Entrepreneurship, Human Capital and Wealth *

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Abstract

This paper studies how financial constraints and human capital accumulation interact in shaping entrepreneurial decisions. We use Danish administrative data to provide new evidence on the role that human capital accumulation plays for selection into entrepreneurship. We show that entrepreneurs, compared to workers of the same age, on average i) earned higher wages before starting their business ii) experienced higher growth rates in wages iii) have more years of education and labor market experience. We account for our empirical findings in a quantitative general equilibrium life-cycle model and use it to analyze how human capital accumulation and financial constraints jointly determine i) the life-cycle patterns of entry into entrepreneurship ii) the productivity of businesses started at different stages of an individual's life-cycle and how they interact in affecting aggregate TFP and resource mis-allocation. Through counterfactual exercises we establish how most efficiency losses due to the presence of financial frictions stem from the fact that high human capital entrepreneurs run undercapitalized businesses, rather than high human capital individuals not selecting into entrepreneurship. We conclude by using the calibrated model to quantify the efficiency and welfare effects of a tax policy reform aimed at incentivizing business creation by young individuals.

JEL codes: E21, L26, J24

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1 Introduction

This paper studies entrepreneurship and the process of business formation. We study both an individual's decision to become an entrepreneur and measures of economic activity upon selecting into entrepreneurship, such as productivity and size of the business. We construct a new dataset based on Danish administrative data, which allows us to observe different characteristics of individuals both before and after their transition into entrepreneurship, including measures of their human capital and wealth. We use these measure to study two competing hypothesis regarding the formation of entrepreneurs. The first has to do with financial constraints, which implies that individuals need to accumulate wealth to start and operate a business at a profitable size. The second component is the role of human capital, which is more than just a good business idea and refers to the set of learnable skills that individuals need to accumulate to run a firm, such as the ability to manage a company, the capacity of organizing complicated tasks and maintaining networks. While the existing literature highlights the importance of these components in isolation, we analyze them jointly and study how they interact in driving entrepreneurial decisions.[1]

The paper makes two fundamental contributions. On the empirical side we show that, while largely unexplored in the literature, human capital accumulation is a key driver of selection into entrepreneurship and not only important for explaining differences in business outcomes, which has been the focus of most prior work so far. Second, motivated by the empirical evidence we propose a new quantitative macroeconomic model of entrepreneurship that accounts for both financial constraints and human capital in entrepreneurial activity. Compared to past work, the key modeling difference in our set-up is that we separate overall business productivity in an exogenous stochastic component- which captures the quality of the business idea- and an endogenous component which reflects the entrepreneur's human capital and is slowly accumulated over the life-cycle.[2] We show how accounting for human capital accumulation is not only important to match a prominent feature of the data, but also because it changes our conclusions on how financial frictions affect macroeconomic outcomes by distorting entrepreneurs' extensive and intensive margin decisions.

[1] The role of financial constraints as barrier to entrepreneurship is studied in Evans and Jovanovic (1989), Evans and Leighton (1989) and Hurst and Lusardi (2004) among others. The relationship between human capital and entrepreneurial outcomes is investigated in Smith et al. (2019) who use US tax data to show that on average around three quarters of pass-through business profits represent returns to owners human capital, rather than compensation for holding productive financial wealth. Queiró (2022) uses Portuguese administrative data to show that firms started by more educated entrepreneurs start bigger and display higher growth rates.

[2] Standard macroeconomic models of entrepreneurship- from the seminal work by Cagetti and De Nardi (2006) to more recent papers by Bruggemann (2021) and Guvenen et al. (2023)- assume that entrepreneurial ability is exogenous and stochastic, and abstract from the role of human capital in entrepreneurship.

On the empirical side, we build a rich and detailed panel data set on the universe of Danish firms created between 1996 and 2019. By identifying the ultimate owners of these firms we are able to match firm level data with individual level information on business owners' characteristics. We begin by showing that entrepreneurs are self-selected in terms of different measures of human capital. Specifically, we document that entrepreneurs, compared to workers of the same age, on average i) earned higher wages before starting their business ii) experienced higher growth rates in wages iii) have more years of education and labor market experience iv) are positively selected in terms of unobserved earnings ability, as measured by the residuals of a Mincerian wage regression. We additionally show that the degree of positive selection in terms of human capital between future entrepreneurs and workers remains unchanged across the family wealth distribution, suggesting that human capital cannot be entirely substituted with wealth in entrepreneurial activity. We use information on fathers' wealth to indirectly proxy for the presence of liquidity constraints. If the latter were the main reason holding back individuals from entrepreneurial activity we would expect the propensity of becoming an entrepreneur to increase as borrowing constraints become looser. We find that the probability of becoming an entrepreneur is essentially flat along most of the family wealth distribution and only increasing in the tails. We additionally show that entrepreneurs coming from wealthier families do not seem to start businesses earlier in life compared to the rest of the population. While our findings are suggestive of the fact that liquidity constraints are not empirically important in hindering most business formation in Denmark, they do not imply that wealth does not matter for entrepreneurship. Conditional on entry, wealth affects the scale of the business if individuals face binding borrowing constraints and can allow entrepreneurs to choose projects of different quality, ultimately affecting business success.

To quantify how financial constraints and human capital accumulation jointly affect i) the life-cycle patterns of entry into entrepreneurship ii) the productivity of businesses started at different stages of an individual's life-cycle iii) aggregate TFP and resource mis-allocation we propose a general equilibrium life-cycle model in which individuals endogenously choose between being workers and entrepreneurs. In the model aspiring entrepreneurs face collateral constraints and need both good business ideas and human capital to run a firm. The presence of collateral constraints implies that individuals save and accumulate wealth to start a business at a profitable scale. Human capital is slowly accumulated over an individual's life-cycle and determines labor income if individuals become workers, while it affects business productivity if agents become entrepreneurs. The interaction between human capital accumulation, business ideas and wealth generate a non-trivial sorting of individuals across occupations. The model is brought to the data through a simulated method of moments procedure, by targeting data moments which are informative about the underlying structural parameters. Importantly, our model is able to replicate several untargeted moments, as well as the main selection mechanisms into entrepreneurship observed in the data. A key property of the model, which is confirmed in the data, is that older individuals start on average more successful businesses. This results from the fact that average business productivity increases with the entrepreneur's age at founding, because of the higher accumulated stock of human capital. By decomposing the sources of business productivity at start we show that young entrepreneurs substitute lower levels of human capital with higher than average quality of business ideas, while individuals that open businesses later in life tend to have more skills but worse business ideas.

Through counterfactual exercises we establish how financial constraints mostly distort entrepreneurs' intensive margin decisions (how much capital and labor to demand), while human capital accumulation plays a more important role in explaining extensive margin choices (whether to start a business and when) and the related life-cycle patterns of entry into entrepreneurship. We further run a counterfactual exercise in which we completely eliminate collateral constraints and separate the partial from the general equilibrium responses. On the intensive margin, eliminating financial frictions improves the allocation of resources both in partial and general equilibrium as entrepreneurs can borrow more for the same productivity levels and thus produce more output. Extensive margin decisions are affected differently when general equilibrium effects are taken into account. In partial equilibrium, the absence of collateral constraints makes entrepreneurship more attractive and reduces the threshold level of human capital at which individuals become entrepreneurs. In turn this implies a higher level of entrepreneurial activity in the economy and an inflow of entrepreneurs who are of lower quality than the average entrepreneur of the baseline economy. In general equilibrium, the indirect increase in the wage pushes low-quality aspiring entrepreneurs back to paid employed jobs, reinforcing the intensive margin efficiency effects such that while the share of entrepreneurs in the economy decreases, their average productivity goes up. We additionally compare the effects of removing financial frictions in the baseline model to a more standard macroeconomic model of entrepreneurship in which entrepreneurs do not need human capital to run a business, but only need ideas and wealth. We find that the increase in entrepreneurial TFP when collateral constraints are removed is stronger in a model with human capital than without, because the fraction of undercapitalized entrepreneurs- and their distance to the optimal size- is larger. This is a consequence of the fact that in the baseline economy entrepreneurs accumulate human

capital while running their firm, which implies that- conditional on the same quality of the business idea- the target firm size increases as firms and entrepreneurs become older. In a model with no human capital there is less scope for business growth, implying that there are also less intensive margin efficiency gains from eliminating borrowing constraints.
In the final part of the paper we study the efficiency and welfare properties of a tax reform aimed at incentivizing business creation by young individuals. Specifically, we consider a new tax regime in which entrepreneurs under the age of 30 are exempted from paying income taxes. We find that such a tax reform is self-financing, meaning it can be implemented by keeping the budget balanced without having to increase taxes for other categories. We show that this is the case because the tax reform helps productive- but financially constrained entrepreneurs- to raise more capital and run bigger firms, with positive effects on entrepreneurial TFP. We measure the welfare effects of the policy using the consumption-equivalent variation measure (CEV) and evaluate whether a newborn individual would prefer to be born under the new tax regime or the status-quo. We find large positive welfare effects arising from the reform and that also workers with an ex-ante very small probability of ever selecting into entrepreneurship would benefit from the new tax regime by receiving higher wages in equilibrium. The next section discusses how our work relates to the existing literature.

