4	12.8	0.29	0.02	0.06
Activities of financial holding companies	89.8	11.5	0.35	0.01	0.01
Manufacturing of paper and paperboard	63.6	9.7	0.34	0.04	0.01
Production of primary aluminum	547.7	8.1	0.14	0.01	0.04
Other technical consultancy	24.4	5.6	0.16	0.03	0.01
Distribution of electricity	31.4	5.1	0.18	0.01	0.00
Manufacture of fertilizers and nitrogen compounds	120.0	4.7	0.10	0.00	0.01
Construction of oil-platforms and modules	554.9	4.6	0.25	0.01	0.01
Operation of marine fish farms	152.6	4.2	0.15	0.01	0.01
Extraction of crude petroleum	3.6	4.2	0.18	0.05	0.03
Scheduled long-distance bus transport	2.5	3.5	0.52	0.08	0.00
Other monetary intermediation	268.9	3.2	0.22	0.07	0.04
Construction of residential and non-residential buildings	6.2	3.1	0.34	0.10	0.05
Wholesale of computers , computer equip. and software	37.1	2.9	0.23	0.02	0.00
Scheduled long-distance passenger transport in coastal waters	4.3	2.7	0.28	0.03	0.00
Production of electricity through water power	14.5	2.7	0.24	0.01	0.01
Freezing of fish, fish fillets crustaceans and mollusks	0.04	2.5	0.17	0.01	0.00

Notes: "Average Mkt. Cap" is the average market capitalization of the company during our sample period (in billions of NOK). "Average number" is the average number of owners of less than 3 stocks (in thousands). "Fraction shareholders" is the share out of all stockholders in the company who are owners of less than 3 stocks. "Ownership share" is the share of the firm owned by owners of less than 3 stocks. "Share wealth invested" is the average share of the total stock market wealth of owners of less than 3 stocks that is invested in that particular company.

Table A.9: Random Assignment Test

	Dep. var.: Buy-and-hold return	
	(1)	(2)
Secondary schooling	0.016	−0.019
	(0.024)	(0.017)
Technical college/university	0.105**	−0.012
	(0.032)	(0.021)
Log lagged earnings	0.032**	0.007
	(0.011)	(0.009)
Log lagged fin. wealth	−0.331**	−0.008
	(0.011)	(0.007)
Age group FE	Yes	Yes
Portfolio-year FE	No	ω-β-σ
R^2	.19	.53
Clusters	422	422
Observations	1,872,891	1,872,801
P-val	0	0.6

Notes: All specifications include age-group fixed effects. The dependent variable is the buy-and-hold return. Specification (2) includes a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the portfolio, 7 bins of volatility for the observed part of the portfolio and year. P-val reports results for the test of joint significance of the regressors listed in the table.

Table A.10: Baseline Entry Results – Reduced-form

	Dep. var.: becomes entrepreneur ($E_{i,t}$)				
	(1)	(2)	(3)	(4)	(5)
$r_{i,t}$	0.157*	0.279**	0.018		
	(0.066)	(0.097)	(0.078)		
$r_{i,t}$, $r_{OSEAX,t} \leq r_{OSEAX,median}$				−0.061	
				(0.134)	
$r_{i,t}$, $r_{OSEAX,t} > r_{OSEAX,median}$				0.407**	
				(0.118)	
$r_{i,t} \leq 0$					−0.154
					(0.257)
$r_{i,t} > 0$					0.345**
					(0.122)
Sample	All	$\leq 600k$	$> 600k$	$\leq 600k$	$\leq 600k$
Age group FE	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes
Primary sector-year FE	Yes	Yes	Yes	Yes	Yes
Portfolio-year FE	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ
R^2	0.002	0.003	0.007	0.003	0.003
Clusters	422	422	422	422	422
Observations	13,027,888	10,444,167	2,583,400	10,444,167	10,444,167
Median fin. wealth	255.9	175.7	1111.6	175.7	175.7

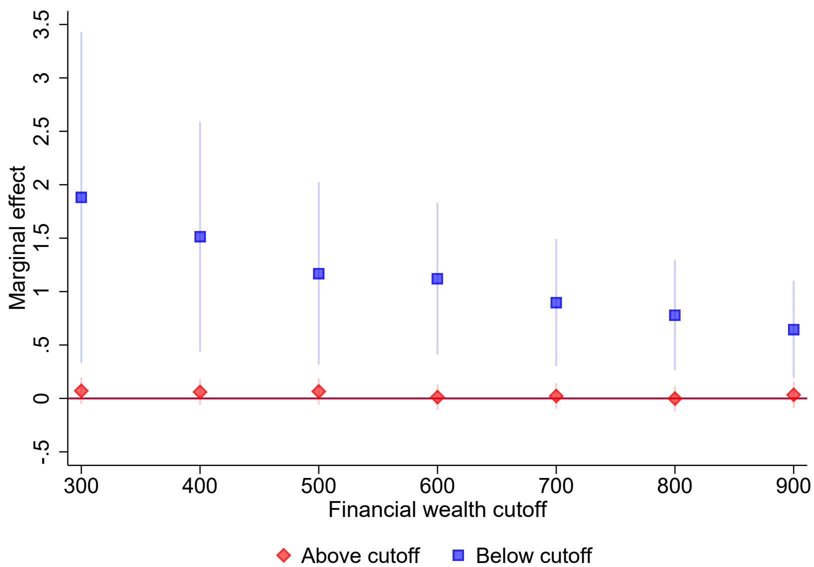
Notes: All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years and 50-65 years. The flexible controls in all specifications include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the stock portfolio, 7 bins of volatility for the observed part of the stock portfolio and year. Specifications (2) and (3) are restricted to gross financial wealth of up to 600k NOK and above 600k NOK in 2010 prices, respectively. An entrepreneur is defined as a household that owns at least 1/3 of the book value of stocks in an incorporated non-financial firm with at most 3 stock owners which employs at least one worker. For transition to entrepreneurship we only consider newly-created firms and households who have not owned stocks in any private firm in the past. In addition, we require that the newly-created firm does not own publicly traded domestic stocks in the year of foundation unless it has employees that are not members of the entrepreneur's household. Furthermore, upon transitioning to entrepreneurship a household is dropped from our sample. Buy-and-hold returns $r_{i,t}$ are defined as $r_{i,t} = r_t^f + \omega_{i,t-1}\mathbf{s}'_{i,t-1}\mathbf{r}_t$, where r_t^f is the risk-free return in year t, $\omega_{i,t-1}$ denotes the share of financial wealth held in domestic stocks at the end of year $t-1$, $\mathbf{s}_{i,t-1}$ the weight in the stock portfolio of each domestic stock, and $\mathbf{r}_t$ the vector of realized excess returns of domestic stocks in year t. Standard errors in parentheses are clustered at the municipality level with a total of 422 clusters in each specification. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table A.11: Additional Robustness

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
kroner change	1.212**	0.822**	0.796*	1.090**	1.063**	1.214**	1.224**
	(0.389)	(0.285)	(0.368)	(0.406)	(0.366)	(0.395)	(0.420)
Age group FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loc.-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio-year FE	ω-β_{CRSP}-σ	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ
Clusters	422	422	422	422	422	422	422
F-stat	3499.5	2805.8	3926.3	4251	6604.5	3363.7	3116.6
Observations	10,418,197	10,527,283	9,082,494	10,444,167	10,458,309	14,848,142	8,383,652
Description	CRSP index	No trimming	No business income	$E_{i,t}$ or starting employment	Alternative fin. wealth	Lower fin. wealth threshold	Exclude 2008-2010

Notes: 2SLS estimates with buy-and-hold kroner change in financial wealth due to stock returns instrumented with the buy-and-hold return. The buy-and-hold kroner change in t is defined as the product of buy-and-hold returns $r_{i,t}$ and lagged financial wealth. For easier interpretation the coefficient estimates reflect the effect of a 10,000 NOK kroner change on the propensity to become an entrepreneur in basis points. All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years and 50-65 years. Flexible controls include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the portfolio, 7 bins of volatility for the observed part of the portfolio and year. We define an entrepreneur as a household that owns at least 1/3 of the book value of stocks in an incorporated non-financial firm with at most 3 stock owners which employs at least one worker. When considering the transition to entrepreneurship we only consider newly-created firms and households who have not owned stocks in any private firm in the past. In addition we require that the newly-created firm does not own publicly traded domestic stocks in the year of foundation unless it has employees that are not members of the entrepreneur's household. Furthermore, upon transitioning to entrepreneurship a household is dropped from our sample. For specification (1) the betas are replaced with betas with respect to the CRSP value-weighted index. For specification (3) we restrict the sample to households that have not received business income in the year prior to the firm's foundation. For specification (4) we consider either our baseline entrepreneurship definition or existing firms transitioning to positive employment. For specification (5) we define an alternative buy-and-hold portfolio return formed by constructing domestic stock exposure formed by replacing gross financial wealth with an alternative measure that replaces the value of stock wealth held in Norwegian public stocks on the tax returns with the value of the domestic stock portfolio we compute directly. In (6) we decrease the lower bound on lagged financial wealth to 10,000 NOK and in (7) we exclude the period of 2008-2010. All specifications are restricted to gross financial wealth of up to 600k 2010 NOK. Standard errors in parentheses are clustered at the municipality level with a total of 422 clusters in each specification. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

Figure A.4: Robustness to Different Cutoffs for Moderate Financial Wealth Group



Notes: 2SLS estimates with buy-and-hold kroner change in financial wealth due to stock returns instrumented with the buy-and-hold return. The buy-and-hold kroner change in t is defined as the product of buy-and-hold returns $r_{i,t}$ and lagged financial wealth. For easier interpretation the coefficient estimates reflect the effect of a 10,000 NOK kroner change on the propensity to become an entrepreneur in basis points. All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years and 50-65 years. Flexible controls include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the portfolio, 7 bins of volatility for the observed part of the portfolio and year. We define an entrepreneur as a household that owns at least 1/3 of the book value of stocks in an incorporated non-financial firm with at most 3 stock owners which employs at least one worker. When considering the transition to entrepreneurship we only consider newly-created firms and households who have not owned stocks in any private firm in the past. In addition we require that the newly-created firm does not own publicly traded domestic stocks in the year of foundation unless it has employees that are not members of the entrepreneur's household. Furthermore, upon transitioning to entrepreneurship a household is dropped from our sample. The figure includes 95% confidence bands.

Table A.12: Entry Results With an Interaction Effect With Initial Financial Wealth

	Dep. var.: becomes entrepreneur ($E_{i,t}$)	
	(1)	(2)
kroner change	1.266*	0.445*
	(0.607)	(0.215)
kroner change × log(gross fin.wealth$_{t-1}$)	–0.342*	
	(0.171)	
log(gross fin.wealth$_{t-1}$)	4.403**	
	(0.411)	
kroner change × gross fin.wealth$_{t-1}$		–0.014+
		(0.008)
gross fin.wealth$_{t-1}$		0.423**
		(0.044)
Age group FE	Yes	Yes
Location-year FE	Yes	Yes
Primary sector-year FE	Yes	Yes
Portfolio-year FE	ω-β-σ	ω-β-σ
Clusters	422	422
Observations	13,027,888	13,027,888
F-stat	293.2	851.6
Median fin. wealth	255.9	255.9

Notes: 2SLS estimates with buy-and-hold kroner change in financial wealth due to stock returns instrumented with the buy-and-hold return. The buy-and-hold kroner change in t is defined as the product of buy-and-hold returns $r_{i,t}$ and lagged financial wealth. For easier interpretation the coefficient estimates reflect the effect of a 10,000 NOK kroner change on the propensity to become an entrepreneur in basis points. All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years and 50-65 years. The flexible controls in all specifications include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the stock portfolio, 7 bins of volatility for the observed part of the stock portfolio and year. We define an entrepreneur as a household that owns at least 1/3 of the book value of stocks in an incorporated non-financial firm with at most 3 stock owners which employs at least one worker. When considering the transition to entrepreneurship we only consider newly-created firms and households who have not owned stocks in any private firm in the past. In addition we require that the newly-created firm does not own publicly traded domestic stocks in the year of foundation unless it has employees that are not members of the entrepreneur's household. Furthermore, upon transitioning to entrepreneurship a household is dropped from our sample. The value of (log) gross fin. wealth is re-centered using the average (log) gross fin. wealth of the moderate wealth group. Standard errors in parentheses are clustered at the municipality level with a total of 422 clusters in each specification. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table A.13: Robustness to Additional Covariates – Full Sample

	Dep. var.: becomes entrepreneur ($E_{i,t}$)					
	(1)	(2)	(3)	(4)	(5)	(6)
kroner change	0.234*	0.238*	0.261*	0.218*	0.223*	0.063
	(0.100)	(0.105)	(0.103)	(0.102)	(0.110)	(0.068)
Age group FE	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Primary sector-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Financial wealth-year FE	Yes	No	No	No	No	No
Portfolio-year FE	ω-β-σ	ω-β-σ	3-factor model	ω-β-σ	ω-β-σ	None
Clusters	422	422	422	422	422	422
F-stat	791	842.1	590.4	751.8	582.8	1220.6
Observations	13,027,888	12,097,641	12,980,386	13,025,358	9,322,143	13,027,998
Description	Wealth bins	Labor income control	3-factor model	Addn'l. sectoral controls	Portfolio composition	No portfolio characteristics

Notes: 2SLS estimates with buy-and-hold kroner change in financial wealth due to stock returns instrumented with the buy-and-hold return. The buy-and-hold kroner change in t is defined as the product of buy-and-hold returns $r_{i,t}$ and lagged financial wealth. For easier interpretation the coefficient estimates reflect the effect of a 10,000 NOK kroner change on the propensity to become an entrepreneur in basis points. All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years and 50-65 years. Flexible controls in specifications (1), (2), (4) and (5) include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the portfolio, 7 bins of volatility for the observed part of the portfolio and year. Flexible controls in specification (3) include a 6-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of market betas from a Fama-French 3-factor model (Fama and French, 1993) for the observed part of the portfolio, 7 bins of volatility for the observed part of the portfolio, 2 bins for exposure to the SMB factor, 2 bins for exposure to the HML factor and year. Additional controls in specification (1) include 6 bins of financial wealth times year. Additional controls in specification (2) include lagged labor market income. Additional controls in specification (4) include an interaction between the level 1 NACE sector of the largest direct portfolio holding and year. Specification (5) includes a three-way interaction of 8 bins of share of financial wealth invested in directly-held domestic stocks, 5 bins of share of financial wealth held in domestic mutual funds and year. Note that for specification (5) we drop observations after 2015. We define an entrepreneur as a household that owns at least 1/3 of the book value of stocks in an incorporated non-financial firm with at most 3 stock owners which employs at least one worker. When considering the transition to entrepreneurship we only consider newly-created firms and households who have not owned stocks in any private firm in the past. In addition we require that the newly-created firm does not own publicly traded domestic stocks in the year of foundation unless it has employees that are not members of the entrepreneur's household. Furthermore, upon transitioning to entrepreneurship a household is dropped from our sample. Standard errors in parentheses are clustered at the municipality level with a total of 422 clusters in each specification. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table A.14: Robustness to Alternative Return Definitions – Full Sample

	Dep. var.: becomes entrepreneur ($E_{i,t}$)				
	(1)	(2)	(3)	(4)	(5)
kroner change	0.342*	0.559*	0.222*	0.144+	
	(0.168)	(0.271)	(0.096)	(0.086)	
placebo kroner change					–0.027
					(0.107)
Age group FE	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes
Primary sector-year FE	Yes	Yes	Yes	Yes	Yes
Portfolio-year FE	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ
Clusters	422	422	422	422	422
F-stat	519.4	245.2	735.2	1433.9	2457.3
Observations	12,618,094	12,333,597	13,027,888	13,027,866	12,940,413
Description	< 3 stock owner	< 3 stock owner (top 20 stocks)	Own employer stock	Heterogeneous risk-free rate	Placebo returns

Notes: 2SLS estimates with buy-and-hold kroner change in financial wealth due to stock returns instrumented with the buy-and-hold return. The buy-and-hold kroner change in t is defined as the product of buy-and-hold returns $r_{i,t}$ and lagged financial wealth. For easier interpretation the coefficient estimates reflect the effect of a 10,000 NOK kroner change on the propensity to become an entrepreneur in basis points. All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years and 50-65 years. Flexible controls in all specifications include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the portfolio, 7 bins of volatility for the observed part of the portfolio and year. We define an entrepreneur as a household that owns at least 1/3 of the book value of stocks in an incorporated non-financial firm with at most 3 stock owners which employs at least one worker. When considering the transition to entrepreneurship we only consider newly-created firms and households who have not owned stocks in any private firm in the past. In addition we require that the newly-created firm does not own publicly traded domestic stocks in the year of foundation unless it has employees that are not members of the entrepreneur's household. Furthermore, upon transitioning to entrepreneurship a household is dropped from our sample. Column (1) restricts the sample to households with less than 3 directly-held stocks and (2) further requires the main stock holding to be among the top 20 most popular traded Norwegian companies. In Column (3) we replace in the excess buy-and-hold portfolio return the return of the firm which the household head is employed in with the OSEAX return for that year. n column (4) we allow for household-level heterogeneity in the risk-free rate. The heterogeneous risk-free rate is based on Fagereng et al. (2020) and is computed as the ratio of interest income over the sum of deposit holdings in $t-1$ and one-half of the change in deposit holdings from year $t-1$ to t net of interest income. In (5) we instrument the excess gain at $t+1$ with the residualized placebo return, defined as $r_{i,t+1} = r^f_{t+1} + \omega_{i,t-1}\mathbf{s}'_{i,t-1}\mathbf{r}_{t+1}$, where r^f_{t+1} is the risk-free return in year $t+1$, $\omega_{i,t-1}$ denotes the share of financial wealth held in domestic stocks at the end of year $t-1$, $\mathbf{s}_{i,t-1}$ the weight in the stock portfolio of each domestic stock, and $\mathbf{r}_{t+1}$ the vector of realized excess returns of domestic stocks in year $t+1$. Standard errors in parentheses are clustered at the municipality level with a total of 422 clusters in each specification. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

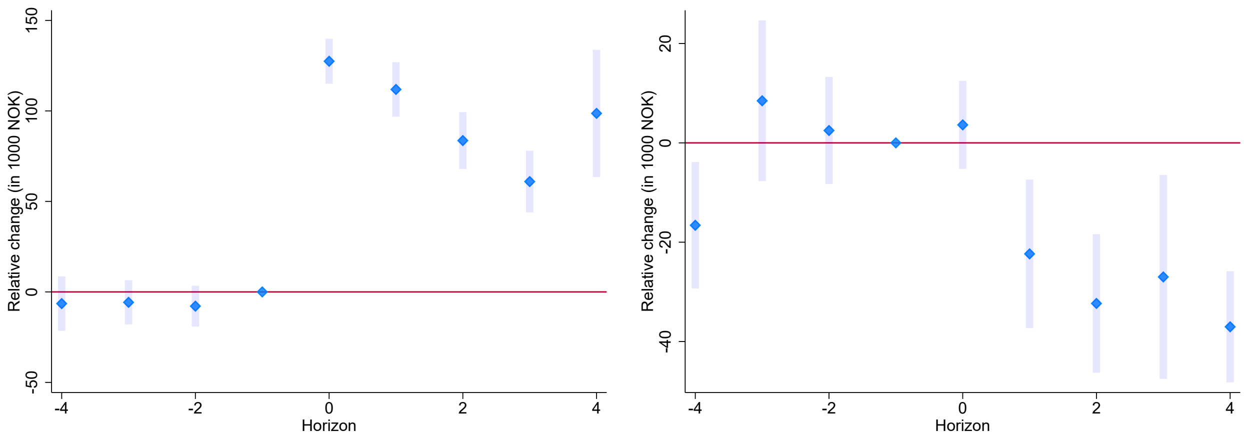
Table A.15: Additional Robustness - Full Sample

	Dep. var.: becomes entrepreneur ($E_{i,t}$)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
kroner change	0.263*	0.155*	0.166+	0.249*	0.242**	0.266*	0.226*
	(0.102)	(0.066)	(0.097)	(0.104)	(0.088)	(0.104)	(0.103)
Age group FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Loc.-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Portfolio-year FE	ω-β_{CRSP}-σ	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ	ω-β-σ
Clusters	422	422	422	422	422	422	422
F-stat	500.5	386.2	702.9	776.7	800.1	765.8	627.5
Observations	12,982,146	13,162,135	11,094,162	13,027,888	13,030,748	17,431,866	10,496,933
Description	CRSP index	No trimming	No business income	$E_{i,t}$ or starting employment	Alternative fin. wealth	Lower fin. wealth threshold	Exclude 2008-2010

Notes: 2SLS estimates with buy-and-hold kroner change in financial wealth due to stock returns instrumented with the buy-and-hold return. The buy-and-hold kroner change in t is defined as the product of buy-and-hold returns $r_{i,t}$ and lagged financial wealth. For easier interpretation the coefficient estimates reflect the effect of a 10,000 NOK kroner change on the propensity to become an entrepreneur in basis points. All specifications include age-group fixed effects for 3 age groups of the household head: 20-34 years, 35-49 years and 50-65 years. Flexible controls include a four-way interaction between 8 bins of exposure to directly-held domestic stocks, 7 bins of betas for the observed part of the portfolio, 7 bins of volatility for the observed part of the portfolio and year. We define an entrepreneur as a household that owns at least 1/3 of the book value of stocks in an incorporated non-financial firm with at most 3 stock owners which employs at least one worker. When considering the transition to entrepreneurship we only consider newly-created firms and households who have not owned stocks in any private firm in the past. In addition we require that the newly-created firm does not own publicly traded domestic stocks in the year of foundation unless it has employees that are not members of the entrepreneur's household. Furthermore, upon transitioning to entrepreneurship a household is dropped from our sample. For specification (1) the betas are replaced with betas with respect to the CRSP value-weighted index. For specification (3) we restrict the sample to households that have not received business income in the year prior to the firm's foundation. For specification (4) we consider either our baseline entrepreneurship definition or existing firms transitioning to positive employment. For specification (5) we define an alternative buy-and-hold portfolio return formed by constructing domestic stock exposure using an alternative measure of gross financial wealth that replaces the value of stock wealth held in Norwegian public stocks on the tax returns with the value of the domestic stock portfolio we compute directly. In (6) we decrease the threshold of financial wealth to 10 thousand norwegian kroner and in (7) we exclude the period of 2008-2010. Standard errors in parentheses are clustered at the municipality level with a total of 422 clusters in each specification. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

Figure A.5: Household balance sheet outcomes given a high stock return

(a) Liquid financial wealth (b) Active change in stock holdings



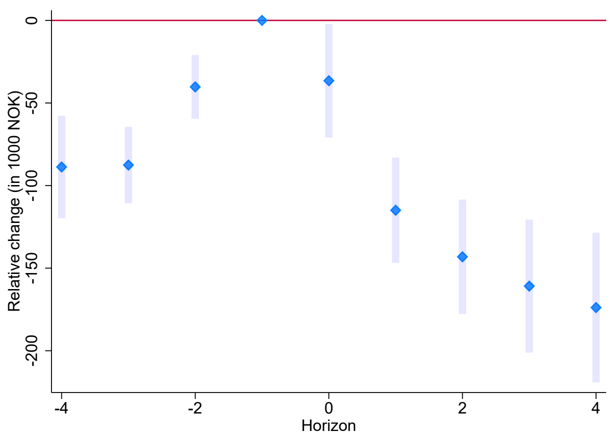
Notes: Each figure plots the regression coefficients from estimating a local projections difference-in-differences model (LP-DiD) with a clean control group, as proposed by Dube et al. (2025). Specifically, we estimate

$$\Delta y_{i,t-1,t+h} = \alpha^h + \beta^h D_{i,t} + \Gamma_h' \cdot X_{i,t-1} + \varepsilon_{i,t}^h,$$

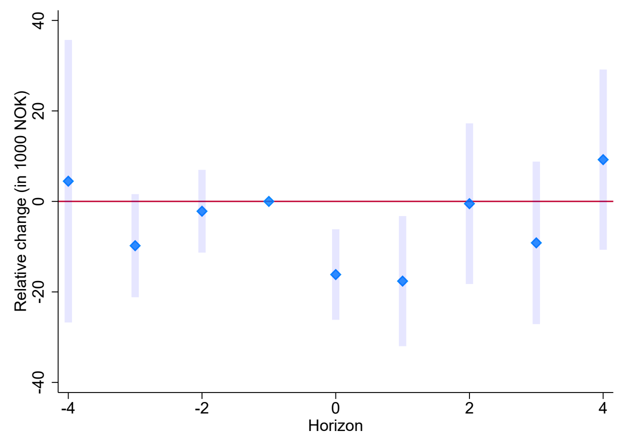
for different outcomes y, and different horizons h, where i denotes household, t denotes year, and $D_{i,t}$ is an indicator for the household having a buy-and-hold return in t that is higher than 20 %. Each outcome enters as the kroner change relative to its pre-event level. The sample includes direct stock owners as of $t-1$ that are treated with a return higher than 20 % at most once. The clean control group excludes households that have been treated by the specific horizon. All regressions include the controls from our baseline specification on the propensity to start a business. Liquid financial wealth is defined as total financial wealth net of Norwegian private equity wealth. Active change in stock holdings is defined as the annual change in the value of the portfolio of directly-held stocks, holding stock prices fixed throughout the year. Standard errors are clustered on the municipality level and the figure includes 95% confidence bands.

Figure A.6: Household balance sheet outcomes given entry into business

(a) Liquid financial wealth



(b) Active change in stock holdings



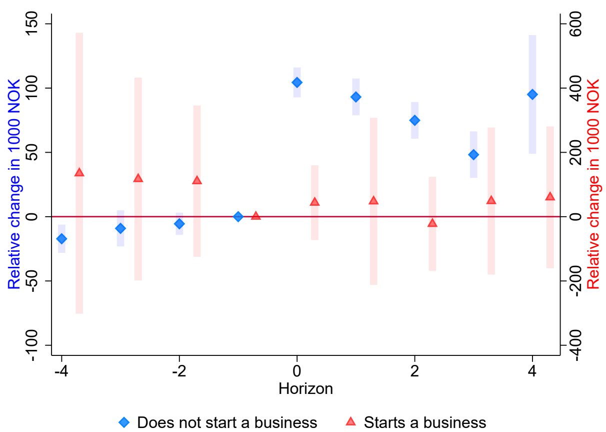
Notes: Each figure plots the regression coefficients from estimating a local projections difference-in-differences model (LP-DiD) with a clean control group, as proposed by Dube et al. (2025). Specifically, we estimate

$$\Delta y_{i,t-1,t+h} = \alpha^h + \beta^h E_{i,t} + \Gamma_h' \cdot X_{i,t-1} + \varepsilon_{i,t}^h,$$

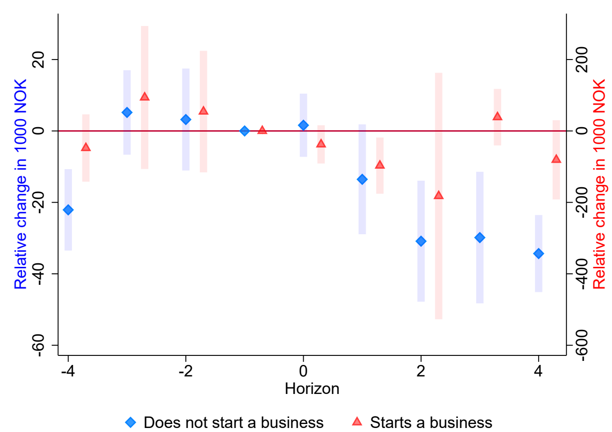
for different outcomes y, and different horizons h, where i denotes household, t denotes year, and $E_{i,t}$ is an indicator for the household starting a business in t as per our baseline definition. Each outcome enter as the kroner change relative to its pre-event level. The sample includes direct stock owners as of $t-1$ that have not started a business by $t-1$. The clean control group excludes households that have been treated by the specific horizon. All regressions include the controls from our baseline specification on the propensity to start a business. Liquid financial wealth is defined as total financial wealth net of Norwegian private equity wealth. Active change in stock holdings is defined as the annual change in the value of the portfolio of directly-held stocks, holding stock prices fixed throughout the year. Standard errors are clustered on the municipality level and the figure includes 95% confidence bands.

Figure A.7: Dynamic outcomes given high stock return by entrepreneurship status

(a) Liquid financial wealth



(b) Active change in stock holdings



Notes: Each figure plots the regression coefficients from estimating a local projections difference-in-differences model (LP-DiD) with a clean control group, as proposed by Dube et al. (2025). Specifically, we estimate

$$\Delta y_{i,t-1,t+h} = \alpha^h + \sum_{j \in \{0,1\}} \beta_j^h \mathbf{1}\{E_{i,t} = j\} \times D_{i,t} + \Gamma_h' \cdot X_{i,t-1} + \varepsilon_{i,t}^h,$$

for different outcomes y, and different horizons h, where i denotes household, t denotes year, and $D_{i,t}$ is an indicator for the household having a buy-and-hold return in t that is higher than 20 %, and $E_{i,t}$ is an indicator for the household starting a business in t as per our baseline definition. Each outcome enters as the kroner change relative to its pre-event level. The sample includes direct stock owners as of $t-1$ that are treated with a return higher than 20 % at most once. The clean control group excludes households that have been treated by the specific horizon. All regressions include the controls from our baseline specification on the propensity to start a business. Liquid financial wealth is defined as total financial wealth net of Norwegian private equity wealth. Active change in stock holdings is defined as the annual change in the value of the portfolio of directly-held stocks, holding stock prices fixed throughout the year. Standard errors are clustered on the municipality level and the figure includes 95% confidence bands.

Table A.16: Firm and Entrepreneur Outcomes – No Selection Correction

	Sales	Wage bill	Empl.	Value Added	VA/worker	EBITDA
Kroner change	2.586*	0.818**	0.002+	1.621+	0.328	0.536*
	(1.108)	(0.295)	(0.001)	(0.842)	(0.377)	(0.271)
N	1,327	1,327	1,327	1,327	1,327	1,327
Mean	1574.2	522.1	2.1	1037.5	605.9	162.3
Median	951.9	374.5	1	752.7	458.4	52.1

	Total assets	Fixed assets	Working capital	Equity	Total liabilities	Sector median assets
Kroner change	1.036**	0.093	0.346*	0.334*	0.572*	0.605*
	(0.372)	(0.100)	(0.158)	(0.141)	(0.257)	(0.292)
N	1,327	1,327	1,327	1,327	1,327	904
Mean	642.4	133.1	143.5	149.7	471.6	519.6
Median	424.5	36.1	98.5	118.6	318.8	437.5

	Private firm equity	Log of pre-entry earnings
Kroner change	0.534*	-0.0001
	(0.249)	(0.001)
N	1,327	1,260
Mean	138.89	13.25
Median	60.49	13.52

Notes: All regressions are propensity score weighted and include 3 financial wealth bin fixed effects. All monetary values are in 2010 NOK. Firm-level outcomes are winsorized at the 5th and 95th percentiles. Working capital is defined as the difference between current assets and current liabilities. "Sector median assets" denotes the median total assets of newly created firms in the NACE rev 2 2-digit sector that the firm is started in. "Private firm equity" denotes the book value of a household's holdings of private firm equity. "Log of pre-entry earnings" is the log of previous year's labor market earnings. Bootstrapped standard errors in parentheses. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

Table A.17: Firm and Entrepreneur Outcomes – 10% trim

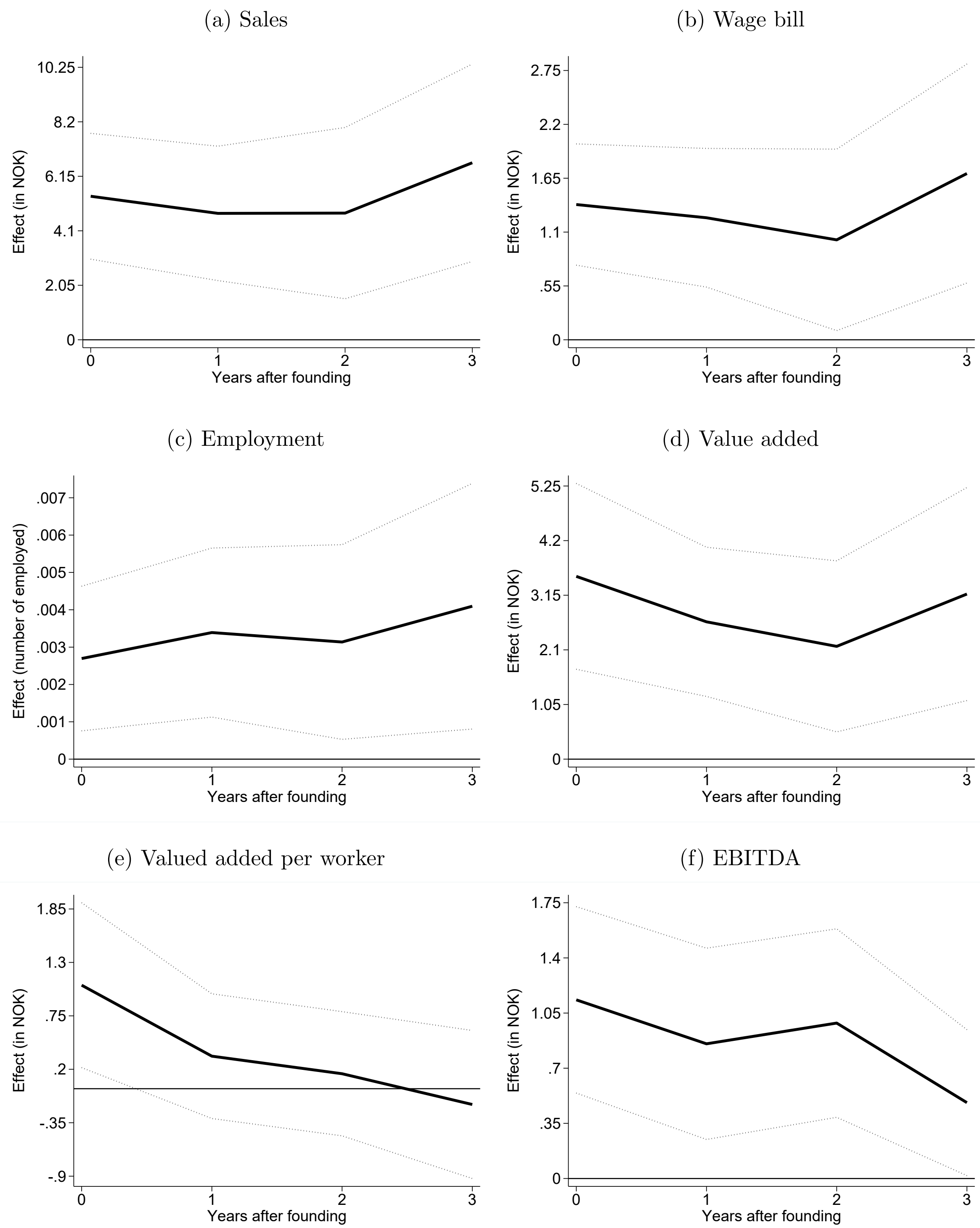
	Sales	Wage bill	Empl.	Value Added	VA/worker	EBITDA
Kroner change	5.418**	1.368**	0.003*	3.517**	1.070*	1.159**
	(1.473)	(0.398)	(0.001)	(1.111)	(0.532)	(0.365)
N	1,041	1,041	1,041	1,041	1,041	1,041
Mean	1820	565.4	2.1	1192.3	686.1	189.6
Median	1403.6	426.7	1	909.8	556.3	76

	Total assets	Fixed assets	Working capital	Equity	Total liabilities	Sector median assets
Kroner change	2.092**	0.157	0.707**	0.673**	1.110*	1.305**
	(0.657)	(0.171)	(0.239)	(0.200)	(0.449)	(0.455)
N	1,041	1,041	1,041	1,041	1,041	694
Mean	745.3	154.5	170.1	171.6	544.6	524.2
Median	458	36.1	113.7	118.6	327.6	437.5

	Private firm equity	Log of pre-entry earnings
Kroner change	1.097*	-0.001+
	(0.431)	(0.001)
N	1,041	985
Mean	162.9	13.28
Median	86.71	13.48

Notes: All regressions are propensity score weighted and include 3 financial wealth bin fixed effects. All monetary values are in 2010 NOK. Firm-level outcomes are winsorized at the 5th and 95th percentiles. Working capital is defined as the difference between current assets and current liabilities. "Sector median assets" denotes the median total assets of newly created firms in the NACE rev 2 2-digit sector that the firm is started in. "Private firm equity" denotes the book value of a household's holdings of private firm equity. "Log of pre-entry earnings" is the log of previous year's labor market earnings. Bootstrapped standard errors in parentheses. + denotes significance at the 10% level, * denotes significance at the 5% level, and ** denotes significance at the 1% level.