1.1 Related Literature

This paper relates to several strands of literature. The decision to start a business and become an entrepreneur is an infrequent career choice.[3] Until recently, data limitations have forced the literature to sidestep several aspects that contribute to our understanding of the process of business formation.[4] On the empirical side, we contribute to recent work studying the characteristics of individuals that select into entrepreneurship using administrative data. Queiró (2022) uses Portuguese administrative data to analyze the relationship between education and entrepreneurial outcomes, while Gendron-Carrier (2023) uses Canadian admin data to show that individuals who previously worked in high-wage firms tend to do better as future entrepreneurs. Using US administrative data sources Bhandari et al. (2022) compare the average life-time incomes of self and paid employed individuals to draw new conclusions on the returns to entrepreneurship. We contribute to this growing literature by constructing a new dataset based on the full Danish administrative data and are

[3] The share of individuals who ever become entrepreneurs in our sample is 7.4%.

[4] Most past work on entrepreneurship was based on survey data, see for example Evans and Leighton (1989), Hurst and Lusardi (2004), De Nardi et al. (2007) and Poschke (2013).

able to distinguish between owners of sole proprietorships, partnerships and limited liability companies, which has been shown by Levine and Rubinstein (2017), to be crucial for the correct measurement of entrepreneurship. We provide new evidence emphasizing the importance of skills and human capital accumulation for the understanding of selection into entrepreneurship over an individual's life-cycle. We also provide new observations on the relationship between wealth and selection into entrepreneurship, connecting to the literature suggesting that liquidity constraints are a main barrier to aspiring entrepreneurs (Evans and Jovanovic (1989) and Evans and Leighton (1989)).

On the theory side, we propose a new quantitative macroeconomic model that extends the canonical model of entrepreneurship by Cagetti and De Nardi (2006), allowing for a realistic life-cycle structure and human capital accumulation. Our work connects to papers that use models of entrepreneurship to understand macroeconomic outcomes, such as Allub and Erosa (2019) who build an occupational choice model that distinguishes between self-employed and entrepreneurs to quantify the effects of financial frictions on GDP and inequality, Wellschmied and Yurdagul (2021) who argue on the importance of accounting for endogenous hours worked to understand the wealth distribution among entrepreneurs and Kozeniauskas (2018), Salgado (2020) who propose a model of entrepreneurship with technological change to account for the decline in the share of entrepreneurs in the US economy. Our paper also relates to the strand of research that incorporates entrepreneurs in otherwise standard incomplete-market models to evaluate efficiency and welfare properties of tax reforms. Examples of such recent work are Bruggemann (2021) and Guvenen et al. (2023). A paper close in spirit to ours is Bhandari and McGrattan (2020). The authors highlight the importance of accounting for entrepreneurs' sweat equity when designing business and corporate taxes. The concept of sweat equity and human capital share some similarities but differ in two major respects. In Bhandari and McGrattan (2020) entrepreneurs can invest time in creating sweat equity which increases the firm's productivity. Typical activities that would rise sweat equity are marketing and networking activities that build customer bases and client lists. In this sense the notion of sweat equity is closer to the concept of intangible capital and is firm specific, rather than individual specific as human capital. Second, the authors do not investigate the role of sweat equity for business creation nor study how it affects transitions into entrepreneurship, which is the focus here. We show how accounting for human capital accumulation allows to draw new conclusions on the type of individuals that open a business at different stages of their life and how our framework can be used to reevaluate the effects of financial frictions on aggregate entrepreneurial activity and on the productivity of new ventures that are created.

Finally, our work also relates to papers that use structural econometric models as Hincapié (2020), Catherine (2022) and Gendron-Carrier (2023) to disentangle the role of different economic forces, from cognitive to non-cognitive abilities, non-pecuniary benefits, labor market experience and risk aversion in driving selection into entrepreneurship. The reminder of the paper is organized as follows. Section 2 describes the data, while section 3 provides empirical evidence on the role of human capital and wealth for selection into entrepreneurship. Section 4 introduces the model and section 5 discusses how we bring it to the data. Section 6 is dedicated to the study of the model properties and counterfactual exercises. Section 7 analyses the policy reform and the final section concludes.

2 The Data

Our analysis is based on administrative data for the entire Danish population. We combine multiple administrative data sources to construct a unique dataset, that maps all firm ownership in the Danish economy between 1996-2019. This includes direct and indirect ownership of both incorporated firms (ltd. corporations)[5], and of unincorporated firms (proprietorships, partnerships), the timing of ownership relations, and the allocation of ownership shares in cases with multiple owners.

Our primary interest lies in identifying individuals that transition into entrepreneurship for the first time, their main characteristics at the time of transition, and the subsequent performance of their firms. We characterize individual entrepreneurs using detailed records of labor market histories, education, wealth, income, age, gender and we measure firm performance using annualized data on employment, revenue and value-added.

The primary unit of observation is an individual. We start by restricting the sample to all men born between 1962 and 1976, implying that individuals are aged 20-57 in the sample[6]. All firm related variables, for example revenues, value-added and employment, are weighted by the ownership shares of the individual. We define an individual as an entrepreneur if at any given moment in time in our sample, the individual is the owner of a limited liability firm with positive revenues, positive assets and who has hired at least one employee over the entrepreneurial spell. We define the start of the entrepreneurial spell with the year in which the individual started owning shares of the limited liability firm.

[5]There are three types of limited corporations in Denmark, relevant to the data period: A/S, ApS and IvS, that differ mainly in terms of capital requirements. As per 2020, A/S has a capital requirement of 250.000 dkk, ApS has a capital requirement of 40.000 dkk, and IvS has a capital requirement of 1 dkk. The capital requirement of ApS was reduced from 125.000 dkk to 80.000 dkk in 2010, and then reduced further to 50.000 dkk in 2014, and 40.000 in 2020. IvS was introduced in 2014 and discontinued in 2019.

[6]We do not observe firm ownership for cohorts born before 1962.

We further restrict the sample such that we can divide individuals in two types: workers and entrepreneurs. Workers are individuals with paid-employed jobs who have worked at least part-time in the last year. We drop individuals that are and remain self-employed during the time period of the dataset. Finally, we keep only entrepreneurs for which we observe the transition into entrepreneurship. This leaves us with 8,620,260 observations for a total of 400,930 individuals. Of these, 7.4% are entrepreneurs at some point in time, while the rest are workers.

3 Empirical Evidence

Table 1 reports summary statistics for our sample.[7] In the upper part of the table, we present a simple measure of standardized hourly wages that adjust for differences in age and calendar year. This measure is obtained by dividing each individual's wage by the average wage of people with the same age, in the same year. For entrepreneurs we use the wages they were earning before transitioning into the entrepreneurial spell.[8] We see that future entrepreneurs earned on average around 20% higher standardized wages compared to workers before transitioning into entrepreneurship. We further construct a measure of the average annual real wage growth for workers and entrepreneurs.[9] Aspiring entrepreneurs are not only positively selected in terms of levels of prior earnings, but also in terms of annual growth rates, experiencing an average increase in wages of 3.4% against a 1.3% of workers. The last block of the table provides the distribution of the highest education achieved by the two groups. Interestingly, among entrepreneurs we observe a high share of individuals where the highest level of completed education is high school or vocational training, whereas among the workers we have a higher share of individuals at the extreme of the education distribution. That is, they exhibit a higher fraction of people that only completed comprehensive school and a higher fraction that completed a PhD or equivalent.

Turning to the life-cycle dynamics of entrepreneurship in Denmark, Figure 1 shows the regression coefficients of the probability of becoming an entrepreneur on age. We see that the age distribution at founding is hump-shaped, with an average age at founding of 38. The qualitative patterns of the age distribution at founding in Denmark are similar to the ones

[7]Throughout our work median and percentiles in the data are computed as averages around percentiles to comply with Danish data privacy policies.

[8]Wages of individuals are always measured (and observed) only when they are paid employed workers. This implies that for entrepreneurs we observe and measure their wages before their transition into entrepreneurship. We refer to them as future entrepreneurs.