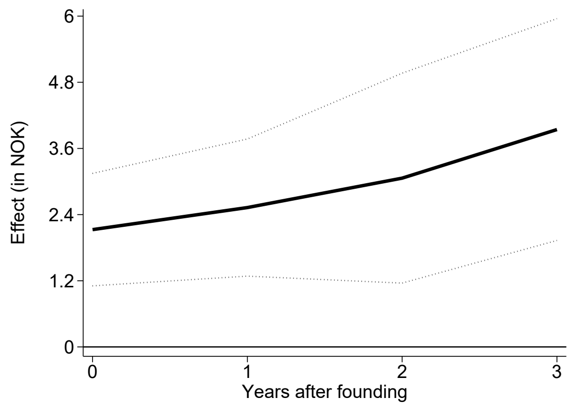
Figure A.8: Dynamic firm-level outcomes (part 1)



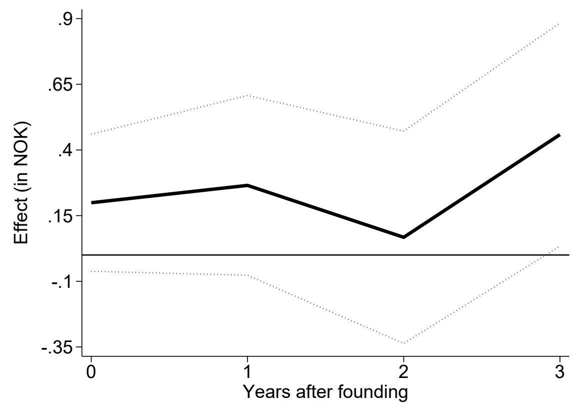
Notes: The figures present coefficient estimates for each outcome at different horizons since firm founding. All regressions are propensity score weighted and include 3 financial wealth bin fixed effects. All monetary values are in 2010 NOK. Outcomes are winsorized at the 5th and 95th percentiles. Working capital is defined as the difference between current assets and current liabilities. The sample is based on the selection correction procedure described in Section 6. 90% confidence error band based on bootstrapped standard errors.

Figure A.9: Dynamic firm-level outcomes (part 2)

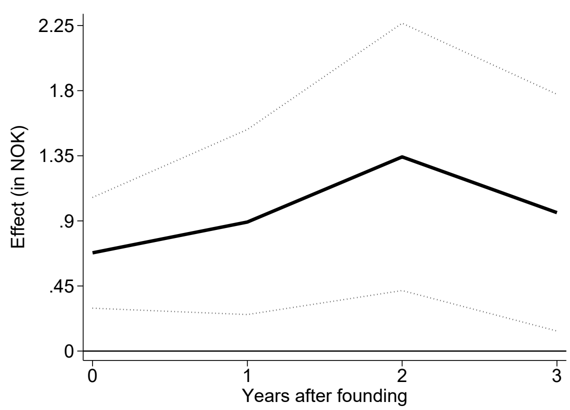
(a) Assets



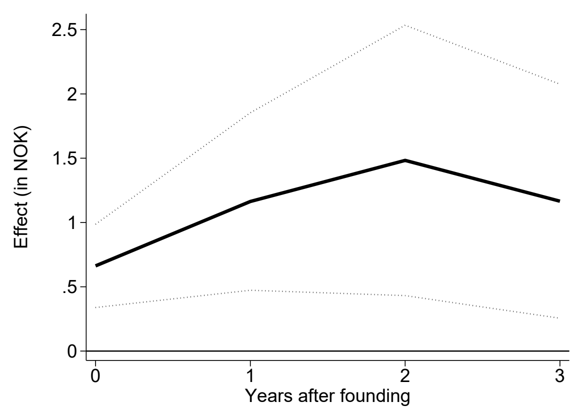
(b) Fixed assets



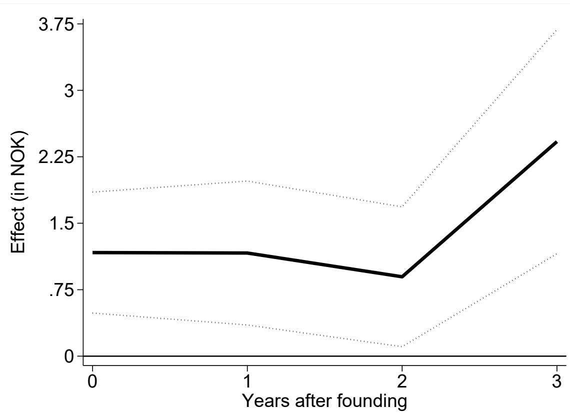
(c) Working capital



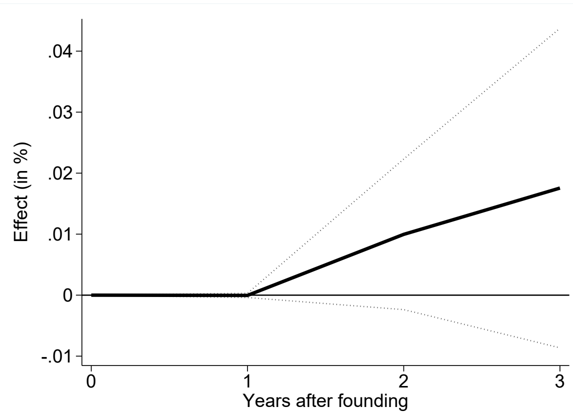
(d) Equity



(e) Liabilities



(f) Survival



Notes: The figures present coefficient estimates for each outcome at different horizons since firm founding. All regressions are propensity score weighted and include 3 financial wealth bin fixed effects. All monetary values are in 2010 NOK. Outcomes are winsorized at the 5th and 95th percentiles. Working capital is defined as the difference between current assets and current liabilities. The sample is based on the selection correction procedure described in Section 6. 90% confidence error band based on bootstrapped standard errors.

B Model Appendix

In this appendix, we present the details omitted from Section 2. Appendix B.1 describes two example models both of which satisfy Assumption (M): one with financial frictions and one in which entrepreneurship provides non-pecuniary benefits. We also show that the two models differ in terms of their predictions for the effect of wealth on profits, which we estimate in our empirical analysis to differentiate the two models. Appendix B.2 shows that our analysis is robust to allowing for residual heterogeneity beyond productivity. Appendix B.3 analyzes a dynamic extension to illustrate the asymmetric effects of positive vs negative returns on entry. Finally, Appendix B.4 presents the proofs omitted from the main text.

B.1 Models that Satisfy Assumption (M)

Consider the entry model described in the main text. Specifically, a continuum of individuals i differ in log business productivity z_i and wealth a_i (along with observable covariates x_i). Conditional on entry, individuals' profits, non-pecuniary benefit from entrepreneurship and log size are given by functions that depend only on productivity and wealth, $\pi_i = \pi\left(z_i, a_i\right), u_i^e = u^e\left(z_i, a_i\right), k_i = k\left(z_i, a_i\right)$. Individuals enter if their profits and non-pecuniary benefits from entrepreneurship exceed their reservation wage

$$\pi\left(z_i, a_i\right) + u^e\left(z_i, a_i\right) \geq w(z_i).$$

In the main text, we show that if $\pi\left(\cdot\right), u^e\left(\cdot\right), w(\cdot)$ and $k\left(\cdot\right)$ satisfy Assumption (M), which we reproduce here, then the model satisfies a rank preservation property that enables us to control for unobserved productivity.

Assumption (M). $\frac{\partial(\pi(z_i,a_i)+u^e(z_i,a_i))}{\partial a_i} \geq 0$ and $\frac{\partial(\pi(z_i,a_i)+u^e(z_i,a_i)-w(z_i))}{\partial z_i} > 0, \frac{\partial k(z_i,a_i)}{\partial z_i} > 0.$

We next describe two example economies that satisfy Assumption (M) but differ in terms of their predictions for $\frac{\partial \pi(z_i,a_i)}{\partial a_i}$. In both cases, we assume the reservation wage does not depend on business productivity, $w(z_i) = w$. We can allow wages to increase with business productivity to some extent, as long as the net benefit from entering into business is increasing in business productivity as captured by Assumption (M).

B.1.1 Model with Financial Frictions

Suppose there is no non-pecuniary benefit from entrepreneurship, $u^e\left(z_i, a_i\right) = 0$, but the entrepreneur faces financial frictions. We analyze two types of frictions. First, the entrepreneur faces a *borrowing constraint*: capital must be financed up front and the entrepreneur can borrow only against a fraction of expected profitability. Second, the entrepreneur faces *uninsurable risk*: ex-post productivity realizations are random and the entrepreneur cannot share this risk with outside investors (i.e., she cannot issue equity). We start with a baseline model that features the borrowing constraint in isolation. The borrowing constraint limits the scale at which the entrepreneur can operate, providing one mechanism by which wealth increases entrepreneurship. We then introduce uninsurable risk, which provides a complementary mechanism: even when the borrowing constraint does not bind, a risk-averse entrepreneur voluntarily limits her leverage, so that firm size remains proportional to wealth. This friction also reduces the certainty-equivalent return from entrepreneurship, raising the wealth threshold for entry, but does not alter the qualitative predictions. For the extension with idiosyncratic risk, we focus on CRRA preferences with $\gamma \leq 1$. Most of our results hold with arbitrary risk aversion parameter γ, but we need $\gamma \leq 1$ to ensure more productive entrepreneurs operate at weakly greater size when the borrowing constraint does not bind. We ignore fixed costs of entry for now, but show in Appendix B.2 that the key results extend naturally to that case.

Baseline model without uninsurable risk. Suppose individual i produces according to the Cobb-Douglas technology

$$F\left(K, L; z_i\right) = \exp\left(z_i\right) K^{\alpha} L^{1-\alpha}, \tag{B.1}$$

where $K = \exp\left(k\right)$ is capital, L is labor and z_i is log productivity. We let ξ denote the rental rate of capital and w denote the competitive wage.

We capture financial frictions with a working capital channel along with a borrowing constraint on capital. Specifically, the capital rental cost ξK must be paid up front. The entrepreneur can use her own wealth a_i to cover part of this cost and borrow the remainder. Lenders can recover a fraction $\lambda < 1$ of the firm's output net of labor costs in the event of default, which limits the entrepreneur's borrowing capacity.[1] Labor is paid from revenues and is not subject to the borrowing constraint. The entrepreneur therefore solves

$$\begin{aligned} \pi\left(z_i, a_i\right) \quad &= \quad \max_{K,L} \exp\left(z_i\right) K^{\alpha} L^{1-\alpha} - \xi K - wL \\ \text{s.t.} \quad &\quad a_i + \lambda\left[\exp\left(z_i\right) K^{\alpha} L^{1-\alpha} - wL\right] \geq \xi K. \end{aligned} \tag{B.2}$$

Since labor is unconstrained, we can optimize over L first for any given K. The optimal labor satisfies

$$L^*\left(K, z_i\right) = \left(\frac{\left(1-\alpha\right)\exp\left(z_i\right)}{w}\right)^{1/\alpha} K.$$

Substituting back yields a reduced-form profit that is linear in K:

$$\Pi\left(K; z_i\right) \equiv \exp\left(z_i\right) K^{\alpha}\left(L^*\right)^{1-\alpha} - \xi K - wL^* = \left[M\left(z_i\right) - \xi\right] K. \tag{B.3}$$

[1]The model can be generalized to cases in which labor costs also require upfront financing.

Here,

$$M(z_i) \equiv \alpha \left(\frac{1-\alpha}{w}\right)^{(1-\alpha)/\alpha} \exp(z_i)^{1/\alpha}$$

is the marginal revenue product of capital, which is strictly increasing in z_i. The borrowing constraint likewise reduces to

$$a_i + \lambda M(z_i) K \geq \xi K. \tag{B.4}$$

Observe that greater productivity relaxes the constraint for a given K, since higher output net of labor costs enable greater borrowing. Greater assets also relax the constraint directly.

Since profit is linear in K with positive slope $M(z_i) - \xi > 0$ for productive entrepreneurs, the unconstrained problem has no interior solution: every productive entrepreneur wishes to scale up indefinitely. The constraint therefore always binds, and the entrepreneur's optimal capital is

$$K(z_i, a_i) = \Lambda(z_i) \cdot a_i \quad \text{where} \quad \Lambda(z_i) \equiv \frac{1}{\xi - \lambda M(z_i)}, \tag{B.5}$$

provided $\lambda M(z_i) < \xi$. The firm size is a leveraged multiple of entrepreneur wealth. The leverage ratio $\Lambda(z_i)$ is strictly increasing in business productivity: more productive entrepreneurs are more profitable, can pledge more to lenders, and therefore operate at higher leverage. The log size function is

$$k(z_i, a_i) = \log \Lambda(z_i) + \log a_i, \tag{B.6}$$

which is increasing in both z_i and a_i. The profit function is $\pi(z_i, a_i) = [M(z_i) - \xi] \Lambda(z_i) a_i$, which is also strictly increasing in both z_i and a_i. The following lemma collects the properties of this model and shows that it satisfies Assumption (M).

Lemma 1. *Suppose $M(z_i) \in (\xi, \xi/\lambda)$. Greater productivity strictly increases profits and log size, $\frac{\partial \pi(z_i,a_i)}{\partial z_i} > 0$, $\frac{\partial k(z_i,a_i)}{\partial z_i} > 0$. Greater initial assets strictly increase profits and log size, $\frac{\partial \pi(z_i,a_i)}{\partial a_i} > 0$, $\frac{\partial k(z_i,a_i)}{\partial a_i} > 0$.*

Intuitively, entrepreneurs operate at a constrained level and greater initial wealth enables them to operate at a higher scale, increasing their size as well as their profit. Greater productivity also increases size by enabling greater leverage. Greater productivity also increases profits both directly and indirectly by bringing the firm size closer to the unconstrained level.

Extension: Uninsurable risk and risk aversion. In the baseline model above, output is deterministic and risk preferences play no role. We now introduce ex-post productivity risk that the entrepreneur cannot share with outside investors—a financial friction that, combined with risk aversion, provides a complementary mechanism by which wealth affects entrepreneurship. Even when the borrowing constraint does not bind, the risk-averse entrepreneur voluntarily limits her leverage, so that firm size remains proportional to wealth. Uninsurable risk also reduces the certainty-equivalent return from entrepreneurship, raising the wealth threshold for entry. We show that the remaining model predictions are qualitatively preserved.

Suppose that realized output includes a multiplicative shock $\tilde{\varepsilon}_i$,

$$F\left(K, L; z_i, \tilde{\varepsilon}_i\right) = \exp\left(\tilde{\varepsilon}_i\right) \exp\left(z_i\right) K^\alpha L^{1-\alpha}.$$

Here, $\tilde{\varepsilon}_i$ is drawn from a distribution with bounded support and is independent of z_i and a_i. We assume the entrepreneur chooses capital K before the realization of $\tilde{\varepsilon}_i$ and labor L after. Because the entrepreneur cannot issue equity claims on the firm, she retains some residual risk from $\tilde{\varepsilon}_i$.[2]

The entrepreneur has risk preferences characterized by a CRRA utility function

$$v\left(c\right) = \frac{c^{1-\gamma} - 1}{1-\gamma}, \quad \gamma > 0. \tag{B.7}$$

For now we do not place any restriction on γ.

As before, the entrepreneur must pay the rental cost of capital up front partly by borrowing from lenders. Lenders are well diversified and lend against the expected output net of labor costs. Only a fraction λ of this is pledgeable.

With these assumptions, the entrepreneur's problem can be written as

$$\begin{aligned} & \max_{K, L(\tilde{\varepsilon}_i)} \ \mathbb{E}\left[v\left(c_i\right)\right] && \text{(B.8)} \\ \text{where} \quad & c_i = a_i + \left[\exp(z_i)\exp(\tilde{\varepsilon}_i) K^\alpha L(\tilde{\varepsilon}_i)^{1-\alpha} - wL\right] - \xi K \\ \text{s.t.} \quad & a_i + \lambda \mathbb{E}\left[\exp(z_i)\exp(\tilde{\varepsilon}_i) K^\alpha L(\tilde{\varepsilon}_i)^{1-\alpha} - wL\right] \geq \xi K. \end{aligned}$$

The entrepreneur chooses labor to maximize profits state by state. The optimal labor satisfies

$$L^*(\tilde{\varepsilon}_i) = \left(\frac{(1-\alpha)\exp(z_i)\exp(\tilde{\varepsilon}_i)}{w}\right)^{1/\alpha} K.$$

Substituting back, output net of labor costs is

$$\exp(z_i)\exp(\tilde{\varepsilon}_i) K^\alpha (L^*)^{1-\alpha} - wL^* = M(z_i)\exp(\tilde{\varepsilon}_i)^{1/\alpha} K,$$

where $M(z_i) = \alpha\left(\frac{1-\alpha}{w}\right)^{(1-\alpha)/\alpha}\exp(z_i)^{1/\alpha}$ is the marginal revenue product of capital defined above.

Define the *indirect residual productivity* ε_i by $\exp(\varepsilon_i) \equiv \exp(\tilde{\varepsilon}_i)^{1/\alpha}$, so that output net of labor costs equals $\exp(\varepsilon_i)M(z_i)K$. We normalize $\mathbb{E}[\exp(\varepsilon_i)] = 1$, so that the expected marginal revenue product remains $M(z_i)$. Then, the enteperneur's problem becomes

$$\max_K \ \mathbb{E}\left[v\left(c_i\right)\right] \tag{B.9}$$

[2] The timing of input choices is natural: capital must be committed up front, whereas labor can be adjusted to current conditions. If labor were also chosen before the realization of $\tilde{\varepsilon}_i$, the entrepreneur would bear additional residual risk, which would amplify our results.

$$\begin{aligned} \text{where} \qquad & c_i = a_i + [\exp(\varepsilon_i)M(z_i) - \xi]\,K \\ \text{s.t.} \qquad & a_i + \lambda M(z_i)K \geq \xi K. \end{aligned}$$

The entrepreneur chooses K to maximize expected utility subject to the same borrowing constraint as before $(B.4)$.

Writing the choice in terms of the leverage ratio $\Lambda = K/a_i$, the entrepreneur's consumption becomes $c_i = a_i\left[1 + \left(\exp\left(\varepsilon_i\right)M\left(z_i\right) - \xi\right)\Lambda\right]$. We refer to

$$\mathcal{R}\left(\varepsilon_i, z_i, \Lambda\right) \equiv 1 + \left(\exp\left(\varepsilon_i\right)M\left(z_i\right) - \xi\right)\Lambda \tag{B.10}$$

as the gross return on entrepreneurial wealth, so that $c_i = a_i \cdot \mathcal{R}_i$. The entrepreneur's problem can then be written as

$$\max_{\Lambda \leq \bar{\Lambda}(z_i)} \quad E\left[v\left(a_i \cdot \mathcal{R}\left(\varepsilon_i, z_i, \Lambda\right)\right)\right]. \tag{B.11}$$

Here, $\bar{\Lambda}\left(z_i\right) \equiv \frac{1}{\xi - \lambda M(z_i)}$ is the maximum leverage permitted by the borrowing constraint.

After substituting the CRRA utility, the objective becomes

$$E\left[v\left(a_i \cdot \mathcal{R}_i\right)\right] = \frac{a_i^{1-\gamma}}{1-\gamma}E\left[\mathcal{R}_i^{1-\gamma}\right] - \frac{1}{1-\gamma}.$$

The first-order condition for Λ is therefore

$$E\left[\mathcal{R}_i^{-\gamma}\left(\exp\left(\varepsilon_i\right)M\left(z_i\right) - \xi\right)\right] \geq 0, \tag{B.12}$$

with equality if $\Lambda < \bar{\Lambda}\left(z_i\right)$. This condition is *independent of wealth* a_i. Intuitively, CRRA means that the entrepreneur's attitude toward proportional gambles does not depend on the scale of her wealth. Since both the borrowing constraint and the entrepreneurial payoff scale proportionally with wealth, the optimal leverage ratio is wealth-invariant:

$$\Lambda\left(z_i, \gamma\right) = \min\left\{\Lambda^{int}\left(z_i, \gamma\right), \bar{\Lambda}\left(z_i\right)\right\}, \tag{B.13}$$

where $\Lambda^{int}\left(z_i, \gamma\right)$ denotes the interior optimum satisfying Eq. $(B.12)$ with equality. Firm capital is therefore

$$K\left(z_i, a_i\right) = \Lambda\left(z_i, \gamma\right) \cdot a_i, \tag{B.14}$$

and the log size function is

$$k\left(z_i, a_i\right) = \log\Lambda\left(z_i, \gamma\right) + \log a_i. \tag{B.15}$$

This has the same separable form as in the baseline model without risk—wealth enters only through $\log a_i$—regardless of whether the borrowing constraint binds.

We next establish that the optimal leverage is increasing in productivity, so that part of Assumption (M) related to the effect of productivity on firm size is satisfied. We relegate the proofs to the end of this section.

Lemma 2. *Suppose $\gamma \leq 1$. The optimal leverage ratio $\Lambda(z_i, \gamma)$ is strictly increasing in z_i. Therefore, the log size is also strictly increasing in z_i and a_i, $\frac{\partial k(z_i,a_i)}{\partial z_i} > 0$ and $\frac{\partial k(z_i,a_i)}{\partial a_i} > 0$.*

When the borrowing constraint binds, this result always holds because $\bar{\Lambda}(z_i)$ is strictly increasing in z_i as we discussed earlier. When the constraint does not bind, we need the additional condition $\gamma \leq 1$ to ensure that the interior solution for size is increasing with z_i. This condition ensures that the substitution effect of higher productivity dominates the income effect, so that a higher expected return per unit of leverage induces the entrepreneur to scale up. The condition includes log utility ($\gamma = 1$), a common benchmark, and we view it as natural in this setting. In practice, entrepreneurs typically receive additional income from other sources (e.g., a spouse's earnings, part-time work, or future career options) that are not modeled here. Such background income dampens the income effect of higher business productivity, making the effective coefficient of relative risk aversion over entrepreneurial income lower than γ. The condition $\gamma \leq 1$ can therefore be seen as a stand-in for these unmodeled factors.

We now characterize the entry decision. The entrepreneur enters if the expected utility from entrepreneurship exceeds the utility from working. A worker earns $c_i^w = a_i + w$ with certainty, so her utility is $v(a_i + w)$. The entrepreneur's expected utility is $E[v(a_i \cdot \mathcal{R}_i)]$. We express the entry condition in terms of a *certainty-equivalent profit.* Define $\pi^{CE}(z_i, a_i)$ as the certain profit that, added to the entrepreneur's wealth, yields the same utility as the risky entrepreneurial payoff:

$$v\left(a_i + \pi^{CE}\right) = E\left[v\left(a_i \cdot \mathcal{R}_i\right)\right]. \tag{B.16}$$

Since v is strictly increasing, π^{CE} is well defined. To solve for it, note that the right-hand side equals

$$E\left[v\left(a_i \cdot \mathcal{R}_i\right)\right] = \frac{a_i^{1-\gamma} E\left[\mathcal{R}_i^{1-\gamma}\right] - 1}{1-\gamma},$$

while the left-hand side is $v\left(a_i + \pi^{CE}\right) = \frac{\left(a_i + \pi^{CE}\right)^{1-\gamma} - 1}{1-\gamma}$. Equating and solving:

$$\left(a_i + \pi^{CE}\right)^{1-\gamma} = a_i^{1-\gamma} E\left[\mathcal{R}_i^{1-\gamma}\right].$$

This implies

$$a_i + \pi^{CE} = a_i \left(E\left[\mathcal{R}_i^{1-\gamma}\right]\right)^{1/(1-\gamma)} \equiv a_i \cdot \Phi(z_i, \gamma),$$

where $\Phi(z_i, \gamma)$ is the certainty-equivalent gross return on wealth given by

$$\Phi(z_i, \gamma) \equiv \left(E\left[\mathcal{R}\left(\varepsilon_i, z_i, \Lambda(z_i, \gamma)\right)^{1-\gamma}\right]\right)^{1/(1-\gamma)}. \tag{B.17}$$

The certainty-equivalent profit is therefore

$$\pi^{CE}(z_i, a_i) = a_i [\Phi(z_i, \gamma) - 1]. \tag{B.18}$$

The entrepreneur enters if the certainty-equivalent profit exceeds the reservation wage:

$$\pi^{CE}(z_i, a_i) \geq w, \quad \text{i.e.,} \quad a_i \geq \frac{w}{\Phi(z_i, \gamma) - 1} \equiv \overline{a}^{RA}(z_i, \gamma). \tag{B.19}$$

As in the baseline model, the entrepreneur enters into business if her wealth exceeds a threshold. The term $\overline{a}^{RA}(z_i, \gamma)$ denotes the wealth threshold for entry with uninsurable risk. We use $\overline{a}^{RN}(z_i)$ to denote the wealth threshold without uninsurable risk—equivalently, the threshold when the entrepreneur is risk neutral (i.e., $\overline{a}^{RN}(z_i) = \overline{a}^{RA}(z_i, 0)$).

The following result establishes the comparative statics of the profit function $\pi^{CE}(z_i, a_i)$ and establishes the remaining parts of Assumption (M). It also characterizes the entry threshold $\overline{a}^{RA}(z_i, \gamma)$ and describes how uninsurable risk affects entry into business.

Lemma 3. *Consider the model with CRRA preferences (B.7) for any $\gamma > 0$, a borrowing constraint, and uninsurable risk. Suppose $\Phi(z_i, \gamma) > 1$ since otherwise business is not profitable and the agent does not enter for any w.*

(i) The certainty-equivalent profit $\pi^{CE}(z_i, a_i) = a_i [\Phi(z_i, \gamma) - 1]$ is strictly increasing in both wealth and productivity: $\frac{\partial \pi^{CE}}{\partial a_i} > 0$ and $\frac{\partial \pi^{CE}}{\partial z_i} > 0$. Greater wealth and greater productivity both increase entry into entrepreneurship.

(ii) The certainty-equivalent return is strictly less than the expected return: $\Phi(z_i, \gamma) < 1 + [M(z_i) - \xi] \Lambda$. The entry threshold is therefore strictly higher than under the baseline model without risk: $\overline{a}^{RA}(z_i, \gamma) > \overline{a}^{RN}(z_i)$.

This result applies for any $\gamma > 0$—it does not require the restriction $\gamma \leq 1$ that we needed for Lemma 2. The first part of the result implies that the certainty-equivalent profit function $\pi^{CE}(z_i, a_i)$ is increasing in both arguments. Together with Lemma 2, this implies Assumption (M) also holds with uninsurable risk. The certainty-equivalent profit is increasing in wealth since the solution scales linearly with wealth. It is also increasing with business productivity z_i because a higher z_i increases the profit for any given choice of leverage Λ, which implies that it also increases the optimal profit.

The second part of the result shows that uninsurable risk reduces the certainty-equivalent return from entrepreneurship and raises the wealth threshold for entry.

Taken together, uninsurable risk provides a complementary channel by which wealth affects entrepreneurship. Because the entrepreneur cannot share idiosyncratic risk with outside investors, she voluntarily limits her leverage even when the borrowing constraint does not bind. Firm size therefore remains proportional to wealth, and a higher level of wealth is needed to justify the transition to entrepreneurship.

Proof of Lemma 2. When the borrowing constraint binds, $\Lambda = \bar{\Lambda}(z_i) = \frac{1}{\xi - \lambda M(z_i)}$, which is strictly increasing in z_i since $M(z_i)$ is strictly increasing in z_i. This case does not depend on γ.

Now consider the case where the optimum is interior. We apply Topkis' theorem. Since wealth factors out of the objective, the problem is equivalent to maximizing $\tilde{g}(\Lambda, z) = E\left[\frac{\mathcal{R}^{1-\gamma}}{1-\gamma}\right]$. It suffices to show that $\tilde{g}$ is strictly supermodular in (Λ, z). The cross-partial is

$$\frac{\partial^2 \tilde{g}}{\partial \Lambda \partial z} = M'(z) \cdot E\left[\exp(\varepsilon) \cdot \mathcal{R}^{-\gamma-1} \cdot ((1-\gamma)\mathcal{R} + \gamma)\right].$$

Since $M'(z) > 0$, $\exp(\varepsilon) > 0$, and $\mathcal{R} > 0$, the sign is determined by the term $(1-\gamma)\mathcal{R} + \gamma$. For $\gamma \leq 1$, we have $1-\gamma \geq 0$ and $\gamma > 0$, so $(1-\gamma)\mathcal{R} + \gamma > 0$ for all $\mathcal{R} > 0$. Therefore the cross-partial is strictly positive, $\tilde{g}$ is strictly supermodular, and Λ^{int} is strictly increasing in z by Topkis' theorem.

Since $\Lambda(z) = \min\left\{\Lambda^{int}(z), \bar{\Lambda}(z)\right\}$ and both Λ^{int} and $\bar{\Lambda}$ are strictly increasing in z, their minimum Λ is also strictly increasing in z. □

Proof of Lemma 3. (i) From Eq. $(B.18)$, $\frac{\partial \pi^{CE}}{\partial a_i} = \Phi - 1 > 0$ since $\Phi > 1$ by assumption.

For $\frac{\partial \pi^{CE}}{\partial z_i} > 0$, we use a revealed preference argument that does not depend on γ. Consider $z' > z$. We need to show that $\Phi(z', \gamma) > \Phi(z, \gamma)$. Fix any Λ in the feasible set at z (i.e., $\Lambda \leq \bar{\Lambda}(z)$). Since $M(z') > M(z)$, the gross return $\mathcal{R}(\varepsilon, z', \Lambda) > \mathcal{R}(\varepsilon, z, \Lambda)$ for every realization of ε. Because v is strictly increasing, $E[v(a_i \cdot \mathcal{R}(\varepsilon, z', \Lambda))] > E[v(a_i \cdot \mathcal{R}(\varepsilon, z, \Lambda))]$, which implies a strictly higher certainty equivalent at fixed Λ. Since $\bar{\Lambda}(z') \geq \bar{\Lambda}(z)$, the old optimum $\Lambda(z)$ is feasible at z', and the entrepreneur can only do weakly better by reoptimizing. Therefore, the expected utility at z' strictly exceeds that at z, which implies $\Phi(z', \gamma) > \Phi(z, \gamma)$.

(ii) By Jensen's inequality and the strict concavity of v,

$$\Phi(z_i, \gamma) < E[\mathcal{R}_i] = 1 + [M(z_i) - \xi]\Lambda.$$

When $\Lambda = \bar{\Lambda}(z_i)$ (constraint binds), the right-hand side equals $1 + [M(z_i) - \xi]\bar{\Lambda}(z_i)$, the gross return under the baseline model without risk. When $\Lambda < \bar{\Lambda}(z_i)$ (interior solution), the right-hand side is even smaller, since the risk-averse entrepreneur uses lower leverage. In either case, $\Phi - 1 < [M(z_i) - \xi]\bar{\Lambda}(z_i)$ and therefore $\overline{a}^{RA} > \overline{a}^{RN}$. □

B.1.2 Model in which Entrepreneurship Provides Non-pecuniary Benefits

We now describe a complementary model in which wealth affects entrepreneurship through non-pecuniary benefits rather than financial frictions. To ensure a well-defined profit-maximizing scale, we consider a capital-only production technology with decreasing returns,

$$\Pi(K; z_i) = \exp(z_i) K^\alpha - \xi K, \quad \alpha \in (0,1). \tag{B.20}$$

We also assume there are no financial frictions, so the entrepreneur can operate at any desired scale. The strictly concave profit function has a unique interior maximum

$$K^*(z_i) = \left(\frac{\alpha \exp(z_i)}{\xi}\right)^{1/(1-\alpha)},$$

which is strictly increasing in productivity.

Instead, suppose the non-pecuniary utility from entrepreneurship depends on size and consumption,

$$u^e = U^e(K, c; z_i, a_i) \text{ where } c = a_i + \Pi(K; z_i).$$

We assume

$$\frac{\partial U^e}{\partial c} > 0, \; \frac{\partial U^e}{\partial K} \geq 0, \; \frac{\partial^2 U^e}{\partial c \partial K} \geq 0,$$

along with joint concavity of U^e in (c, K) and strict concavity in K. These assumptions capture the idea that individuals enjoy running a larger business, and more so when their consumption is higher. A leading example is $U^e(K, c) = K^\eta c^\beta$ for $\eta \in [0, 1)$ and $\beta \in (0, 1)$.

In this case, the entrepreneur solves

$$\begin{aligned} K(z_i, a_i) &= \arg\max_{K,c} c + U^e(K, c; z_i, a_i) \\ &\quad \text{s.t. } c = a_i + \Pi(K; z_i). \end{aligned} \tag{B.21}$$

As before, we also denote $k(z_i, a_i) = \log K(z_i, a_i)$. The following lemma characterizes the solution and its comparative statics. The result also implies that this model satisfies Assumption (M) (recall that we assume the reservation wage is constant, $w(z_i) = w$).

Lemma 4. *Consider problem* $(B.21)$ *with the assumptions described above. The optimal size is the unique solution to*

$$\frac{\partial \Pi}{\partial K}\left(1 + \frac{\partial U^e}{\partial c}\right) = -\frac{\partial U^e}{\partial K}. \tag{B.22}$$

The optimal size weakly exceeds the profit-maximizing size: that is, $K \geq K^*(z_i)$. *Greater productivity increases the firm size and the total utility from entrepreneurship,* $\frac{\partial k(z_i,a_i)}{\partial z_i} > 0$, $\frac{\partial(\pi(z_i,a_i)+u^e(z_i,a_i))}{\partial z_i} > 0$. *Greater wealth weakly increases the firm size and the total entrepreneurship utility,* $\frac{\partial k(z_i,a_i)}{\partial a_i} \geq 0$, $\frac{\partial(\pi(z_i,a_i)+u^e(z_i,a_i))}{\partial a_i} \geq 0$, *but it* weakly decreases *firm profits,* $\frac{\partial \pi(z_i,a_i)}{\partial a_i} \leq 0$.

Proof. In view of the concavity assumptions, problem $(B.21)$ has a unique solution characterized by the optimality condition $(B.22)$. Since $\frac{\partial U^e}{\partial K} \geq 0$ and $\frac{\partial U^e}{\partial c} > 0$, this condition implies $\frac{\partial \Pi}{\partial K} \leq 0$. Since Π is strictly concave and the profit-maximizing size level $K^*(z_i)$ satisfies $\frac{\partial \Pi(K^*)}{\partial K} = 0$, this also implies $K \geq K^*(z_i)$.

We next establish the comparative statics. Consider $\frac{\partial K(z_i,a_i)}{\partial z_i}$. We rewrite $(B.22)$ as $\frac{\partial(c+U^e)}{\partial K} = 0$.

Implicitly differentiating this expression with respect to z_i, we obtain

$$\frac{\partial K(z_i, a_i)}{\partial z_i} = \frac{\frac{\partial^2(c+U^e)}{\partial K \partial z_i}}{-\frac{\partial^2(c+U^e)}{\partial K^2}}.$$

The denominator is strictly positive. Using $c = a_i + \Pi(K; z_i)$, we calculate the numerator as

$$\frac{\partial^2(c+U^e)}{\partial K \partial z_i} = \frac{\partial^2 \Pi}{\partial K \partial z_i}\left(1 + \frac{\partial U^e}{\partial c}\right) + \frac{\partial \Pi}{\partial K}\frac{\partial^2 U^e}{\partial c^2}\frac{\partial \Pi}{\partial z_i} + \frac{\partial^2 U^e}{\partial K \partial c}\frac{\partial \Pi}{\partial z_i} > 0.$$

Here, the inequality follows since $\frac{\partial^2 \Pi}{\partial K \partial z_i} > 0$, $\frac{\partial U^e}{\partial c} > 0$, $\frac{\partial^2 U^e}{\partial c^2} \leq 0$, $\frac{\partial \Pi}{\partial K} \leq 0$, $\frac{\partial \Pi}{\partial z_i} > 0$ and $\frac{\partial^2 U^e}{\partial K \partial c} \geq 0$. This proves $\frac{\partial K(z_i,a_i)}{\partial z_i} > 0$. Since $k = \log K$, this also implies $\frac{\partial k(z_i,a_i)}{\partial z_i} > 0$.