[9]This growth rate is computed as $g_{it} = \frac{w_{i,t} - w_{i,t-1}}{0.5 * (w_{i,t} + w_{i,t-1})}$.

found by Azoulay et al. (2020) for the US, even if Danish entrepreneurs are slightly younger at business start.

Table 1: Summary Statistics

	Workers	Entrepreneurs
Observations	7,923,893	696,367
Standardized wage		
Average	1.0	1.2
Median	0.9	1.1
Wage growth		
Average	1.3%	3.4%
Median	1.2%	2.7%
Education		
Comprehensive school	19.0%	10.5%
High school	47.2%	53.5%
Vocational school	7.6%	10.7%
Bachelor or equivalent	13.9%	13.2%
Master or equivalent	10.6%	11.2%
Doctorate or equivalent	1.7%	0.9%

Notes — Standardized wages are computed dividing each individual's wage by the average wage of individuals of the same age and in the same calendar year.

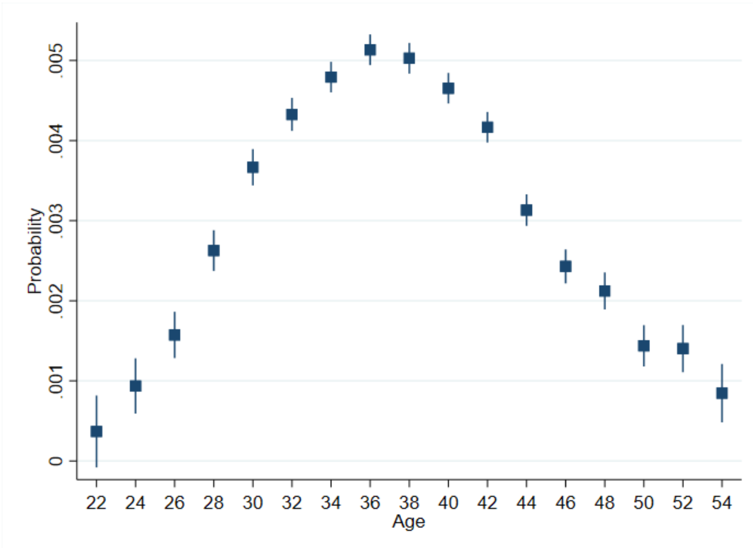


Figure 1: Age distribution at founding

Notes: The table reports the OLS coefficients of the regression of the probability of becoming an entrepreneur on age, without a constant. The sample is the universe of danish men born between 1962 and 1976.

3.1 Selection in terms of human capital

Recent work by Smith et al. (2019) and Queiró (2022) has shown that part of the variation in business outcomes can be explained by differences in the entrepreneur's human capital. In this section we show that human capital differences are not only important to understand entrepreneurial outcomes but also for the understanding of the decision to become an entrepreneur. We present evidence on the fact that entrepreneurs are positively selected, compared to workers, along different measures of human capital usually used in the literature.[10]

We start by measuring human capital in terms of education and labor market experience. For each individual in the data set we construct the variable training years as the sum of years of education and labor market experience at any given point in time. In Figure 2 we plot the average training years by age for workers and future entrepreneurs, before they transition into entrepreneurship. We plot the average training years up to age 38, which is the average age at business start.

We see that future entrepreneurs on average have more training years compared to workers of the same age. These differences are statistically significant at the 5% significance level

[10] For example, wages and residuals from earnings regressions are used in Borjas et al. (2019) to study positive self-selection in terms of skills of migrants vs non-migrants.

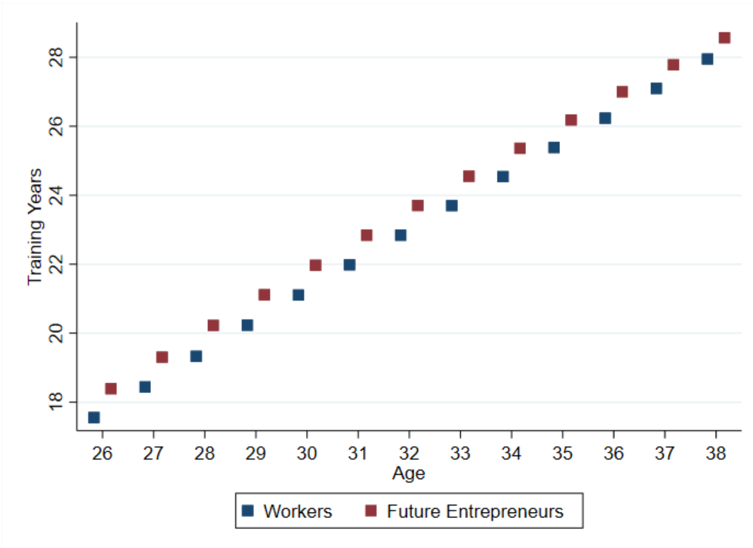


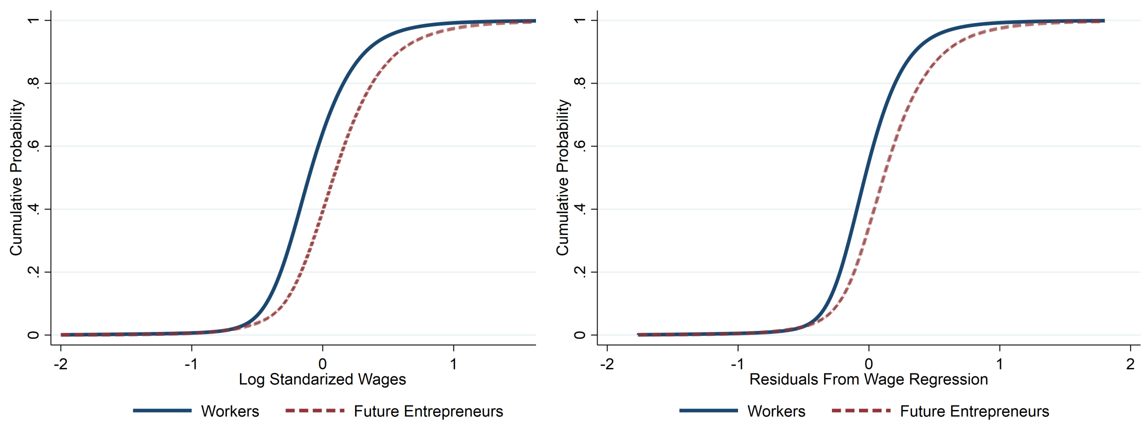
Figure 2: Human capital as average training years

Notes: Training years are defined as the sum of years of education and labor market experience at any given moment in time. Future entrepreneurs are individuals who at some point in their life open a business, while workers are individuals who always remain paid employed workers.

and are also economically relevant. For example, at age 30 aspiring entrepreneurs have on average almost one additional year of training, which reflects both education choices and actual labor market experience. Given that we are conditioning on age this implies that future entrepreneurs have spent more time working or acquiring skills in education, ultimately building up a higher stock of human capital.

A second measure often used to proxy for individuals' human capital are hourly wages. To the extent that markets are competitive, wages reflect individuals' productivity on the job. Our analysis consists in constructing a measure of standardized hourly wages for each individual and to compare cumulative distributions of standardized wages between individuals who at some point in their life open a business, compared to individuals who always remain paid employed workers. We standardize hourly wages by dividing each individual's wage by the average wage earned by people with the same age, in the same year. This procedure helps to account for differences in wages that simply come from life-cycle dynamics and aggregate economic conditions. For future entrepreneurs, we use the hourly wages they were earning before the entrepreneurial spell. By plotting the cumulative distribution function we do not impose any functional form restriction on the data and one can see that the positive selection of aspiring entrepreneurs in terms of prior wages not only holds on average, but along the entire distribution. This means that for any value of standardized wages in the danish economy, the fraction of future entrepreneurs earning lower than a given wage is smaller than the fraction of workers. Panel (a) of figure 3 illustrates the cumulative distribution function for the two groups.

Figure 3: Self-selection of entrepreneurs in terms of observed and unobserved characteristics



(a) Selection in terms of prior standardized wages.

(b) Selection in terms of residuals of wage regressions.

Notes: Panel (a) shows the cdf of standardized wages. Panel (b) plots the cdf of residuals from a wage regression. Future entrepreneurs are individuals who at some point in their life open a business, while workers are individuals who always remain paid employed workers.

Differences in wages partly reflect differences in observables and one can wonder how the two groups differ in terms of unobserved characteristics. To this end, we run simple Mincerian regressions for the two groups in which we regress wages on education (in years), age and year dummies and examine how the residuals differ between the two groups. Goal of the exercise is to establish whether the observed differences in panel (a) of Figure 3 only reflect different education choices or whether workers and future entrepreneurs also differ along unobserved abilities. Panel (b) of Figure 3 shows that the two groups differ in terms of unobserved characteristics, with future entrepreneurs being positively selected. By construction, panel (b) of Figure 3 tells us that workers and entrepreneurs differ in terms of characteristics which are not explained by education and age, but are reflected in wages.

The final piece of evidence we produce to demonstrate that entrepreneurs are positively selected in terms of human capital, is to check how the two groups differ between experienced wage growth. While differences in wages inform us on the stock of accumulated human capital, changes in wages mostly reflect increases in individual's productivity that may stem from different learning abilities on the job. In Figure 4 we show that future entrepreneurs were experiencing higher growth in wages, compared to workers of the same age, before starting a business.

These statistics - while observational- reveal us an important dimension of the data to take into account when modeling selection into entrepreneurship.

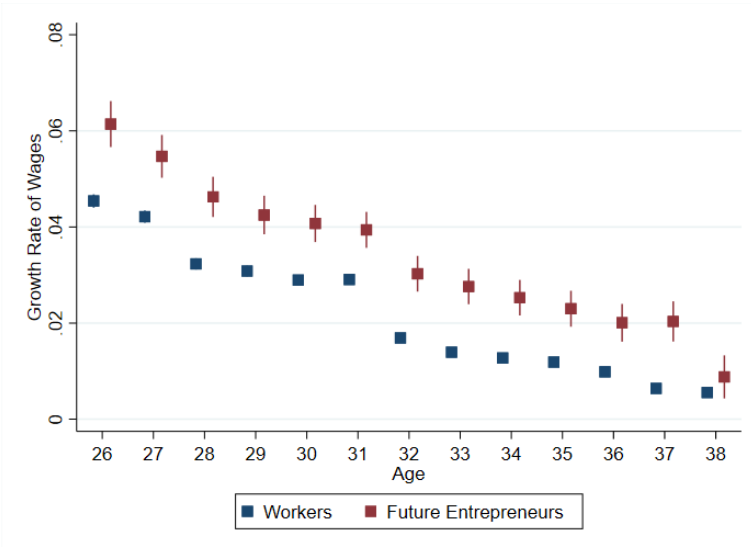


Figure 4: Differences in experienced wage growth

Notes: Yearly growth rates of wages of future entrepreneurs and workers. Future entrepreneurs are individuals who at some point in their life open a business, while workers are individuals who always remain paid employed workers.

3.2 Complementarity between human capital and wealth

We further explore to which extent human capital and wealth are substitutes or complements in entrepreneurial activity. Are entrepreneurs coming from richer families still positively selected in terms of human capital or less so because they can substitute wealth for skills? We check for evidence of substitutability by reporting the average log standardized wage of workers and future entrepreneurs conditional on family wealth. If human capital can be substituted with wealth we expect the differences in log standardized wages between workers and future entrepreneurs to become smaller as we move along the family wealth distribution.[11] Table 2 shows that the differences in log standardized wages between future entrepreneurs and workers do not change as we move along the family wealth distribution. Regardless of the family background, future entrepreneurs earn on average between 16%-

[11] An example of why this can be the case is that entrepreneurs coming from richer families might be better able to hire people to work for them whenever they do not have the right skills to do the activities themselves.

19% more than workers before opening their business and this difference remains constant throughout the family wealth distribution. This evidence, while suggestive, indicates that human capital and skills used in entrepreneurial activities cannot be entirely substituted by higher wealth holdings.

Table 2: Complementarity vs substitutability of human capital and wealth

Fathers' Wealth Decile in 1996	Average Log Standardized Wages		
	Entrepreneurs	Workers	Difference
First decile	0.087	-0.075	0.162
Second decile	0.097	-0.062	0.159
Third decile	0.111	-0.061	0.172
Fourth decile	0.115	-0.064	0.179
Fifth decile	0.111	-0.065	0.176
Sixth decile	0.108	-0.065	0.173
Seventh decile	0.112	-0.067	0.179
Eight decile	0.108	-0.067	0.175
Ninth decile	0.09	-0.074	0.164
Tenth decile	0.089	-0.099	0.188

Notes — The table shows differences in percentiles and statistics of log standardized wages between future entrepreneurs and workers conditional on family wealth.

3.3 Entrepreneurial outcomes and human capital

Up to now we have established that aspiring entrepreneurs are positively selected in terms of human capital with respect to workers. In this section we explore how our measures of human capital relate to business productivity. We classify entrepreneurs in our sample as ex-post high and low productive. For every entrepreneur we compute a measure of his average productivity over the first five years of business (conditional on survival), computed as the ratio between real revenues and employment. We then define an entrepreneur as high productive if he belongs to the top decile of the productivity distribution. Table 3 below provides a set of summary statistics on ex-post high and low productive entrepreneurs.

The summary statistics show that high productive entrepreneurs, compared to low productive ones, are positively selected in terms of our measures of human capital. High productive entrepreneurs display higher average and median standardized wages and experienced higher wage growth before starting their firm. In terms of educational attainment, high productive entrepreneurs also seem more educated as the fraction of entrepreneurs

Table 3: Summary Statistics

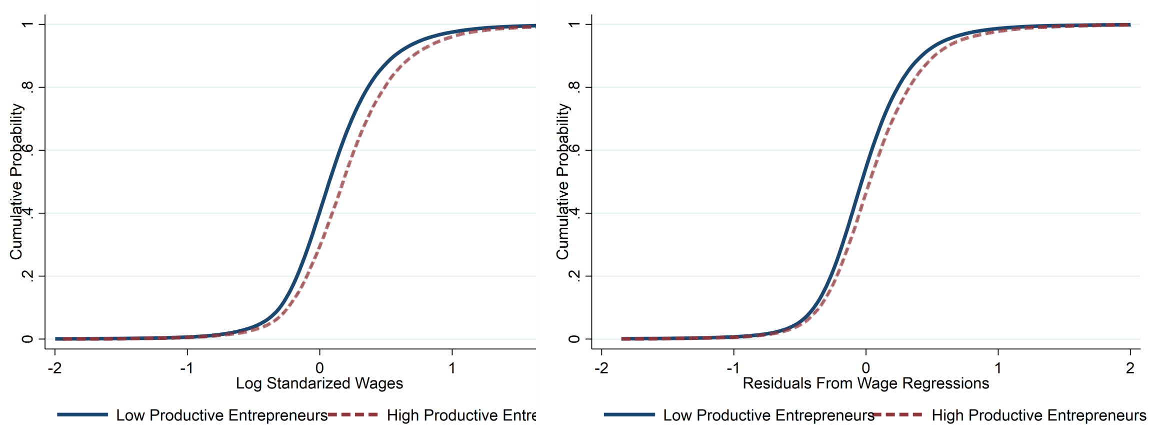
	Low Productive Entrepreneurs	High Productive Entrepreneurs
Observations	$625,497$	$69,494$
Standardized wages		
Average	1.2	1.4
Median	1.1	1.2
Wage growth		
Average	3.3%	4.2%
Median	2.6%	3.4%
Age at founding		
Average	37.8	37.8
Median	38	37
Real net wealth prior to business start		
Average	$18,144$ €	$38,715$ €
Median	$1,459$ €	$13,915$ €
Father's net wealth in 1996		
Average	$150,602$ €	$208,255$ €
Median	$43,899$ €	$54,826$ €
Education		
Comprehensive school	10.9%	7.2%
High school	54.3%	46.4%
Vocational school	10.6%	10.8%
Bachelor or equivalent	12.6%	18.4%
Master or equivalent	10.7%	15.8%
Doctorate or equivalent	0.9%	1.4%

Notes — This table reports summary statistics for high and low productive entrepreneurs. Standardized wages are computed dividing each individual's wage by the average wage of individuals of the same age and in the same calendar year.

with at least a bachelor degree is higher. We also see that ex-post high productive entrepreneurs seem to hold more net wealth at business start and come from richer families as captured by father's net wealth in 1996.

We reproduce the figures showing self-selection in terms of observable and unobservable characteristics for high and low productive entrepreneurs. Figure 5 below shows the two cumulative distribution functions for prior standardized wages and residuals of wage regressions. Compared to Figure 3 - showing the differences between future entrepreneurs and workers - we see that the magnitude of the selection in terms of prior standardized earnings is lower, but still present. Also, the cdf of residuals of wage regressions for the group of high productive entrepreneurs first order stochastically dominates the cdf for the group of low-productive entrepreneurs. Our findings suggest that human capital is not only related to selection into entrepreneurship, but it also positively associated with future firm performance.

Figure 5: Selection of high vs low productive entrepreneurs in terms of observed and unobserved characteristics



(a) Selection in terms of prior wages.