Next consider $\frac{\partial K(z_i,a_i)}{\partial a_i}$. As before, $\frac{\partial K(z_i,a_i)}{\partial a_i}$ has the same sign as $\frac{\partial^2(c+U^e)}{\partial K \partial a_i}$. We calculate

$$\frac{\partial^2(c+U^e)}{\partial K \partial a_i} = \frac{\partial \Pi}{\partial K}\frac{\partial^2 U^e}{\partial c^2} + \frac{\partial^2 U^e}{\partial K \partial c} \geq 0.$$

Here, the inequality follows since $\frac{\partial \Pi}{\partial K} \leq 0$, $\frac{\partial^2 U^e}{\partial c^2} \leq 0$ and $\frac{\partial^2 U^e}{\partial K \partial c} \geq 0$. This implies $\frac{\partial K(z_i,a_i)}{\partial a_i} \geq 0$ and thus $\frac{\partial k(z_i,a_i)}{\partial a_i} \geq 0$. Since $\frac{\partial \Pi}{\partial a_i} = \frac{\partial \Pi}{\partial K}\frac{\partial K}{\partial a_i}$ and $\frac{\partial \Pi}{\partial K} \leq 0$, this also implies $\frac{\partial \pi(z_i,a_i)}{\partial a_i} \leq 0$.

Finally, consider the comparative statics of the total utility from entrepreneurship, $\pi(z_i, a_i) + u^e(z_i, a_i)$. Increasing z_i strictly increases the objective function in problem ($B.21$) for any given choice of K. Therefore, it also strictly increases the maximum, which is given by $a_i + \Pi(K; z_i) + U^e(K, a_i + \Pi(K; z_i); z_i, a_i)$. This implies $\frac{\partial(\pi(z_i,a_i)+u^e(z_i,a_i))}{\partial z_i} > 0$. For the comparative static with respect to a_i, we apply the envelope theorem. The maximized value is $V^* = a_i + \pi(z_i, a_i) + u^e(z_i, a_i)$, and by the envelope theorem

$$\frac{\partial V^*}{\partial a_i} = 1 + \frac{\partial U^e}{\partial c} > 1,$$

where the inequality follows from $\frac{\partial U^e}{\partial c} > 0$. Since $\frac{\partial V^*}{\partial a_i} = 1 + \frac{\partial(\pi+u^e)}{\partial a_i}$, we obtain $\frac{\partial(\pi(z_i,a_i)+u^e(z_i,a_i))}{\partial a_i} = \frac{\partial U^e}{\partial c} > 0$, completing the proof. □

B.2 Unobserved Residual Heterogeneity

In the main text, we assumed firm size, profits, and outside options depend only on entrepreneurial productivity and assets. In practice, these variables might be heterogeneous also on other dimensions. In this appendix, we show that our selection approach is robust to allowing for residual heterogeneity under three additional conditions: (i) the portfolio return is independent of both productivity and the residual heterogeneity, (ii) the effect of the portfolio return on size is separable from the effect of productivity and residuals, and (iii) we focus on entrants with size levels sufficiently far from the entry cutoff. The second condition holds in our theoretical model with financial frictions. With these assumptions, our rank matching approach still controls for unobserved residuals as well as business productivity and identifies the causal effect of wealth on firm-level outcomes.

B.2.1 Setup with Residual Heterogeneity and Separability

For the purpose of this appendix, we focus on individuals with given covariates x_i as well as given initial wealth a_0. For simplicity, we suppress x_i from the notation, e.g., all subsequent expectation operators and distributions are conditional on x_i. At the expense of additional analytical complexity, we could use propensity score reweighting to generalize our results for the unconditional case. We also drop the i subscript from the notation and use $z = z_i$ to denote the productivity, $a = a_i = a_0 R$ to denote initial wealth, and so on.

We let δ denote a vector of *ex-ante* characteristics that can influence firm log size, profits, and outside options beyond entrepreneurial productivity z and wealth $a = a_0 R$. For instance, δ can correspond to industry differences in technology or uninsurable business risks; or individual-level differences in wage earnings potential or risk aversion. Let ε denote a vector of *ex-post* characteristics that can influence ex-post firm size and profits beyond z and a. For instance, ε can correspond to ex-post productivity shocks or simply mistakes (relative to the optimal choice).

Formally, we allow the log size, profit, entrepreneurial utility, and outside option functions depend on these residuals as well as business productivity and wealth. We denote these functions with $k(z, \delta, \varepsilon, a), \pi(z, \delta, \varepsilon, a), u^e(z, \delta, \varepsilon, a), w(z, \delta, \varepsilon)$. The baseline model without residual heterogeneity is a special case in which residuals are constant.

Our main assumption is that the return R is independent from these residuals as well as from the productivity conditional on the covariates. That is, we strengthen Assumption (CIA) as follows.

Assumption (CIA$^{\mathrm{R}}$). Return R is independent of z, δ, ε conditional on covariates x.

This assumption likely holds in our analysis because we focus on a plausibly exogenous variation in the portfolio return. Observe that we do not impose any restriction on the correlation between business productivity and residuals.

Given this assumption, we let $F_{z,\delta,\varepsilon}(z)$ and $F_R(R)$ denote the CDFs. We also use $F_{z,\delta}(z, \delta)$ to denote the marginal CDFs for the corresponding variables. We assume that the residual distributions and the size function are such that for each z and $a = a_0 R$ the corresponding size $k(z, \delta, \varepsilon, a_0 R)$ remains bounded.

With residual heterogeneity, the individual chooses to enter into business if the following condition holds:

$$E_0[\pi(z, \delta, \varepsilon, a) + u^e(z, \delta, \varepsilon, a)] \geq E_0[w(z, \delta, \varepsilon)].$$

Here, $E_0[\cdot]$ denotes the expectation operator after observing the ex-ante shocks δ, z, a but before the ex-post shock ε. We assume the following version of assumption (M).

Assumption (M$^{\mathrm{R}}$). $\frac{d(E_0[\pi(z,\delta,\varepsilon,a)+u^e(z,\delta,\varepsilon,a)])}{da} \geq 0$, $\frac{d(E_0[\pi(z,\delta,\varepsilon,a)+u^e(z,\delta,\varepsilon,a)-w(z,\delta,\varepsilon)])}{dz} > 0$ for each δ and $\frac{dk(z,\delta,\varepsilon,a)}{dz} > 0$ for each δ, ε.

With this assumption, a version of Proposition 1 still holds. For each level of ex-ante residuals δ, there is a threshold level of log productivity $\overline{z}(\delta,a)$ such that an individual enters into business if $z \geq \overline{z}(\delta, a)$. Since the total benefit from entry is increasing in initial assets a, we also have that $\overline{z}(\delta, a)$ is weakly decreasing in a. Therefore, for a wealth level a, the fraction of entrants is given by

$$e(a = a_0 R) = \int_{z \geq \overline{z}(\delta,a)} dF_{z,\delta}(z, \delta).$$

Observe that $e(a_0 R)$ is weakly increasing in R, generalizing Proposition 1 to this case. Intuitively, residual heterogeneity that is uncorrelated with return on wealth does not change the prediction that a higher return increases entry.

Our results on the effect of wealth on business characteristics require two further conditions. Recall that in the baseline model, the monotonicity of size in productivity serves two roles: it ensures that size rank is a proxy for productivity rank, and it ensures that high-size agents all enter (since they have high productivity and therefore high profits). With residual heterogeneity, each role requires a separate condition. Our separability assumption, Assumption (S), addresses the first role: it ensures that changing wealth induces a rank-preserving transformation of the size distribution, so that matching by size rank controls for the joint distribution of productivity and residuals. A trimming condition addresses the second role: we focus on entrants with size sufficiently far from the entry cutoff to ensure that all agents above the cutoff actually enter.

Assumption (S). The (log) size function has the following separable form

$$k(z, \delta, \varepsilon, a) = G(k_0(z, \delta, \varepsilon), a),$$

where $k_0(z, \delta, \varepsilon)$ is increasing in all arguments and $G(k_0, a)$ is an aggregator function that is strictly increasing in the first argument.

A special case is a quasi-linear aggregator function $G(k_0, a) = k_0 + h(a)$, where wealth raises log size by a constant amount regardless of productivity or residuals. Another special case is $G(k_0, a) = k_0 h_0(a) + h_1(a)$, where size can both shift and stretch log size (inclusive of residuals). More generally, Assumption (S) says that the productivity and the residuals affect a baseline log size function $k_0(z, \delta, \varepsilon)$, which can then get arbitrarily transformed by wealth. Under this assumption, productivity and residuals affect the size *rank* in the same way for the high-wealth and the low-wealth agents. Hence, matching agents by their size rank controls for the *joint distribution of productivity and residuals.*

While Assumption (S) may seem restrictive, it is satisfied for the model with financial frictions analyzed in Section B.1.1. As shown in Eq. ($B.6$), in the baseline model without uninsurable risk the log size function takes the form

$$k\left(z_i, a_i\right) = \underbrace{\log \Lambda\left(z_i\right)}_{\equiv k_0(z,\delta,\varepsilon)} + \underbrace{\log a_i}_{\equiv h(a_i)}.$$

This is the quasi-linear special case of Assumption (S), with $h\left(a_i\right) = \log a_i$. This holds because, once labor is optimized out, the reduced-form profit is linear in capital. Thus, the borrowing constraint always binds and firm size is proportional to wealth with a productivity-dependent leverage ratio. Note that the leverage ratio is given by $\Lambda\left(z_i\right) \equiv \frac{1}{\xi - \lambda M(z_i)}$ and depends not only on business productivity z_i but also on structural features such as the return function $M\left(\cdot\right)$, the pledgeability parameter λ, the rental rate of capital ξ. Hence, in this example the residual heterogeneity can capture firm-level or industry-level features that determine the leverage ratio.

With uninsurable risk, Eq. $(B.15)$ shows the log size function still has the same separable form

$$k\left(z_i, a_i\right) = \underbrace{\log \Lambda\left(z_i, \gamma\right)}_{\equiv k_0(z,\delta,\varepsilon)} + \underbrace{\log a_i}_{\equiv h(a_i)}.$$

For the cases in which the borrowing constraint does not bind, the leverage ratio can also depend on the risk aversion coefficient γ as well as the amount of uninsurable risk (see the optimality condition $(B.12)$). Hence, in this example the residual heterogeneity parameters (δ, ε) can also capture heterogeneity in risk-related features.

The separable structure also extends to settings with fixed entry costs. Suppose there is no uninsurable risk but the entrepreneur pays a fixed cost $f > 0$ before scaling. Then, as long as the business is profitable, the borrowing constraint binds and the solution becomes

$$k\left(z_i, a_i\right) = \underbrace{\log \Lambda\left(z_i\right)}_{\equiv k_0(z,\delta,\varepsilon)} + \underbrace{\log\left(a_i - f\right)}_{\equiv h(a_i)}.$$

This satisfies Assumption (S) with $h\left(a_i\right) = \log\left(a_i - f\right)$. Fixed costs therefore do not violate the assumption, as long as the residual heterogeneity primarily concerns the drivers of the leverage ratio as opposed to the fixed cost level.

These examples illustrate that Assumption (S) holds in a large class of models with financial frictions where idiosyncratic differences across entrepreneurs in technology, industry, or borrowing terms affect how much capital a given unit of wealth can support, but do not affect the base wealth that gets scaled up. Beyond these cases, Assumption (S) can be viewed as a benchmark that leads to sharp analytical results.

In addition to Assumption (S), we also focus on agents that exceed the (average) entry cutoff with a sufficient margin. To see why this is necessary, observe that higher productivity z increases both size and profits and thus also the propensity to enter. However, some ex-ante residuals δ—call them size-specific residuals—will increase size without increasing expected profits and the propensity to enter. Therefore, near the (average) entry cutoff, the *entrants* will be relatively more selected on productivity than on size. Hence, the *entrants* with a given size will on average tend to have higher productivity z and lower size-specific residuals δ than the case without residuals. This bias will generally be higher for the low-asset group, who are closer to the entry cutoff, than the high-asset group. This might create systematic differences between average productivity when we compare low-asset agents with rank-matched high-asset agents.

To address this problem, we focus on size levels $\overline{k}$ such that an agent with the corresponding size enters for sure regardless of their residuals. Specifically, we require the size level to exceed a lower cutoff defined as follows

$$\overline{k} \geq \overline{k}^{lower}(a) \equiv \max_{\delta,\varepsilon} k\left(\overline{z}\left(\delta,a\right), \delta, \varepsilon, a\right). \tag{B.23}$$

Here, recall that $\overline{z}\left(\delta,a\right)$ is the productivity cutoff for entry given ex-ante residuals δ. Hence, Eq. $(B.23)$ ensures that all agents with desired size $\overline{k}$ enter.[3] Observe that in the baseline model without residual heterogeneity (constant δ, ε), the lower cutoff is equal to the entry cutoff from the main text, $\overline{k}^{lower}(a) = \overline{k}\left(a\right) = k\left(\overline{z}\left(a\right), a\right)$. In this case, we can consider any size level that corresponds to an entrant. With residual heterogeneity (variable δ, ε), the cutoff $\overline{k}^{lower}(a)$ will typically be larger than the minimum size for an entrant (given by $\min_{\delta,\varepsilon} k\left(\overline{z}\left(\delta,a\right), \delta, \varepsilon, a\right)$) so condition $(B.23)$ requires trimming some entrants by size.

We are now ready to present our result that generalizes Proposition 2 to the case with residual heterogeneity. To state the result, we define some notation. As before for each return level we define the fraction of entrants whose size exceeds $\overline{k}$ (cf. (2))

$$e\left(\overline{k}, a = a_0 R\right) = \int_{z \geq \overline{z}(\delta,a), k \geq \overline{k}} dF_{z,\delta,\varepsilon}\left(z, \delta, \varepsilon\right). \tag{B.24}$$

Next consider an observable firm-level outcome variable, such as firm size or profits, that can be described as a function of productivity, residuals and wealth, $y\left(z, \delta, \varepsilon, a\right)$. We denote the average value of this outcome for entrants whose size exceeds $\overline{k}$ as follows (cf. (3))

$$\mathbf{y}\left(\overline{k}, a = a_0 R\right) = \frac{\int_{z \geq \overline{z}(\delta,a), k \geq \overline{k}} y\left(z, \delta, \varepsilon, a\right) dF_{z,\delta,\varepsilon}\left(z, \delta, \varepsilon\right)}{e\left(\overline{k}, a\right)}. \tag{B.25}$$

Observe that we can calculate the empirical counterparts of the functions $e\left(\cdot\right)$ and $\overline{y}\left(\cdot\right)$ for each threshold $\overline{k}$ and return level R. The following result shows how to use these functions to control for unobserved productivity and calculate the causal effects of return on firm-level outcomes.

Proposition 4 (Rank preservation with residual heterogeneity)**.** *Consider the model with (ex-ante or ex-post) residual heterogeneity. Suppose Assumptions (CIA^R),(M^R), and (S) hold. Consider a*

[3] To see this, consider an agent with arbitrary residuals δ,ε. Condition $\overline{k} > k\left(\overline{z}\left(\delta,a\right), \delta, \varepsilon, a\right)$ implies this agent must have $z > \overline{z}\left(\delta,a\right)$ because k is increasing in productivity z.

return R^L, resulting wealth $a_0 R^L$, and corresponding log size $\overline{k}^L$. Let $R^H > R^L$ denote a higher return. Let $\overline{k}^H \geq \overline{k}^L$ denote the unique log size level that solves (see (B.25))

$$e\left(\overline{k}^H, a_0 R^H\right) = e\left(\overline{k}^L, a_0 R^L\right). \tag{B.26}$$

Consider a size level $\overline{k}^L$ such that the inequalities $\overline{k}^L \geq \overline{k}^{lower}\left(a_0 R^L\right)$ and $\overline{k}^H \geq \overline{k}^{lower}\left(a_0 R^H\right)$ both hold (see (B.23)). Let $\mathbf{y}^H = \mathbf{y}\left(\overline{k}^H, a_0 R^H\right)$ and $\mathbf{y}^L = \mathbf{y}\left(\overline{k}^L, a_0 R^L\right)$ denote the expected firm-level outcome among the high-return entrants with size above $\overline{k}^H$ and the low-return entrants with size above $\overline{k}^L$, respectively. Then, the difference $\mathbf{y}^H - \mathbf{y}^L$ corresponds to the average causal effect of return on the firm-level outcome for the low-wealth entrants with size above $\overline{k}^L$, that is:

$$\mathbf{y}^H - \mathbf{y}^L = \frac{\int_{z \geq \overline{z}(\delta, a_0 R^L), k^L \geq \overline{k}^L} \begin{bmatrix} y\left(z, \delta, \varepsilon, a_0 R^H\right) \\ -y\left(z, \delta, \varepsilon, a_0 R^L\right) \end{bmatrix} dF_{z,\delta,\varepsilon}\left(z, \delta, \varepsilon\right)}{e\left(\overline{k}^L, a_0 R^L\right)}. \tag{B.27}$$

Here, $k^L = k^L\left(z, \delta, \varepsilon, a_0 R^L\right)$ denotes the size function with low return.