(b) Selection in terms of residuals of wage regressions.

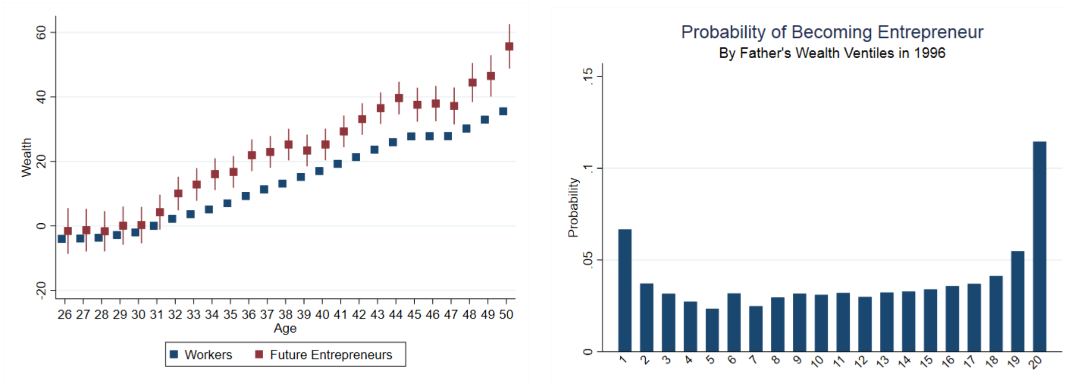
Notes: Panel (a) shows the cdf of standardized wages. Panel (b) plots the cdf of residuals from a wage regression.

3.4 Selection in terms of wealth

In this section we revisit the relationship between financial constraints and selection into entrepreneurship in our data. Standard theories of entrepreneurship like in Evans and Jovanovic (1989), would predict that if financial markets work imperfectly, then aspiring entrepreneurs save to overcome collateral constraints. This would imply that future entrepreneurs hold higher wealth compared to workers with observationally similar characteristics. Additionally, if markets are incomplete and entrepreneurs are risk-averse, then future entrepreneurs also hold wealth to insure themselves against adverse business outcomes.

In panel (a) of Figure 6 we plot net wealth holdings of workers and future entrepreneurs conditional on age. We see that future entrepreneurs hold higher wealth at almost every age, compared to workers. The difference in wealth holdings is statistically significant.

Figure 6: Wealth and selection into entrepreneurship



(a) Net wealth holdings of workers and future entrepreneurs.

(b) Share of entrepreneurs by family wealth

Notes: Panel (a) shows net wealth holdings of workers and future entrepreneurs. Net wealth is measured as the sum of financial wealth and housing, minus outstanding debt. Panel (b) plots the share of individuals who ever become entrepreneurs by the ventiles of their father's wealth measured at the beginning of the sample (1996).

Given that savings decisions are the result of individuals' choices, we cannot tell whether the differences in wealth holdings stem from the presence of liquidity constraints or from other reasons.[12] To get closer at understanding the role of wealth held to overcome potential borrowing constraints, we use information on fathers' wealth in 1996 - the beginning of the sample - as a proxy for liquidity constraints. If indeed borrowing constraints were holding individuals back from entrepreneurship, we would expect the fraction of individuals that become entrepreneurs to increase as borrowing constraints get looser. The underlying assumption is that as we move along the family wealth distribution, individuals are less and less borrowing constraint either because they can directly get resources from their family or because they can pledge part of their family assets as collateral to obtain credits from banks.[13] Panel (b) of Figure 7 shows that the probability of becoming an entrepreneur is not monotonically increasing with family wealth. The relationship between family wealth and selection into entrepreneurship is essentially flat along most of the central part of the distribution and only increasing in the first and last ventile. Part of this can be explained by the fact that entrepreneurs are over represented in the tails of the wealth distribution and

[12]For example, higher wealth holdings can arise mechanically from differences in incomes or from differences in preferences between future entrepreneurs and workers.

[13]Of course family wealth also captures other aspects, like transferable entrepreneurial knowledge (or the business itself) between parents and children. But if anything, this would reinforce the positive relationship between family wealth and the propensity of becoming an entrepreneur.

are likely to pass over the family business. We further ask whether better access to credit impacts the life-cycle dynamics of entrepreneurship by regressing the age at business start on the ventiles of father wealth. As can be seen in Figure 7, on average entrepreneurs that come from richer families do not start their business earlier in life, with the exception of individuals who come from very rich backgrounds who start their firm about 1.5 years younger on average. These findings do not imply that wealth does not matter for entrepreneurship, but rather that the need of accumulating wealth is likely not the only driver of the life-cycle patterns of selection into entrepreneurship.

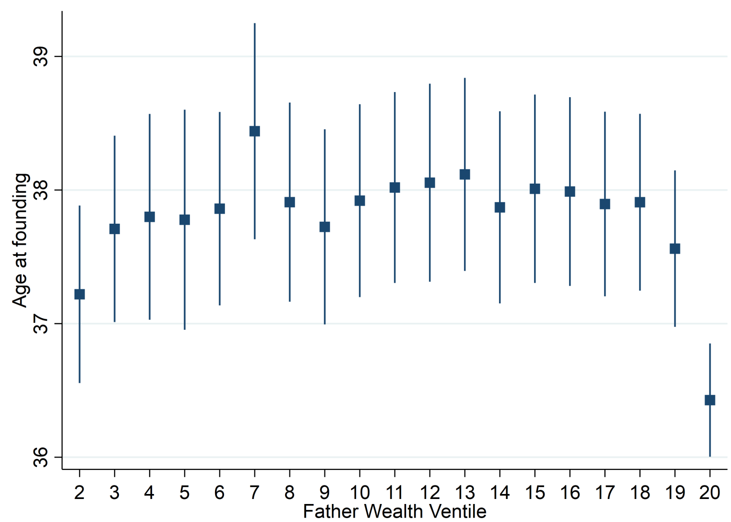


Figure 7: Age at founding by father wealth

Notes: The figure plot the OLS regression coefficients of the age at business start on the ventiles of father wealth in 1996, without a constant.

To sum up, our empirical evidence shows that i) future entrepreneurs earn higher wages compared to workers of the same age and experience higher wage growth before opening their business ii) future entrepreneurs are positive selected also in terms of unobserved earnings abilities as measured by the residuals of wage regressions iii) higher levels of human capital at business start are associated with higher firm productivity measures. We additionally find that future entrepreneurs on average hold more wealth compared to workers, but that the probability of becoming an entrepreneur is essentially flat along the central part of the family wealth distribution.

While observational, our findings suggest that human capital accumulation is an important dimension to take into account to understand entrepreneurship. In the next section we propose a model that accounts for our empirical findings and we use it to study the interaction between financial constraints and human capital accumulation in shaping entrepreneurial decisions.

4 The model economy

We consider a small open economy with a realistic life-cycle structure and overlapping generations in which in every period individuals have to decide whether to start a business and become entrepreneurs or work as paid employed workers. To become entrepreneurs individuals need wealth, a good business idea and human capital. The latter can be accumulated both while being a worker and while being an entrepreneur with a learning by doing technology. Human capital is transferable across occupations. The process by which individuals accumulate human capital is the same across occupations and depends on a learning ability term which is individual specific. Human capital has two effects. On one side it determines total labor income as a worker, on the other it affects business productivity and hence entrepreneurial profits. Entrepreneurs face collateral constraints and every period have to decide how much capital and labor to hire. The presence of collateral constraints give rise to financial frictions and the need for prospective entrepreneurs to save enough wealth to pledge as collateral in order to borrow the optimal amount of capital to use in the production process. Markets are assumed to be incomplete so agents save to self-insure against idiosyncratic risk. Individuals pay progressive labor income taxes and retire at an exogenous age J_r with pension benefits b. Government revenues are used to finance the retirement system and wasteful government spending G .

Demographic structure

The economy is populated by overlapping generations in which in each period a continuum of agents are born. Time is discrete and agents can live up to a maximal age J. The demographic patterns are assumed to be stable in the sense that at any point in time agents of age j make up a constant fraction μ_j of the population. Agents retire at age J_r with social security benefit b, which is independent of their labor market history.

Endowments

In every period individuals are endowed with a business idea and a learning ability. The quality of the business idea, θ, affects overall business productivity if the individual decides to become an entrepreneur and start a business. The term θ is assumed to follow an AR(1) process with Gaussian innovations. The learning ability, ξ, is a fixed personal trait that determines the speed at which human capital is accumulated and is drawn from an exogenous distribution at age $j = 1$.

Human capital

Human capital is accumulated according to the following law of motion:

$$h_{j+1} = h_j + \xi_i h_j$$

where ξ_i stands for the individual's learning capacity and is time-constant. Workers and entrepreneurs share the same human capital accumulation technology.

Production technology

Entrepreneurs decide how much capital k and external labor units n to hire, while being endowed with the following production technology:

$$y = \theta_j h_j \left(k_j^{\gamma}(n_j)^{1-\gamma}\right)^{v},\ v \in [0, 1)$$

The parameter $v < 1$ implies that entrepreneurs face decreasing returns to scale. The term θ, which stands for the quality of the business idea, directly affects business productivity together with the stock of accumulated human capital h_j. The parameter γ determines the share of income accruing to the variable factors of production, namely capital and labor.

Preferences

All agents have identical preferences and choose consumption to maximize the following objective function:

$$\mathbb{E}\left[\sum_{j=1}^{J} \beta^{j-1} u(c_j)\right] \tag{1}$$

where the period utility function $u(c)$ is assumed to be of the CRRA class.

Market arrangements

Markets are incomplete in the sense that agents cannot fully insure themselves against idiosyncratic sources of risk by trading state-contingent assets.

Workers are not allowed to borrow, but can save in a risk-free asset. Entrepreneurs can borrow capital within a period to invest in their firm. However, they face collateral constraints, meaning they can only borrow up to a fraction λ of their wealth: $k \leq \lambda a$. The collateral constraint faced by entrepreneurs is motivated by the fact that financial markets are assumed to work imperfectly, due to non perfectly enforceable contracts.

4.1 The individual problem

At the beginning of every period individuals have to decide whether to become entrepreneurs or workers. Individuals know their learning ability ξ, their stock of accumulated human capital h, they observe the quality of the business idea θ and form expectations about future business ideas. Occupational choices are made at the beginning of every period, after the business idea shock has realized. Workers then choose consumption and savings, while entrepreneurs also decide how much external capital and labor to hire. Each individual at beginning of life is endowed with some positive level of human capital stock.

We write the household problem in recursive form. Let $\mathbf{x}_j = (a, \theta, h, \xi)$ be the individual state vector at age j, where a stands for asset holdings, θ is the business idea, h is the stock of human capital, and ξ represents the learning ability. The value function of a household at age j is $V_j(\mathbf{x}_j) = \max \left\{V_j^w(\mathbf{x}_j), V_j^e(\mathbf{x}_j)\right\}$ where $V_j^w(\mathbf{x}_j)$ and $V_j^e(\mathbf{x}_j)$ represent the value of being a worker and an entrepreneur at age j respectively.

Consider a household of age $j < J_r$. If $V_j^e(\mathbf{x}_j) \geq V_j^w(\mathbf{x}_j)$ he decides to become an entrepreneur and solves the following dynamic problem:

$$V_j^e(\mathbf{x}_j) = \max_{c_j, a_{j+1}, k_j, n_j} \left\{u(c_j) + \beta \mathbb{E}\left[V_{j+1}(\mathbf{x}_{j+1})\right]\right\} \tag{2}$$

s.t

$$c_j + a_{j+1} = y_j + a_j - T_y(y_j) \tag{3}$$

$$y_j = \pi(h_j, \theta_j) + r a_j \tag{4}$$

$$k_j \leq \lambda a_j \tag{5}$$

$$a_{j+1} \geq 0 \tag{6}$$

$$n_j \geq 0 \tag{7}$$

$$h_{j+1} = h_j + \xi_i(h_j) \tag{8}$$

where $\pi(h_j, \theta_j)$ stands for entrepreneurial profits. Business profits depend on the entrepreneur's human capital stock, his business idea, the amount of physical capital k_j and the amount of external labor inputs hired n_j. The term $T_y(y_j)$ is a tax function which determines how much taxes must be paid for given level of income y_j. The entrepreneur chooses capital and external labor to maximize profits:

$$\pi(h_j, \theta_j) = \max_{k_j, n_j} \left\{ \theta_j h_j \left(k_j^{\gamma} (n_j)^{1-\gamma} \right)^{v} - (r+\delta) k_j - w n_j \right\} \tag{9}$$

s.t

$$k_j \leq \lambda a_j \tag{10}$$

$$n_j \geq 0 \tag{11}$$

If $V_j^w(\mathbf{x}_j) > V_j^e(\mathbf{x}_j)$ the agent becomes a worker and his dynamic problem reads:

$$V_j^w(\mathbf{x}_j) = \max_{c_j, a_{j+1}} \{ u(c_j) + \beta \mathbb{E} \left[V_{j+1}(\mathbf{x}_{j+1}) \right] \} \tag{12}$$

s.t

$$c_j + a_{j+1} = y + a_j - T_y(y_j) \tag{13}$$

$$y_j = w h_j + r a_j \tag{14}$$

$$a_{j+1} \geq 0 \tag{15}$$

$$h_{j+1} = h_j + \xi_i h_j \tag{16}$$

Workers and entrepreneurs pay progressive labor income taxes. At age J^r agents retire and they all solve the same problem:

$$W_j(\mathbf{x}_j) = \max_{c_j, a_{j+1}} \{ u(c_j) + s_{j+1} \beta \mathbb{E} \left[W_{j+1}(\mathbf{x}_{j+1}) \right] \} \tag{17}$$

s.t

$$c_j + a_{j+1} = b_j + (1+r) a_j \tag{18}$$

$$a_{j+1} \geq 0 \tag{19}$$

The transfer b_j is independent of the individual labor income history.

4.2 Government

The government collect taxes from labor and entrepreneurial income and finances pension benefits b as well as wasteful resources G. We adopt the tax function of Heathcote et al.

(2017):

$$T_y(y) = y - \tau_y y^{(1-\psi)} \tag{20}$$

The parameter τ_y governs the average level of income taxes, while ψ captures the degree of tax progressivety.

4.3 Equilibrium

Let $\mathbf{x}_j = (a, \theta, h, \xi)$ be the individual state vector at age j. Denote by $\Gamma_1(\mathbf{x}_j) \ldots \Gamma_J(\mathbf{x}_j)$ the distributions of individuals over states by age. We can then define a competitive equilibrium for this economy.

Definition: ***A recursive competitive equilibrium for this economy*** *is defined as value functions* $V_j(\mathbf{x}_j)$,$V_j^e(\mathbf{x}_j)$, $V_j^w(\mathbf{x}_j)$, *policy functions* $c_j(\mathbf{x}_j), a_j(\mathbf{x}_j)$ $n_j(\mathbf{x}_j), k_j(\mathbf{x}_j), \mathbb{I}_e(\mathbf{x}_j), \mathbb{I}_w(\mathbf{x}_j)$, *prices* (r, w) *and distributions* $\Gamma_1(\mathbf{x}_j) \ldots \Gamma_J(\mathbf{x}_j)$ *such that*:

1. *Given prices* (r, w) *the value functions and associated policy functions solve the individual problem described above.*

2. *The labor market clears:*

$$\sum_{j=1}^{J_r-1} \psi_j \int_{\mathbf{x_j}} h_j(\mathbf{x_j}) \mathbb{I}_w(\mathbf{x}_j)\, d\Gamma_j(\mathbf{x}_j) = \sum_{j=1}^{J_r-1} \psi_j \int_{\mathbf{x_j}} n_j(\mathbf{x}_j) \mathbb{I}_e(\mathbf{x}_j)\, d\Gamma_j(\mathbf{x}_j)$$

   where $\mathbb{I}_w(\mathbf{x}_j) = 1$ when an individual is a worker and $\mathbb{I}_e(\mathbf{x}_j) = 1$ when an individual is an entrepreneur.

3. *The Government budget constraint clears:*

$$\sum_{j=1}^{J_r-1} \psi_j \left[T_y(y) w \int_{\mathbf{x_j}} h_j \mathbb{I}_w(\mathbf{x}_j)\, d\Gamma_j(\mathbf{x}_j) \right] + \sum_{j=1}^{J_r-1} \psi_j \left[T_y(y) \int_{\mathbf{x_j}} \pi_j(\mathbf{x}_j) \mathbb{I}_e(\mathbf{x}_j)\, d\Gamma_j(\mathbf{x}_j) \right] =$$
$$\sum_{j=J_r}^{J} \psi_j \left[b \int_{\mathbf{x}_j} \mathbb{I}_r(\mathbf{x}_j)\, d\Gamma_j(\mathbf{x}_j) \right] + G$$

   where $\mathbb{I}_r(\mathbf{x}_j) = 1$ when an individual is retired.

4. *The distributions* $\Gamma_1(\mathbf{x}_j)\ldots\Gamma_J(\mathbf{x}_j)$ *are consistent with the population structure, the exogenous processes and individual behavior.*

Under the assumption of a small open economy, the interest rate r is fixed and there is no need of an additional asset market clearing condition.