Proof. We first define the functions k^L and k^H as follows

$$\begin{aligned} k^L\left(z, \delta, \varepsilon\right) &= k^L\left(z, \delta, \varepsilon, a_0 R^L\right) = G\left(k_0\left(z, \delta, \varepsilon\right), a_0 R^L\right) \\ k^H\left(z, \delta, \varepsilon\right) &= k^H\left(z, \delta, \varepsilon, a_0 R^H\right) = G\left(k_0\left(z, \delta, \varepsilon\right), a_0 R^H\right). \end{aligned}$$

Here, the second equalities use Assumption (S). Recall also that G is strictly increasing in the first argument. Thus, for each return R it has a strictly increasing inverse function that we denote by $G^{inv}\left(\cdot, a_0 R\right)$. In view of this observation, the equation for k^L implies

$$k_0\left(z, \delta, \varepsilon\right) = G^{inv}\left(k^L\left(z, \delta, \varepsilon\right), a_0 R^L\right).$$

Subtituting this into the equation for k^H, we obtain

$$\begin{aligned} k^H\left(z, \delta, \varepsilon\right) &= G\left(G^{inv}\left(k^L\left(z, \delta, \varepsilon\right), a_0 R^L\right), a_0 R^H\right) \\ &\equiv g\left(k^L\left(z, \delta, \varepsilon\right)\right). \end{aligned}$$

Here, the last line defines the function $g\left(k\right) = G\left(G^{inv}\left(k, a_0 R^L\right), a_0 R^H\right)$, which is strictly increasing because both G and G^{inv} are strictly increasing. It follows that the size function k^H is a monotonic transformation of the size function k^L.

Next observe that since we focus on size levels sufficiently far from the entry cutoff for both return groups, we can drop the conditioning on entry in the definitions of functions $\mathbf{e}\left(\cdot\right)$ and $\mathbf{y}\left(\cdot\right)$.

In particular, the fraction of low-return entrants with size above $\overline{k}^L$ satisfies

$$e\left(\overline{k}^L, a_0 R^L\right) = \int_{k^L \geq \overline{k}^L} dF_{z,\delta,\varepsilon}\left(z,\delta,\varepsilon\right).$$

Likewise, for the high-return entrants, the fraction with size above $\overline{k}^H$ satisfies

$$\begin{aligned} e\left(\overline{k}^H, a_0 R^H\right) &= \int_{k^H \geq \overline{k}^H} dF_{z,\delta,\varepsilon}\left(z,\delta,\varepsilon\right) \\ &= \int_{g(k^L) \geq \overline{k}^H} dF_{z,\delta,\varepsilon}\left(z,\delta,\varepsilon\right) \\ &= \int_{k^L \geq g^{inv}\left(\overline{k}^H\right)} dF_{z,\delta,\varepsilon}\left(z,\delta,\varepsilon\right). \end{aligned}$$

Here, the second line substitutes $k^H = g\left(k^L\right)$. The last line uses the observation that $g(\cdot)$ is strictly increasing to describe the integrated region as $k^L \geq g^{inv}\left(k^H\right)$ where g^{inv} denotes the inverse function of $g(\cdot)$. Comparing this with the expression for $e\left(\overline{k}^L, a_0 R^L\right)$ proves that $\overline{k}^H$ that solves Eq. $(B.26)$ satisfies $\overline{k}^L = g^{inv}\left(\overline{k}^H\right)$ or equivalently $\overline{k}^H = g\left(\overline{k}^L\right)$.

Next consider an outcome variable, $y\left(z,\delta,\varepsilon, a_0 R\right)$. The average of this outcome among the low-return entrants is given by

$$\mathbf{y}\left(\overline{k}^L, a_0 R^L\right) = \frac{\int_{k^L \geq \overline{k}^L} y\left(z,\delta,\varepsilon, a_0 R^L\right) dF_{z,\delta,\varepsilon}\left(z,\delta,\varepsilon\right)}{e\left(\overline{k}^L, a_0 R^L\right)}.$$

Its average among the high-return entrants is given by

$$\begin{aligned} \mathbf{y}\left(\overline{k}^H, a_0 R^H\right) &= \frac{\int_{k^H \geq \overline{k}^H} y\left(z,\delta,\varepsilon, a_0 R^H\right) dF_{z,\delta,\varepsilon}\left(z,\delta,\varepsilon\right)}{e\left(\overline{k}^H, a_0 R^H\right)} \\ &= \frac{\int_{g(k^L) \geq g\left(\overline{k}^L\right)} y\left(z,\delta,\varepsilon, a_0 R^H\right) dF_{z,\delta,\varepsilon}\left(z,\delta,\varepsilon\right)}{e\left(\overline{k}^H, a_0 R^H\right)} \\ &= \frac{\int_{k^L \geq \overline{k}^L} y\left(z,\delta,\varepsilon, a_0 R^H\right) dF_{z,\delta,\varepsilon}\left(z,\delta,\varepsilon\right)}{e\left(\overline{k}^L, a_0 R^L\right)}. \end{aligned}$$

Here, the second line substitutes $k^H = g\left(k^L\right)$ and $\overline{k}^H = g\left(\overline{k}^L\right)$. The last line then substitutes $e\left(\overline{k}^H, a_0 R^H\right)$ with $e\left(\overline{k}^L, a_0 R^L\right)$ and $g\left(k^L\right) \geq g\left(\overline{k}^L\right)$ with $k^L \geq \overline{k}^L$.

Combining the expressions for $\mathbf{y}^H = \mathbf{y}\left(\overline{k}^H, a_0 R^H\right)$ and $\mathbf{y}^L = \mathbf{y}\left(\overline{k}^L, a_0 R^L\right)$, we obtain

$$\mathbf{y}^H - \mathbf{y}^L = \frac{\int_{k^L \geq \overline{k}^L} \left[\begin{array}{c} y\left(z, \delta, \varepsilon, a_0 R^H\right) \\ -y\left(z, \delta, \varepsilon, a_0 R^L\right) \end{array}\right] dF_{z,\delta,\varepsilon}\left(z, \delta, \varepsilon\right)}{e\left(\overline{k}^L, a_0 R^L\right)}.$$

This proves $(B.27)$ since we can drop the conditioning on entry, $z \geq \overline{z}\left(\delta, a_0 R^L\right)$. □

Despite residual heterogeneity, our rank-matching approach identifies the causal effect of wealth on firm-level outcomes. Two conditions make this possible. Assumption (S) ensures that changing wealth induces a rank-preserving mapping of size: agents with a given productivity-residual configuration (z, δ, ε) are ranked in the same order by size regardless of their wealth level. Matching agents by size rank therefore controls for the unobserved joint distribution of productivity and residuals. The trimming condition $\overline{k} \geq \overline{k}^{lower}$ ensures that all agents above the size cutoff actually enter, so that the observed size distribution coincides with the potential size distribution. This condition is needed because, unlike in the baseline model, an agent with high size-specific residuals but low productivity might choose not to enter despite having a large potential size. We next provide a calibration exercise that illustrates the potential bias near the entry cutoffs and provides some guidance on how to choose the trimming near the cutoffs.

B.2.2 Numerical Calibration and Robustness

Model for calibration. Consider the setup from Section B.1.1 with financial frictions and $\alpha = 1$.[4] We assume that the share of potential entrepreneurs in the population of individuals is χ. Among the potential entrepreneurs, we assume that individuals draw log productivity z from a normal distribution with mean z_0 and standard deviation σ_z. Potential entrepreneurs can have two levels of initial wealth $a \in \left\{a^L, a^H\right\}$, with $a^L < a^H$. We assume that scale is bounded above by a maximum leverage ratio denoted by Λ, so that using $(B.5)$, the baseline log size function (without residual heterogeneity) is

$$k\left(z_i, a_i\right) = \log\left(\min\left\{\frac{1}{\xi - \lambda \exp z_i}, \Lambda\right\}\right) + \log a_i, \tag{B.28}$$

for $\xi - \lambda \exp z_i > 0$ and

$$k\left(z_i, a_i\right) = \log \Lambda + \log a_i,$$

for $\xi - \lambda \exp z_i \leq 0$. Profits given log size k are

$$\pi\left(z_i, k_i\right) = \exp\left(z_i + k_i\right) - \xi \exp\left(k_i\right). \tag{B.29}$$

[4] We work with $\alpha = 1$ for our numerical illustration, since given the Cobb-Douglas production function, using other values of α does not substantively change the model properties, but the model calibration become substantially more complex.

We add residual heterogeneity to log size and log profits as follows

$$\begin{aligned} k\left(z, \delta^k, a\right) &= k(z, a) + k_\delta \cdot \delta^k \\ \log \pi\left(z, \delta^k, \delta^\pi, a\right) &= \log \pi\left(z, k\left(z, \delta^k, a\right)\right) + \pi_\delta \cdot \delta^\pi, \end{aligned} \tag{B.30}$$

where $k(z, a)$ and $\pi(z, k)$ on the right-hand sides denote the baseline functions from $(B.28)$–$(B.29)$. Note that since we are unable to separately identify ex ante from ex post heterogeneity, for the purposes of our calibration we only model ex ante heterogeneity. We adopt the convention that $k_\delta, \pi_\delta \geq 0$ so that residuals increase both the log size and profit functions. For simplicity we assume that individuals draw values of δ^k and δ^π independently from each other and from their z_i and a_i according to standard normal distributions.[5]

Entry occurs whenever

$$\pi\left(z_i, \delta_i^k, \delta_i^\pi, a_i\right) + u^e \geq w, \tag{B.31}$$

given some non-pecuniary benefit level u^e and an outside wage option of w.[6]

Calibration. We calibrate the parameters of this model as follows:

- We consider two equal-size groups of potential entrepreneurs with wealth a^L and a^H, each equal to 0.5% of the population of individuals (so that the share of potential entrepreneurs is $\chi = 1\%$).
- We normalize the mean log productivity z_0 to 0.[7]
- Since we cannot separately identify w from u^e, we set the non-pecuniary benefit $u^e = 0$.
- We focus on households with initial (i.e. pre-stock return realization) financial wealth between (50k, 400k], which corresponds to the lowest initial financial wealth bin in our implementation of the selection correction procedure in Section 6. Among these, we set a^L to be the average financial wealth (including the buy and hold kroner gain) of the lowest stock return group (with buy-and-hold excess stock return between -10%, and 0%) and similarly, we set a^H to be the average financial wealth of the highest stock return group (with buy-and-hold return of over 40%). This corresponds (in thousands of NOK) to $a^L = 194$ and $a^H = 332$, respectively. We cannot calibrate k_δ precisely, so we will present results for two different values of k_δ, which we consider as bounds on the degree of residual heterogeneity in size. To set these bounds, we compute a total factor productivity (TFP) measure in our population of start-ups, using value added as a measure of output, fixed assets (tangibles and intangibles) as a measure of

[5] For technical reasons we symmetrically truncate these distributions at 3 times the standard deviation.

[6] Note that any heterogeneity in non-pecuniary benefits or the outside wage is subsumed in the heterogeneity in ex ante profits δ_i^π.

[7] Equivalently, we calibrate all parameters in the model relative to some mean log productivity level z_0.

capital, number of employees as measure of labor and a Cobb-Douglas production function with capital elasticity of 0.3. We then partial out 4-digit NACE sector fixed effects and 2-digit NACE sector-by-year fixed effects from the log of this TFP measure. The resulting residual measure is our proxy for z in the model. We take the log of total assets to proxy for k in our model, as we do for the selection correction procedure in Section 6. We then regress log total assets on the residualized log TFP. The residual standard deviation of log total assets is 1.14 log points. This residual, in addition to the contribution of residual heterogeneity, as in our model above, and measurement error in log TFP, also includes the differential effects of the entrepreneur's own financial wealth.

To get a sense of the contribution of own wealth heterogeneity, we use our estimate of the effect of stock wealth on total assets from Section 6, Table 6. According to our estimates, every 1000 kroner increase in stock wealth leads to an increase in total assets of around 2130 kroner. We can express this estimate as a semi-elasticity by dividing it by either the mean or median of total assets of startups (from Table 6). The resulting semi-elasticity is 0.00306 when using the mean and 0.00465 when using the median of total assets. Combining this coefficient with the standard deviation in stock wealth among stock-wealth holding entrepreneurs (which is 272 thousand kroner), implies a causal effect of stock wealth variation on initial size variation of between 0.83 and 1.26 log points. Comparing against the residual standard deviation of log total assets, the contribution of residual heterogeneity to log total assets can be between 0 and 0.78 log points. We therefore calibrate the model for two separate values of k_δ, namely $k_\delta^{low} = 0.05$ and $k_\delta^{high} = 0.15$.

- We also cannot calibrate π_δ precisely and instead use $\pi_\delta = k_\delta$. This assumption on π_δ is not too important since π_δ plays a very limited role in biasing our rank matching procedure.

We are left with 4 free parameters: ξ, λ, w, and σ_z, which we calibrate jointly by targeting the following 4 data moments using simulated method of moments:

- the average sales of the firms created by low and high wealth entrants as defined above;
- the inter-quartile range of log TFP (after accounting for 4-digit NACE sectors and 2-digit NACE sector-by-time fixed effects) among the low and high wealth entrants as defined above;[8]
- the entry rate of the low wealth potential entrepreneurs;
- the entry rate of the high wealth entrepreneurs;

All of the data moments are propensity-score reweighted as described in Section 6.

[8] We use the inter-quartile range rather than the standard deviation of log TFP to reduce the impact of outliers in the measure of the standard deviation. In the model we equate this to the standard deviation of log productivity of entrants.

To compute the corresponding model moments for the purposes of the calibration, we simulate two groups of 50000 potential entrepreneurs, each with wealth a^L and a^H. For each potential entrepreneurs we draw log productivity z_i, as well as residual heterogeneity δ_i^k and δ_i^π. We then use Eq. (B.28)-(B.31) to determine size, revenue, profits and entry decisions. Finally, we compute the model moments corresponding to the above data moments *among* the set of entrants.

Table B.1 includes the calibrated parameters from this procedure, while Table B.2 includes a list of our calibration targets and the resulting model moments evaluated at the calibrated parameters. The model can match the targeted moments very well for both levels of k_δ.

Table B.1: Jointly-calibrated parameters

Parameter	Value ($k_\delta = 0.05$)	Value ($k_\delta = 0.15$)
w	367.9	386.4
σ_z	0.494	0.493
λ	0.101	0.091
ξ	0.596	0.575

Table B.2: Model and data moments

Moment	Data	Model ($k_\delta = 0.05$)	Model ($k_\delta = 0.15$)
Dispersion in z	0.45	0.45	0.45
Low wealth entry rate (%)	23	23	23
High wealth entry rate (%)	40	40	40
Average sales	1310	1309.9	1310

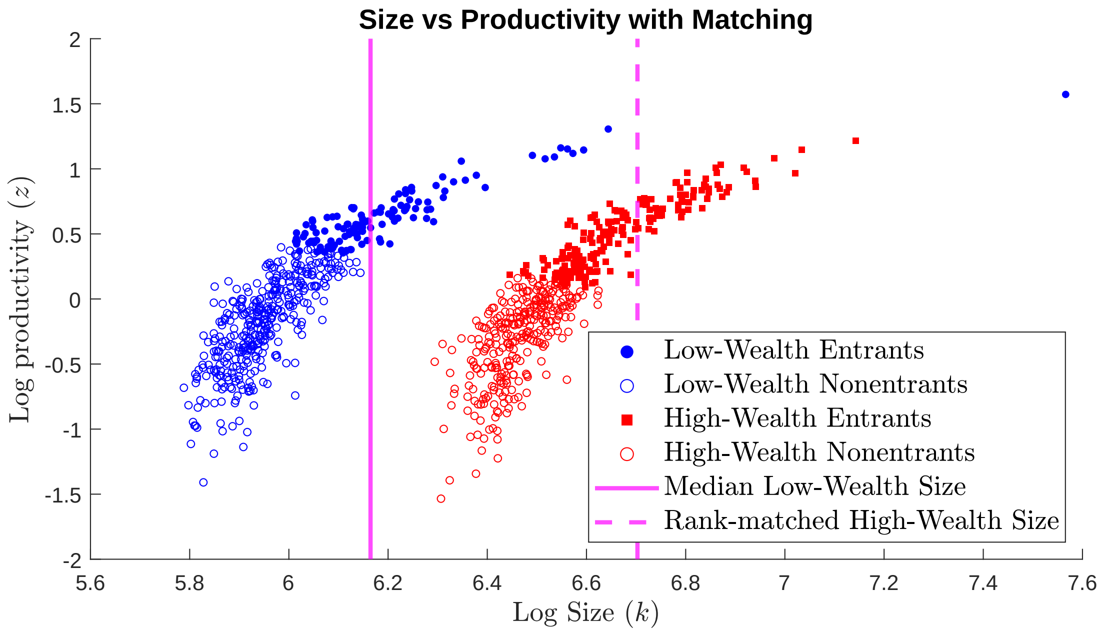
Simulation and bias evaluation. We use the calibrated model to evaluate the bias from using our rank matching procedure relative to the true wealth effect among low wealth entrants. For each wealth level $a \in \{a^L, a^H\}$, we simulate $n = 1,000,000$ agents, who differ in log productivity z and the residuals.