5 Mapping the Model into Data

In this section we describe how we map the model to the data. The model is solved in general equilibrium and brought to the data through a simulated method of moments procedure. Agents enter the economy at age $j = 1$, real age 20 and retire at age $J_r = 45$, real age 65. All agents die at age $J = 71$, real age 91. Individuals start with zero wealth and the lowest level of human capital at age $j = 1$. Some parameters are calibrated using external evidence, while the remaining ones are calibrated internally.

Externally calibrated parameters

The preference parameters σ and β are taken from Bruggemann (2021). Specifically, we set the coefficient of risk aversion in the utility function σ to 1.5 and the discount factor β to 0.96. The values τ_y and ψ of the tax function are taken from Holter et al. (2019) who estimate equation 20 for Denmark. The value for τ_y is 0.69, while ψ is set to 0.22. Lastly, we set the depreciation rate $\delta = 0.04$ and the interest rate to 1%.

Internally calibrated parameters

We are left with seven parameters to calibrate internally and we do so by targeting seven different data moments. The business quality shock θ_j follows an AR(1) process of the type:

$$\theta_{it} = \zeta\theta_{it-1} + \nu_{it} \tag{21}$$

where the innovations are drawn from a Normal distribution $\nu_{it} \sim \mathcal{N}(0, \sigma_\nu)$. The learning ability ξ is drawn from a log-normal distribution $\xi \sim \mathcal{LN}(\mu_\xi, \sigma_\xi)$.

Under these functional form assumptions the parameters to calibrate are $[\mu_\xi, \sigma_\xi, v, \gamma, \lambda, \zeta, \sigma_\theta]$. The first two parameters govern the average and standard deviation of the log-normal distribution from which the learning ability ξ is drawn. The term v is the return to scale parameter in the entrepreneurial production technology and γ is the parameter affecting the share of income accruing to capital and labor in the production function. The parameter λ defines the severity of the collateral constraint, while the last two parameters ζ, σ_ν determine the stochastic process for the entrepreneurial business quality shock. These parameters are calibrated by targeting seven different data moments which are informative about the underlying structural parameters. The calibration procedure follows a standard simulated method of moments approach. For a set of candidate parameter values we solve the household problem, we find the stationary equilibrium and compute model moments from a panel of $N = 100,000$ individuals. The simulated method of moments approach consists in selecting parameter values such that the squared distance between data and model moments is minimized. The solution to the minimization problem is a vector $\hat{X}$ of parameter values such that the following objective function is minimized:

$$L(X) = \min_X (\hat{\Omega} - \Omega(X))' W (\hat{\Omega} - \Omega(X)) \tag{22}$$

where $\Omega(X)$ are the moments computed from the simulated data, $\hat{\Omega}$ are the empirical moments and $W = I$. The minimization is performed by generating random Sobol sequences inside reasonable parameter spaces and selecting the combination of parameters that minimizes equation 22. In the next section we discuss which moments we target to separately identify the human capital accumulation process, from the collateral constraint parameter and the business quality shock.

5.1 Identification

Given the complexity and non-linearity of the model, all moments are jointly affected by all parameters in equilibrium. However, some moments are more informative than others for certain parameters. In this section we provide intuitive arguments regarding identification. The key challenge in mapping the model to the data is to select data moments that are informative about the underlying structural parameters. We choose moments that separately identify the three main mechanisms that affect selection into entrepreneurship in the model economy: the human capital accumulation process, financial frictions and the quality of the business idea.

We use moments from wage data of all individuals in our sample to inform the human capital accumulation process. To the extent that markets are competitive, wages are informative about the stock of human capital accumulated by individuals.[14]

Human capital accumulation process

[14] Statistics on wages are commonly used in the literature on human capital accumulation and macroeconomic outcomes to inform the human capital accumulation process. See Huggett et al. (2011) and Huggett et al. (2006) for an example.

Specifically, we target the average growth rate of wages of individuals of age 25-30 to calibrate the mean of the learning ability μ_ξ, while we target a measure of dispersion in wages -the ratio of the 75th to 25th percentile of the wage distribution at age 40- to calibrate the standard deviation of the learning ability σ_ξ. Lower values of the average learning ability imply lower growth rates in wages and higher values of the standard deviation in the learning ability imply higher dispersion in wages for a given age. By calibrating the human capital accumulation process using wage data and not statistics related to life-cycle patterns of entry into entrepreneurship helps us to cleanly separate the human capital channel from other mechanisms.

Business quality shock

To calibrate the two parameters defining the stochastic process of the business quality shock (ρ and σ_ν) we target the share of entrepreneurs that fail within the first five years and the magnitude of selection in terms of prior wages between future entrepreneurs and workers. The first moment is naturally linked to ρ. In fact, higher shares of failure within the first five years mean that the business quality shock is less persistent and bad shocks can hit individuals after short time periods since they started their business. The standard deviation of the business quality shock is informed by the degree of selection in terms of prior wages between aspiring entrepreneurs and workers. The intuitive reason is that the bigger the difference in prior wages between entrepreneurs and workers, the more important is the role of human capital in entrepreneurship and less so the quality of the business idea. In this sense, a small variance of the business quality shock implies that individuals have business ideas which are very similar in quality and what drives some individuals into entrepreneurship while others not, are differences in accumulated human capital. On the other side, with a big variability in the quality of the business idea, entrepreneurs are individuals who are observationally similar to workers, who however happened to be lucky and get a good draw of θ. We calibrate σ_θ to match the difference in average prior standardized wages between future entrepreneurs and workers, which is our measure of selection.

Financial frictions

To discipline the severity of the collateral constraint λ we use the average ratio between initial total firm assets and the owner's wealth. Whenever collateral constraints are binding, λ exactly pins down the ratio $\frac{k}{a}$, which is the model equivalent of firm assets to individual's wealth. Importantly, the bigger this ratio, the bigger the value of λ, meaning the lower are collateral constraints as aspiring entrepreneurs can access external finances easily. By targeting the average of this ratio, our value of λ reflects the fact that some individuals may not be constrained.

Remaining parametrs

Finally, we target the overall share of entrepreneurs in the economy and the median number of employees at business start to inform the two parameters of the production function v and γ. The value of the pension benefit b is calibrated to match the replacement rate in the Danish economy, which is 84%.

6 Model Validation and Properties

In this section we discuss how the model performs in matching the targeted moments as well as moments and data profiles which were not explicitly targeted in the calibration procedure. Specifically, goal of this section is to describe how the model is able to generate the same selection mechanisms into entrepreneurship observed in the data. This is a useful model validation exercise which ensures that our structural framework can be used as a laboratory to study counterfactual scenarios and the effectiveness of policy interventions.
Second, in this section we explore the main model mechanisms and shed light on the interplay between human capital accumulation, the business idea and financial frictions in explaining selection into entrepreneurship over the life-cycle, the productivity of new entrepreneurs and resource misallocation.

6.0.1 Model validation: targeted and untargeted data moments

Table 4 provides an overview of the moments we target and how close we get in matching them. We see that the model matches all moments relatively well. The model understates initial firm size, while overstating slightly the average selection in terms of prior wages. However, as we show in more detail in the next section, the model is able to replicate fairly well the overall selection in terms of human capital between workers and future entrepreneurs.

Moment	Data	Model
Average growth rate wages age 25-30	3.8%	3.8%
Ratio p75/p25 wages age 40	2.6	2.6
Share of entrepreneurs	7.4%	7.3%
Share entrepreneurs that fail within first 5 years	46.3%	48.1%
Difference in average standardized wages	0.24	0.30
Ratio average firm assets to owner's wealth at business start	3.3	3.2
Median number of employees at business start	2.9	3.4

Table 4: Targeted moments

Parameter	Value
Average learning ability μ_ξ	-3.5
Standard deviation learning ability std_ξ	0.85
Returns to scale parameter v	0.54
AR(1) coefficient ρ	0.899
Standard deviation of the innovation sd_θ	0.20
Collateral constrain parameter λ	3.3
Production function parameter γ	0.523

Table 5: Internally calibrated parameters

Table 6 below provides an overview of life-cycle moments of entry into entrepreneurship, which were not explicitly targeted in the calibration procedure. Interestingly, the model is able to come close in matching the two central moments of the age distribution at founding even if it does so by generating a bit too many young and old entrepreneurs and less entrepreneurs in their mid forties, compared to the data. The median age at business start in the model is 36, against 38 in the data and a higher fraction of individuals start a firm already in young ages in the real data, while less so in the model. This can be seen from the first decile of the age distribution at founding being 26 in the data and 29 in the model.