Figure B.1 shows a sample (500 in each group) of the resulting productivity and sizes for low and high wealth potential entrepreneurs for both levels of size noise. In addition, we illustrate our rank matching procedure for the median size low-wealth entrant. Specifically, we fix a target log size k^L corresponding to the median of the size distribution of low-wealth entrants. We then apply our rank matching approach to this entrant. In particular, among the high-wealth group, we find the entrant that has the same rank in the size distribution of high-wealth entrants. We denote the log size of this high-wealth entrant with $k^H\left(k^L\right)$. The estimated wealth effects on log size is then

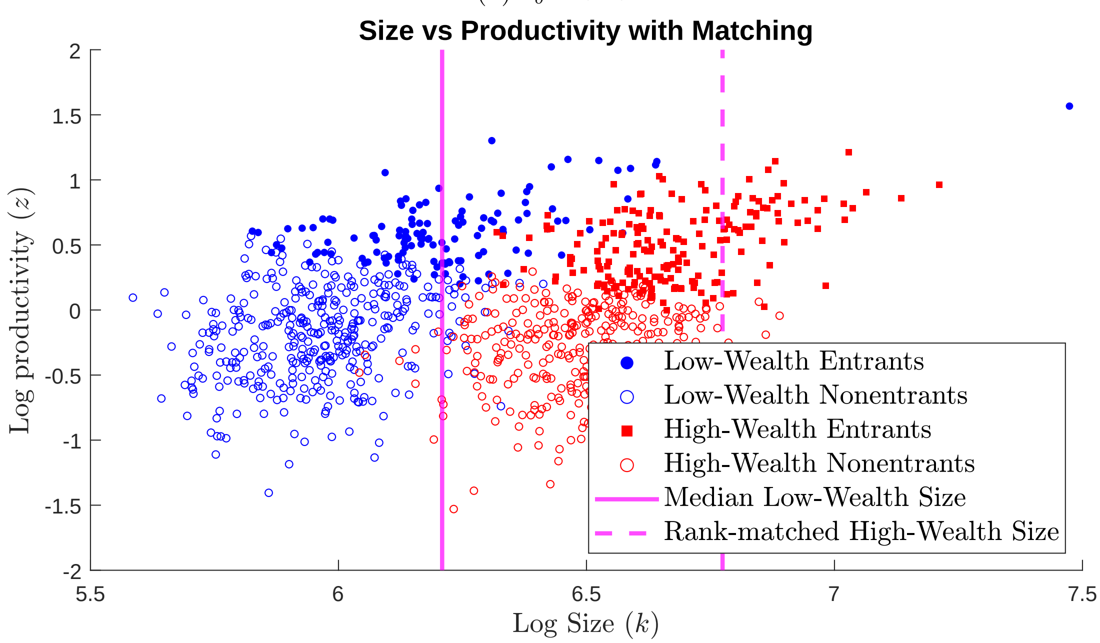
$$\Delta k\left(k^L\right) \quad = \quad k^H\left(k^L\right) - k^L.$$

Figure B.1: Simulation results and rank matching for median size low-wealth entrant

(a) $k_\delta = 0.05$

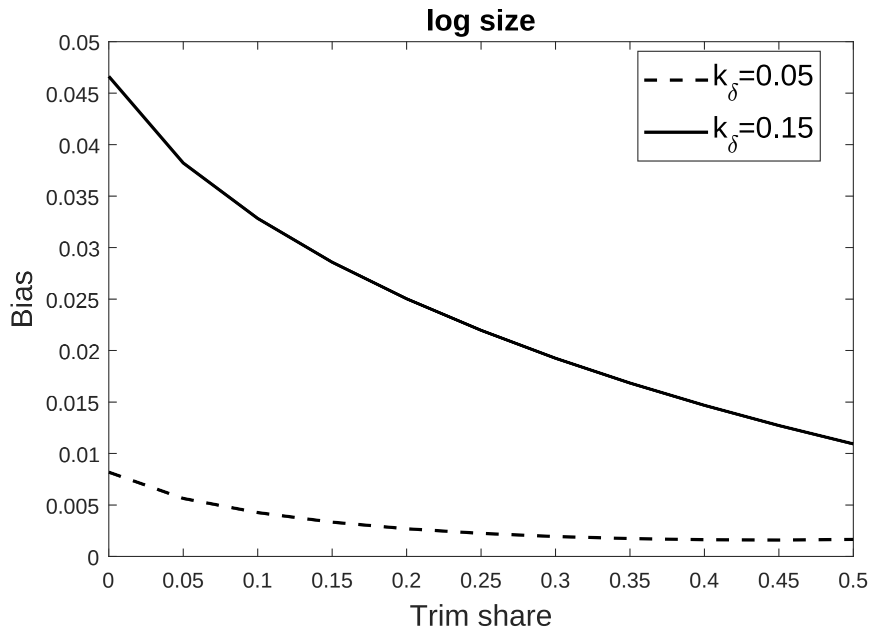


(b) $k_\delta = 0.15$



We use the simulation to compute two quantities. First, we compute the counterfactual average wealth effect on size among the low wealth entrants, should they have instead had high wealth.

Figure B.2: Bias behavior for different trim shares and different levels of residual heterogeneity



This is the true wealth effect. This wealth effect is independent of the value of k_δ. Second, we use the rank matching procedure from Proposition 2 between the groups of low wealth entrants and the rank-matched group of high wealth entrants. We then compute the average difference in log size between these two groups for both values of k_δ.

The average wealth effect on log size is 0.537 log points. In the case with $k_\delta = 0.05$, the rank-matched effect is 0.546, while in the case with $k_\delta = 0.15$, that effect is 0.584. Therefore, the bias for log size from the rank matching procedure is relatively small, though as expected, it is larger in the case of larger residual heterogeneity in size.

Trimming diagnostic. The main reason for the bias in the rank matching procedure is selection due to entry. Specifically, as explained in Section B.2.1 above, selection due to entry creates a bias since low-wealth entrants have a higher average productivity and lower size-specific residuals compared to the matched high-wealth group. In this calibration, these differences result in a larger rank-matched effect on size than the true rank-matched effect. The size of this selection effect and the resulting bias depends on the share of entrants close to the entry cutoff. By Equation (B.23), allowing for a sufficient margin on the size of the two groups of entrants would reduce or even fully remove the bias. In practice, this implies trimming a certain share of low-size low- and high-wealth entrants and applying the rank matching procedure on these sub-groups.

Figure B.2 shows how the bias in the rank-matched measured effect varies with the trimming share for the two levels of residual heterogeneity. In both cases, increasing the trim share decreases the bias. One can draw two important conclusions. First, the trimming effect is convex—doing some trimming decreases the bias by more than subsequent increases in the trim share. This allows for computing an *upper bound* in the bias that selection due to entry induces using the sensitivity of estimates to a small trimming share. Second, trimming matters less at low levels of residual heterogeneity.

Therefore, our simulation results point to an evaluation of the stability of the estimated effects on firm outcomes to a small trimming robustness. This diagnostic tool can both inform about the likely size of the bias due to unobserved heterogeneity as well as to the likely size of unobserved heterogeneity in driving the firm outcomes. In our specific empirical context, conducting a 10% trimming robustness (Table A.17 in the Data Appendix) results in a very limited change in the estimated effect on total assets, from 2128 NOK down to 2092 NOK per 1000 NOK increase in stock wealth. In terms of a change in the estimated semi-elasticity, this corresponds to between 0.007 and 0.012, depending on whether the mean or median total assets are used for the normalization. Therefore, the estimated effects are stable to the trimming robustness. Moreover, by Figure B.2, the limited change in the estimated effect is more consistent with a lower value of the residual heterogeneity.

B.3 Dynamic Extension

In the main text, we focus on a static model of entry into entrepreneurship. In this appendix, we consider a tractable dynamic model and investigate the interaction of wealth dynamics with the entry decision. This setup motivates two features of our empirical analysis: our regression specification, which uses wealth *changes* rather than levels as the key regressor, and the asymmetric effect of positive versus negative portfolio returns on entry. Both results follow from the threshold structure of the entry decision and therefore extend to richer environments than the one we analyze. For instance, allowing for time-varying productivity through learning or innovation would shift the entry threshold by raising the value of entrepreneurship relative to wage work, but would preserve the qualitative prediction that entry is triggered by wealth crossing a threshold. For tractability, we abstract away from such features as well as from non-pecuniary benefits from entrepreneurship, focusing instead on financial frictions as the channel by which wealth affects entry. Our goal is to derive *qualitative insights* that we expect to apply more broadly.

We proceed in three steps. First, we consider the dynamic problem of a worker who makes (speculative) portfolio investments in risky assets. Second, we consider the dynamic problem of an entrepreneur. Finally, we consider the choice between work and entrepreneurship and derive the implications for our empirical analysis.

B.3.1 Worker's Dynamic Problem with Risky Portfolio Choice

Time is discrete $t \in \{0, 1, ..\}$. A worker starts with assets a_0 and earns a constant wage w in each period t. The worker makes a consumption-savings decision and a portfolio decision. We let s_{t+1} denote the payoff-relevant state in the next period $t+1$ and assume it is drawn from an i.i.d. distribution over a finite set $s \in S$. There is a risk-free asset denoted by f and gross-return given by R^f. There are also risky assets denoted by $j \in J$ and gross return given by $R^j(s)$. The worker believes $s_{t+1} = s$ with probability $\pi_s \geq 0$ where $\sum_{s \in S} \pi(s) = 1$. The worker's recursive problem can then be written as follows

$$\begin{aligned} V^W(a_t) &= \max_{c_t, \{\omega_t^j\}_j} \log c_t + \beta E_t \left[V^W(a_{t+1}) \right] \qquad \text{(B.32)} \\ \text{s.t. } a_{t+1} &= (a_t + w - c_t) \left[R^f + \sum_{j \in J} \omega_t^j \left(R(s) - R^f \right) \right] \geq -\frac{R^f w}{R^f - 1}. \end{aligned}$$

The worker starts the period with assets a_t and wage w. She chooses how much to consume c_t and how to invest her remaining wealth $a_t + w - c_t$. She invests a fraction of her wealth ω_t in the risky asset and keeps the rest in the risk-free asset. We allow for both short-selling and leverage subject to a natural borrowing limit.

We assume there is no arbitrage, each asset is non-redundant (that is, its return cannot be replicated using other assets), and the number of assets is the same as the number of states, $|J| + 1 = |S|$. These assumptions are stronger than necessary but they simplify the analysis as they ensure that markets are complete. Specifically, there are unique Arrow-Debreu state prices $\{q(s)\}_{s \in S}$ such that

$$\begin{aligned} \sum_{s \in S} q(s) R^f &= 1 \\ \sum_{s \in S} q(s) R^j(s) &= 1 \text{ for each } j \in J. \end{aligned}$$

Using these prices, we can rewrite the worker's problem as

$$\begin{aligned} &V^W(a_t) = \max_{c_t, \{a_{t+1}(s)\}_{s \in S}} \log c_t + \beta \sum_{s \in S} \pi(s) V^W(a_{t+1}(s)) \qquad \text{(B.33)} \\ &\text{s.t. } \sum_{s \in S} a_{t+1}(s) q(s) = a_t + w - c_t. \end{aligned}$$

By varying her portfolio weights, the worker effectively purchases Arrow-Debreu securities for the continuation states subject to a budget constraint.

Next, we define the worker's lifetime wealth including the value of her human capital as

$$\overline{a}_t = a_t + w + \frac{w}{R^f} + \frac{w}{(R^f)^2} + ... = a_t + \frac{R^f w}{R^f - 1}.$$

Rewriting $(B.33)$ in total wealth $\overline{a}_t = a_t + \frac{R^f w}{R^f - 1}$, we obtain

$$\begin{aligned} V^W(\overline{a}_t) &= \max_{c_t, \{\overline{a}_{t+1}(s)\}_{s\in S}} \log c_t + \beta \sum_{s\in S} \pi(s) V^W(\overline{a}_{t+1}(s)) \\ \text{s.t. } &\sum_{s\in S} \overline{a}_{t+1}(s) q(s) = \overline{a}_t - c_t. \end{aligned} \tag{B.34}$$

The worker's problem is equivalent to the problem of someone who has higher wealth (that includes the human capital) but receives no wage income.

To solve this problem, we conjecture that the value function takes the form

$$V^W(\overline{a}_t) = \frac{\log(\overline{a}_t)}{1-\beta} + v^W, \tag{B.35}$$

where v^W denotes the value of a worker with effective unit wealth. Substituting this into $(B.32)$ and using the optimality conditions, we obtain

$$\begin{aligned} c_t &= (1-\beta)\overline{a}_t \\ \text{and } \overline{a}_{t+1}(s) &= \overline{a}_t \frac{\beta\pi(s)}{q(s)} \text{ for each } s \in S. \end{aligned} \tag{B.36}$$

The worker spends a constant fraction of her effective wealth. The worker's portfolio wealth in a particular state depends on *her* perceived discounted-probability $\beta\pi(s)$ relative to the Arrow-Debreu price $q(s)$.

To understand the wealth dynamics better, let us define *the risk-neutral probability* $\pi^*(s) = q(s) R^f$, which satisfies $\sum_s \pi^*(s) = 1$ since $\sum_s q(s) = \frac{1}{R^f}$. We can then rewrite the worker's wealth dynamics as follows:

$$\left(a_{t+1} + \frac{R^f w}{R^f - 1}\right) = \left(a_t + \frac{R^f w}{R^f - 1}\right) \beta R^f \frac{\pi(s)}{\pi^*(s)}. \tag{B.37}$$

The worker's wealth in state s depends on three factors: (i) her past wealth, (ii) her discount factor relative to the risk-free rate βR^f, (iii) her perceived probability for state s relative to the risk-neutral probability, $\frac{\pi(s)}{\pi^*(s)}$. On average, the worker's wealth grows if she has a relatively high propensity to save ($\beta R^f > 1$) and shrinks if she has a relatively low propensity to save ($\beta R^f < 1$). In addition, the worker's wealth also grows after realizations of states which she assigns a greater probability than the risk-neutral probability ($\frac{\pi(s)}{\pi^*(s)} > 1$), and shrinks after realizations in which she assigns a lower probability ($\frac{\pi(s)}{\pi^*(s)} < 1$). The worker adjusts her portfolio weights to achieve this outcome. For instance, if state s is such that the return of a risky asset j exceeds the risk-free rate,

$R^j(s) - R^f > 0$, the worker can increase her wealth in this state by choosing a positive exposure to stock j, $\omega_t^j > 0$.

For future reference, we also solve for the worker's unit-wealth value as

$$v^W = \frac{\log(1-\beta) + \frac{\beta}{1-\beta}\sum_{s\in S}\pi(s)\left(\log\frac{\beta\pi(s)}{q(s)}\right)}{1-\beta}. \tag{B.38}$$

Note that the unit-wealth value is increasing in the difference between the worker's discounted probability $\beta\pi(s)$ and the Arrow-Debreu price $q(s) = \pi^*(s)/R^f$.

B.3.2 Entrepreneur's Dynamic Problem

We model the entrepreneur's dynamic problem following Moll (2014). An entrepreneur with wealth a_t has access to a Cobb-Douglas production technology

$$f(K_t, L_t; z) = \exp(z) K_t^{\alpha} L_t^{1-\alpha},$$

where z is log productivity. She can rent capital at a constant competitive rate ξ subject to a borrowing constraint $K_t \leq \Lambda a_t$ where $\Lambda > 1$, and rent labor at a constant competitive wage w. Substituting for optimal labor given capital, $L_t = \left(\frac{(1-\alpha)\exp(z)}{w}\right)^{1/\alpha} K_t$, the entrepreneur's static profit problem reduces to

$$\pi(z, a_t) = \max_{K_t \geq 0} [M(z) - \xi] K_t \text{ s.t. } K_t \leq \Lambda a_t,$$

where $M(z) = \alpha\left(\frac{1-\alpha}{w}\right)^{(1-\alpha)/\alpha} \exp(z)^{1/\alpha}$ is the marginal revenue product of capital. Every productive entrepreneur ($M(z) > \xi$) therefore operates at the maximum scale $K_t = \Lambda a_t$. The net profit is

$$\pi(z, a_t) = \Pi_a(z) a_t \text{ where } \Pi_a(z) = [M(z) - \xi]\Lambda. \tag{B.39}$$

These expressions are the same as in the static model (Eq. $(B.6)$), with Λ now a constant rather than a productivity-dependent function. Assumption (S) therefore holds here as well.[9]

The entrepreneur starts the period with assets a_t. After operating her business, she receives period profits $\pi(z, a_t)$. At the end of the period, she makes a consumption-savings decision out of wealth $a_t + \pi(z, a_t)$ similar to the worker. For symmetry, we assume the entrepreneur makes a portfolio choice among the same assets as before. Her dynamic problem can then be written as the

[9] In contrast to the static model, where the leverage ratio $\Lambda(z)$ is endogenously determined by a borrowing constraint and strictly increasing in productivity, here we follow Moll (2014) and treat Λ as a constant. This simplification is without loss for the dynamic analysis, whose focus is the entry decision rather than the productivity-leverage relationship.

following analogue of $(B.34)$

$$V^E(a_t) = \max_{c_t, \{a_{t+1}(s)\}_{s\in S}} \log c_t + \beta \sum_{s\in S} \pi(s) V^E(a_{t+1}(s)) \tag{B.40}$$
$$\text{s.t.} \sum_{s\in S} a_{t+1}(s) q(s) = (1+\Pi_a(z)) a_t - c_t.$$

To solve this problem, we conjecture that the value function takes the form (cf. $(B.35)$)

$$V^E(a_t) = \frac{\log(a_t)}{1-\beta} + v^E, \tag{B.41}$$

where v^E denotes the value of an entrepreneur with unit wealth. Substituting this into $(B.40)$ and using the optimality conditions, we obtain

$$\begin{aligned} c_t &= (1-\beta)(1+\Pi_a(z)) a_t \\ \text{and } a_{t+1}(s) &= (1+\Pi_a(z)) a_t \frac{\beta\pi(s)}{q(s)} \text{ for each } s\in S. \end{aligned}$$

Similar to the worker, the entrepreneur takes risky positions in financial markets that reflects her beliefs. In equilibrium, asset growth is driven by the net profits, as well as the financial market forces that we discussed earlier.

Using the solution, we also solve for the entrepreneur's unit-wealth value as

$$\begin{aligned} v^E &= \frac{\log(1-\beta) + \frac{\log(1+\Pi_a(z))}{1-\beta} + \frac{\beta}{1-\beta}\sum_{s\in S}\pi(s)\left(\log\frac{\beta\pi(s)}{q(s)}\right)}{1-\beta} \\ &= v^W + \frac{\log(1+\Pi_a(z))}{(1-\beta)^2}. \end{aligned} \tag{B.42}$$

Note that $v^E > v^W$: for the same effective wealth, the entrepreneur receives greater value because she uses her wealth to increase the size of her business, profits, and consumption.

B.3.3 Choice Between Work and Entrepreneurship

Consider an individual that can choose between work and entrepreneurship. We start with the case in which the individual has a choice *only at the beginning of period* 0*:* once she makes the choice, she remains a worker or an entrepreneur in all future periods. Given an initial wealth a_0, the individual chooses entrepreneurship as long as the value from entrepreneurship exceeds the value from work

$$E_0 = 1 \text{ iff } V^E(a_0) \geq V^W(a_0).$$

Using Eqs. $(B.35 - B.38)$ and $(B.41 - B.42)$, and canceling v^W from both sides, we write this condition as

$$\frac{\log(a_0)}{1-\beta} + \frac{\log(1+\Pi_a(z))}{(1-\beta)^2} \geq \frac{\log\left(a_0 + \frac{R^f w}{R^f - 1}\right)}{1-\beta}$$

which implies

$$a_0 (1+\Pi_a(z))^{1/(1-\beta)} \geq a_0 + \frac{R^f w}{R^f - 1}.$$

After rearranging terms, we obtain

$$a_0 \geq \overline{a}(z) \equiv \frac{\frac{R^f w}{R^f - 1}}{(1+\Pi_a(z))^{1/(1-\beta)} - 1} \simeq \frac{\frac{R^f w}{R^f - 1}}{\frac{\Pi_a(z)}{1-\beta}}. \tag{B.43}$$

Here, the last line linearizes the denominator and provides an approximation that holds when the net profits $\Pi_a(z)$ are relatively small. The individual is more likely to choose entrepreneurship when she has more wealth. Intuitively, as in the static model, greater wealth enables the entrepreneur to increase the scale of her business and increase her profits. Observe also that the individual is more likely to choose entrepreneurship (as reflected by a lower cutoff $\overline{a}(z)$) when the business is more profitable (higher $\Pi_a(z)$) and when the value of wage work is lower (lower $\frac{R^f w}{R^f - 1}$).

Next, suppose entry is a dynamic choice: An individual that has chosen not to become an entrepreneur in the past periods may choose to do so in period t. We assume becoming an entrepreneur is irreversible as before. However, staying a worker has an *option value* to become an entrepreneur in the future. This option value might affect the worker's consumption-savings and portfolio choice decisions. While this option value is interesting, it complicates the analysis and it is beyond the scope of the current paper. Therefore, we make a simplifying behavioral assumption that an individual that chooses to remain a worker *assumes* she will remain a worker for the rest of her life, that is, she ignores the option value. In this case, the individual's decision is characterized by

$$E_t = 1 \text{ iff } V^E(a_t) \geq V^W(a_t) \Leftrightarrow a_t \geq \overline{a}(z), \tag{B.44}$$

where $\overline{a}(z)$ is still given by $(B.43)$.

When the individual stays a worker, she makes the same portfolio decisions as before, and her wealth evolves according to $(B.37)$. These two equations characterize the individual's dynamic choice to become an entrepreneur. As we discussed before, the individual's wealth grows more on average when she has a high propensity to save relative to the risk-free rate (higher βR^f). In addition to this average effect, her wealth grows after state realizations which she assigns a greater probability than the risk-neutral probability. If her wealth grows sufficiently to exceed $\overline{a}(z)$, the individual becomes an entrepreneur. Otherwise, she remains a worker.

Regression specification and asymmetric returns. We next use this characterization to motivate our empirical analysis. Using $(B.32)$, the worker's wealth evolves according to

$$a_{t+1} = (a_t + w - c_t) R_{t+1}(s) \text{ where } R_{t+1}(s) = R^f + \sum_{j \in J} \omega_t^j \left(R(s) - R^f \right).$$

Here, $R_{t+1}(s)$ denotes the worker's realized portfolio return that depends on her (endogenous) weight on the risky portfolio. Using $(B.36)$ to substitute for consumption $c_t = (1-\beta)\left(a_t + \frac{R^f w}{R^f - 1}\right)$, we obtain

$$a_{t+1} = \left(\beta a_t + w \left(\frac{\beta - 1/R^f}{1 - 1/R^f} \right) \right) R_{t+1}(s). \tag{B.45}$$

Combining this with (B.44), the worker enters into business in period $t+1$ iff the following conditions hold

$$\begin{aligned} a_t &< \overline{a}(z) \text{ and} \\ a_{t+1} &\geq \overline{a}(z) \iff a_t r_{t+1}(s) \geq a_t \left[\frac{\overline{a}(z)}{\beta a_t + w\left(\frac{\beta - 1/R^f}{1-1/R^f}\right)} - 1 \right]. \end{aligned} \tag{B.46}$$

Here, $r_{t+1} = R_{t+1} - 1$ is the net portfolio return. The second condition says that the worker enters into business if the return component of wealth change $a_t r_{t+1}$ is sufficiently large. This motivates our regression specification with the stock return component of wealth change as the key regressor. The first condition says the entrants in period t have relatively low wealth and experience an *increase* in wealth. This condition suggests positive returns are likely to generate stronger effects than negative returns—an asymmetric effect that we explore in our empirical analysis.

To formalize the asymmetric effect, it is convenient to rewrite the second condition in $(B.46)$ by dividing both sides by a_t to obtain $r_{t+1}(s) \geq \overline{r}(z, a_t)$, where

$$\overline{r}(z, a_t) \equiv \frac{\overline{a}(z)}{\beta a_t + w\left(\frac{\beta - 1/R^f}{1-1/R^f}\right)} - 1. \tag{B.47}$$

Combining $a_t < \overline{a}(z)$ with $(B.47)$ provides a lower bound for the net cutoff return for entry

$$\overline{r}(z, a_t) \geq \overline{r}(z) \equiv \frac{1}{\beta + \frac{w}{\overline{a}(z)}\left(\frac{\beta - 1/R^f}{1-1/R^f}\right)} - 1. \tag{B.48}$$

The lower bound $\overline{r}(z)$ is decreasing in the discount factor β. Consider the cases $\beta \leq 1/R^f$ and $\beta > 1/R^f$.

When $\beta \leq 1/R^f$, the lower bound satisfies $\overline{r}(z) \geq 0$ and entry requires:

$$r_{t+1}(s) \geq \overline{r}(z, a_t) \geq 0.$$

That is, the individual enters only if her net return $r_{t+1}(s)$ is sufficiently positive, and she remains a worker if her net return is zero or negative. Hence, in this case the return has a strongly asymmetric effect, with positive net returns generating some entry but negative net returns having no effect on entry. For intuition, observe that the individual's propensity to save is relatively low and her wealth satisfies $a_{t+1} \leq a_t \frac{R_{t+1}(s)}{R^f}$ (see Eq. $(B.45)$). In particular, her wealth increases, and she chooses to become an entrepreneur, only if she receives a sufficiently positive net return.

When $\beta > 1/R^f$, the lower bound can satisfy $\overline{r}(z) < 0$ for sufficiently profitable businesses. In this case, there are situations (with a_t lower than but close to $\overline{a}(z)$) in which the individual would enter into business with a zero net return, but does not enter because her net return is negative. Intuitively, the individual's propensity to save is relatively large and the business is sufficiently profitable, so that with a zero net return her wealth would increase and she would become an entrepreneur. Starting from this baseline, realizing a loss on her risky portfolio might prevent entry. However, even in this case, the lower bound $\overline{r}(z)$ implies that sufficiently negative net returns generate no additional effect compared to a baseline net return of $\overline{r}(z)$.

B.4 Omitted Proofs in Section 2

Proof of Proposition 1. Provided in the main text. □

Proof of Proposition 2. To simplify the notation, we drop the conditioning on x_i. We also define the functions $k^L(z_i) = k\left(z_i, a_0 R^L\right)$ and $k^H(z_i) = k\left(z_i, a_0 R^H\right)$. Note that both functions are strictly increasing in z_i. Thus, $k^L(z_i)$ has a strictly increasing inverse functions that satisfies $z_i = k^{L,inv}(k)$ for $k = k^L(z_i)$. This implies

$$k^H(z_i) = k^H\left(k^{L,inv}\left(k^L(z_i)\right)\right) \equiv g\left(k^L(z_i)\right).$$

Here, the last equality defines the function $g(k) = k^H\left(k^{L,inv}(k)\right)$, which is strictly increasing since both $k^H(\cdot)$ and $k^{L,inv}(\cdot)$ are strictly increasing.

Next note that the fraction of low-return entrants with size above $\overline{k}^L$ satisfies

$$e\left(\overline{k}^L, a_0 R^L\right) = \int_{z_i \geq \overline{z}(a_0 R^L), k^L(z_i) \geq \overline{k}^L} dF_z(z_i) = \int_{k^L(z_i) \geq \overline{k}^L} dF_z(z_i).$$

Here, the second equality follows since $k \geq \overline{k}^L \geq \overline{k}\left(a_0 R^L\right)$ already implies $z_i \geq \overline{z}\left(a_0 R^L\right)$. Likewise, for each $\overline{k}^H \geq \overline{k}\left(a_0 R^H\right)$ the fraction of high-return entrants with size above $\overline{k}^H$ satisfies

$$e\left(\overline{k}^H, a_0 R^H\right) = \int_{z_i \geq \overline{z}(a_0 R^H), k^H(z_i) \geq \overline{k}^H} dF_z(z_i) = \int_{g(k^L(z_i)) \geq \overline{k}^H} dF_z(z_i) = \int_{k^L(z_i) \geq g^{inv}\left(\overline{k}^H\right)} dF_z(z_i).$$

Here, the second equality drops the conditioning on $z_i \geq \overline{z}\left(a_0 R^H\right)$ as before and substitutes $k^H(z_i) = g\left(k^L(z_i)\right)$. The last equality substitutes $k^L(z_i) \geq g^{inv}\left(\overline{k}^H\right)$ for $g\left(k^L(z_i)\right) \geq \overline{k}^H$ where

$g^{inv}(\cdot)$ denotes the inverse function of $g(\cdot)$.

Comparing the expressions for $e\left(\overline{k}^L, a_0R^L\right)$ and $e\left(\overline{k}^H, a_0R^H\right)$, we conjecture that the unique $\overline{k}^H$ that solves Eq. (4) satisfies $\overline{k}^L = g^{inv}\left(\overline{k}^H\right)$ or equivalently $\overline{k}^H = g\left(\overline{k}^L\right)$. Note that we also have $\overline{k}^H \geq \overline{k}\left(a_0R^H\right)$ since there are more high-return entrants than low-return entrants (see Figure 1). This verifies the conjecture and establishes $\overline{k}^H = g\left(\overline{k}^L\right)$.

Next consider an outcome variable, $y(z_i, a_0R)$. The average of this outcome among the low-return entrants is given by

$$\mathbf{y}\left(\overline{k}^L, a_0R^L\right) = \frac{\int_{k^L(z_i)\geq \overline{k}^L} y\left(z_i, a_0R^L\right) dF_z(z_i)}{e\left(\overline{k}^L, a_0R^L\right)}.$$

Its average among the high-return entrants is given by

$$\begin{aligned}
\mathbf{y}\left(\overline{k}^H, a_0R^H\right) &= \frac{\int_{k^H(z_i)\geq \overline{k}^H} y\left(z_i, a_0R^H\right) dF_z(z_i)}{e\left(\overline{k}^H, a_0R^H\right)} \\
&= \frac{\int_{g(k^L(z_i))\geq g\left(\overline{k}^L\right)} y\left(z_i, a_0R^H\right) dF_z(z_i)}{e\left(\overline{k}^H, a_0R^H\right)} \\
&= \frac{\int_{k^L(z_i)\geq \overline{k}^L} y\left(z_i, a_0R^H\right) dF_z(z_i)}{e\left(\overline{k}^L, a_0R^L\right)}.
\end{aligned}$$

Here, the second line substitutes $k^H = g\left(k^L\right)$ and $\overline{k}^H = g\left(\overline{k}^L\right)$. The last line then substitutes $e\left(\overline{k}^H, a_0R^H\right)$ with $e\left(\overline{k}^L, a_0R^L\right)$ and $g\left(k^L\right) \geq g\left(\overline{k}^L\right)$ with $k^L \geq \overline{k}^L$.

Combining the expressions for $\mathbf{y}^H = \mathbf{y}\left(\overline{k}^H, a_0R^H\right)$ and $\mathbf{y}^L = \mathbf{y}\left(\overline{k}^L, a_0R^L\right)$, we obtain

$$\mathbf{y}^H - \mathbf{y}^L = \frac{\int_{k^L(z_i)\geq \overline{k}^L} \left[y\left(z_i, a_0R^H\right) - y\left(z_i, a_0R^L\right)\right] dF_z(z_i)}{e\left(\overline{k}^L, a_0R^L\right)}.$$

This proves (5) in view of the observation that we can drop the conditioning on entry, $z_i \geq \overline{z}\left(a_0R^L\right)$. □

Proof of Proposition 3. We use the same notation as in the proof of Proposition 2. In particular, for fixed covariates x_i, the size functions $k^L(z_i) = k\left(z_i, a_0R^L\right)$ and $k^H(z_i) = k\left(z_i, a_0R^H\right)$ are both strictly increasing in z_i, and they satisfy $k^H(z_i) = g\left(k^L(z_i)\right)$ where $g(\cdot)$ is strictly increasing.

We first rewrite the reweighted fraction $e^*\left(\overline{k}^L, a_0R^L\right)$ by substituting the definition of the propensity weights $\omega(x_i) = \frac{dF_x(x_i|R^H)}{dF_x(x_i|R^L)}$ into (8):

$$e^*\left(\overline{k}^L, a_0R^L\right) = \int_{x_i}\int_{z_i \geq \overline{z}(a_0R^L), k^L(z_i)\geq \overline{k}^L} dF_z(z_i|x_i)\, dF_x\left(x_i|R^H\right) = \int_{x_i}\int_{k^L(z_i)\geq \overline{k}^L} dF_z(z_i|x_i)\, dF_x\left(x_i|R^H\right).$$

Here, the second equality follows since $k^L(z_i) \geq \overline{k}^L \geq \overline{k}\left(a_0R^L\right)$ already implies $z_i \geq \overline{z}\left(a_0R^L\right)$.

Next, the unconditional fraction of high-return entrants with size above $\overline{k}^H$ satisfies

$$\begin{aligned} e\left(\overline{k}^H, a_0R^H\right) &= \int_{x_i}\int_{z_i \geq \overline{z}(a_0R^H), k^H(z_i)\geq \overline{k}^H} dF_z(z_i|x_i)\, dF_x\left(x_i|R^H\right) \\ &= \int_{x_i}\int_{g(k^L(z_i))\geq \overline{k}^H} dF_z(z_i|x_i)\, dF_x\left(x_i|R^H\right) \\ &= \int_{x_i}\int_{k^L(z_i)\geq g^{inv}\left(\overline{k}^H\right)} dF_z(z_i|x_i)\, dF_x\left(x_i|R^H\right). \end{aligned}$$

Here, the second equality drops the conditioning on $z_i \geq \overline{z}\left(a_0R^H\right)$ (as in the proof of Proposition 2) and substitutes $k^H(z_i) = g\left(k^L(z_i)\right)$. The last equality substitutes $k^L(z_i) \geq g^{inv}\left(\overline{k}^H\right)$ for $g\left(k^L(z_i)\right) \geq \overline{k}^H$.

Comparing the expressions for $e^*\left(\overline{k}^L, a_0R^L\right)$ and $e\left(\overline{k}^H, a_0R^H\right)$, the unique $\overline{k}^H$ that solves Eq. (10) satisfies $\overline{k}^L = g^{inv}\left(\overline{k}^H\right)$ or equivalently $\overline{k}^H = g\left(\overline{k}^L\right)$. Note also that $\overline{k}^H \geq \overline{k}\left(a_0R^H\right)$ since there are more high-return entrants than low-return entrants.

Next consider the average outcome among the high-return entrants with size above $\overline{k}^H$:

$$\begin{aligned} \mathbf{y}\left(\overline{k}^H, a_0R^H\right) &= \frac{\int_{x_i}\int_{k^H(z_i)\geq \overline{k}^H} y\left(z_i, a_0R^H\right) dF_z(z_i|x_i)\, dF_x\left(x_i|R^H\right)}{e\left(\overline{k}^H, a_0R^H\right)} \\ &= \frac{\int_{x_i}\int_{g(k^L(z_i))\geq g\left(\overline{k}^L\right)} y\left(z_i, a_0R^H\right) dF_z(z_i|x_i)\, dF_x\left(x_i|R^H\right)}{e^*\left(\overline{k}^L, a_0R^L\right)} \\ &= \frac{\int_{x_i}\int_{k^L(z_i)\geq \overline{k}^L} y\left(z_i, a_0R^H\right) dF_z(z_i|x_i)\, dF_x\left(x_i|R^H\right)}{e^*\left(\overline{k}^L, a_0R^L\right)} \\ &= \frac{\int_{x_i}\int_{k^L(z_i)\geq \overline{k}^L} y\left(z_i, a_0R^H\right) dF_z(z_i|x_i)\, \omega(x_i)\, dF_x\left(x_i|R^L\right)}{e^*\left(\overline{k}^L, a_0R^L\right)}. \end{aligned}$$

Here, the second line substitutes $\overline{k}^H = g\left(\overline{k}^L\right)$, $k^H = g\left(k^L\right)$, and $e\left(\overline{k}^H, a_0R^H\right) = e^*\left(\overline{k}^L, a_0R^L\right)$. The third line uses the fact that g is strictly increasing to replace $g\left(k^L(z_i)\right) \geq g\left(\overline{k}^L\right)$ with $k^L(z_i) \geq \overline{k}^L$. The last line substitutes $dF_x\left(x_i|R^H\right) = \omega(x_i)\, dF_x\left(x_i|R^L\right)$.

The reweighted average outcome among the low-return entrants with size above $\overline{k}^L$ is given directly by (9):

$$\mathbf{y}^*\left(\overline{k}^L, a_0R^L\right) = \frac{\int_{x_i}\int_{k^L(z_i)\geq\overline{k}^L} y\left(z_i, a_0R^L\right) dF_z\left(z_i|x_i\right)\omega\left(x_i\right) dF_x\left(x_i|R^L\right)}{e^*\left(\overline{k}^L, a_0R^L\right)}.$$

Here, we again use $k^L\left(z_i\right) \geq \overline{k}^L \geq \overline{k}\left(a_0R^L\right)$ to drop the conditioning on entry $z_i \geq \overline{z}\left(a_0R^L\right)$.

Combining the two expressions, we obtain

$$\mathbf{y}^H - \mathbf{y}^{*L} = \frac{\int_{x_i}\int_{k^L(z_i)\geq\overline{k}^L}\left[y\left(z_i, a_0R^H\right) - y\left(z_i, a_0R^L\right)\right] dF_z\left(z_i|x_i\right)\omega\left(x_i\right) dF_x\left(x_i|R^L\right)}{e^*\left(\overline{k}^L, a_0R^L\right)}.$$

This proves (11) in view of the observation that $k^L\left(z_i\right) \geq \overline{k}^L$ implies $z_i \geq \overline{z}\left(a_0R^L\right)$. □