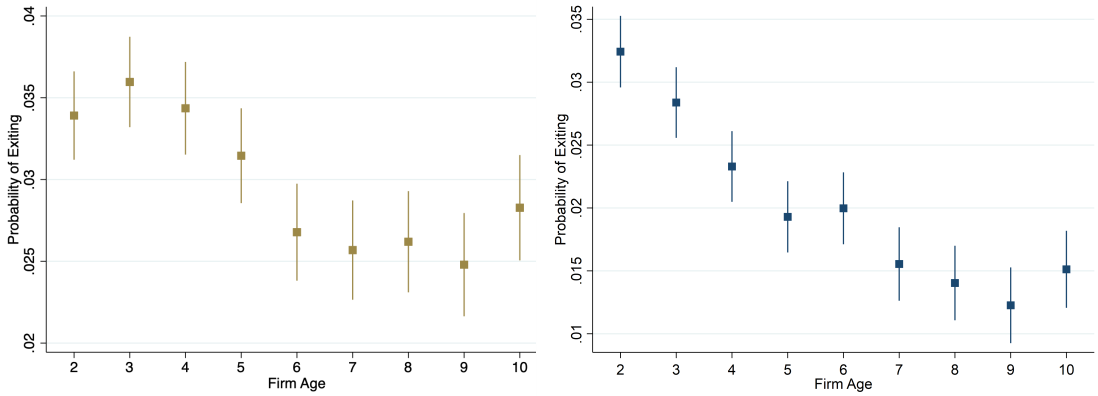
Moment	**Data**	**Model**
Average age at founding	38	35
Std age at founding	6.4	8.2
Median age at founding	38	36
First decile age at founding	29	26
Ninth decile age at founding	46	45

Table 6: Untargeted moments: Age distribution at founding

The model is able to capture fairly well both qualitatively and quantitatively the exit dynamics from entrepreneurship. In Figure 8 we plot the OLS coefficients of regressing a dummy variable taking value one when an entrepreneur goes back to a paid employed job on the years spent in entrepreneurship (firm age). The same regression is run on real and simulated data. We see that the model captures the qualitative decreasing pattern of the probability of exiting from entrepreneurship by firm age, even if it predicts slightly higher probabilities of exit at older firm ages, compared to the data. The probability of exiting from entrepreneurship for an individual who has already spent 9 years as entrepreneur is around 2.5% in the model, but only 1.2% in the data.

We provide evidence on the main selection mechanisms into entrepreneurship that operate in our model economy and compare them to the data. One main result of the empirical section was that aspiring entrepreneurs are positively selected along different measures of human capital and skills. Below we show that our model generates the same patterns. We compute measures of standardized wages in the model by dividing labor income of workers and future entrepreneurs by the average labor income of individuals with the same age. As in the data, wages of future entrepreneurs are the wages they were earning as workers before starting the business. To see how selected future entrepreneurs are in the model economy, we replicate the cumulative distribution function of prior standardized wages computed on the data in the empirical evidence section. In Figure 9 we se that, both in the real and simulated data, future entrepreneurs are positively selected in terms of prior wages. While the average difference in prior wages was targeted, the model is able to reproduce the first order stochastic dominance property of the distribution of standardized wages observed in the data. This is an important property of the model, given the new evidence we provide

Figure 8: Probability of exiting by firm age: **model vs data**



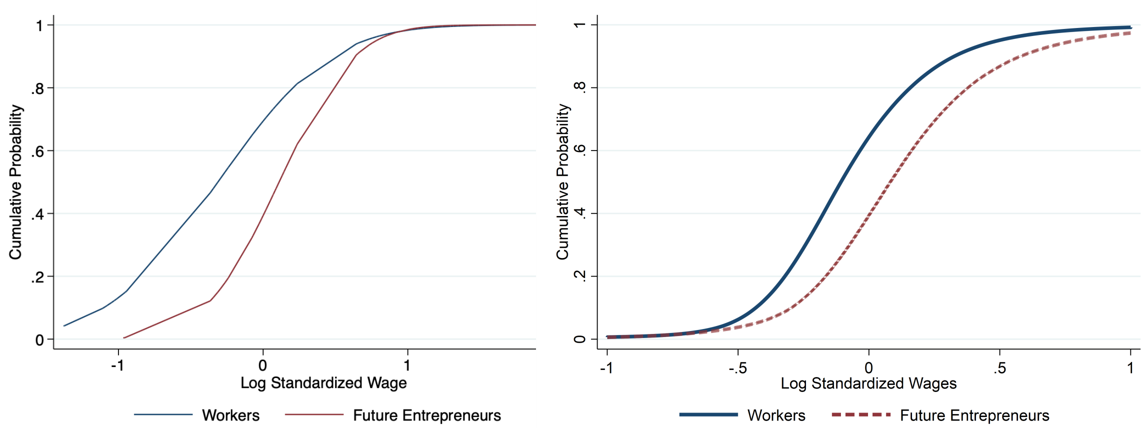
(a) **Model**: Exit probabilities from entrepreneurship by firm age

(b) **Data**: Exit probabilities from entrepreneurship by firm age

Notes: This figure reports the OLS coefficients of regressing the probability of exiting from entrperenurship on the years spent in entrepreneurship (firm age). The same regression is run on real and simulated data.

on the relationship between human capital accumulation and selection into entrepreneurship in the data. In the next subsections we use the model to explore some of its properties through counterfactual exercises.

Figure 9: Self-selection of entrepreneurs in terms of observed characteristics: **model vs data**



(a) **Model**: selection in terms of prior standardized wages.

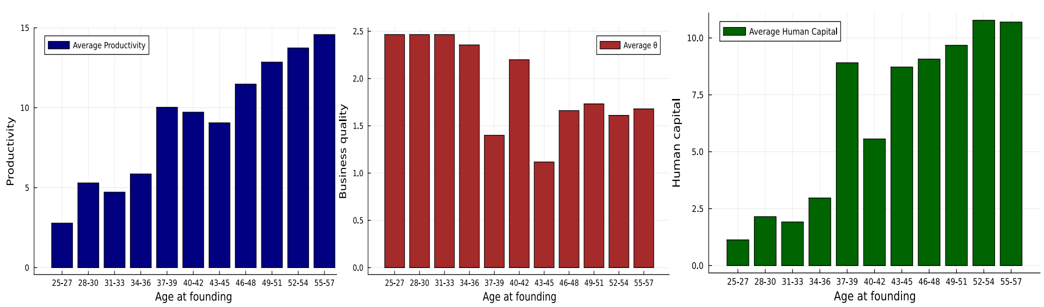
(b) **Data**: selection in terms of prior standardized wages.

Notes: Panel (a) shows the cdf of standardized prior wages in the model. Panel (b) shows the same plot in the data using simulated data.

6.0.2 Model properties: human capital vs business idea

To shed light on the interchangeability of skills vs ideas in driving selection into entrepreneurship at different stages of the life-cycle, we plot the average productivity of new businesses by age at founding. We measure productivity, in the model, with the product of $\theta_j h_j$. From Figure 10 we see that business productivity is increasing in the age at founding, mostly because of the higher stock of human capital that on average individuals have accumulated. We quantify how much of the business productivity is driven by the quality of the idea and how much by the accumulated stock of human capital by plotting the average value of θ and h separately by founding age. On average aspiring entrepreneurs substitute low skills with good business ideas and vice-versa. Individuals who open a business early in life have business ideas of high potential, to compensate for having relatively low human capital. In fact, in the first three age bins only individuals with the best θ draw start a firm. As individuals get older, the average quality of the business idea gets lower (θ goes down), but the average skill of the entrepreneur increases such that overall productivity is actually increasing in age at founding. The substitutability between human capital and θ is evident in the spike in human capital at age $37-39$. This is the first age range in which individuals find it optimal to start a business even if they do not have the best business idea. These individuals are the ones with the highest learning ability ξ who in the age range 37-39 have enough human capital and wealth to compensate for an average θ, that it becomes optimal for them to switch to entrepreneurship rather than stay workers.

Figure 10: Business productivity over the life-cycle



(a) Overall productivity (b) Business quality (c) Human capital

Notes: The three panels show the average level of overall productivity (θh), of human capital and quality of the business idea by age at founding of the entrepreneurs.

6.0.3 Model properties: human capital vs wealth

We further explore the relative importance of human capital versus wealth accumulation for selection into entrepreneurship and the associated life-cycle dynamics. We do this by simulating two alternative economies with different initial conditions. In one case we endow every individual at age $j = 1$ with the average human capital at business start of the average entrepreneur in the baseline economy and in the other case we endow every individual with the average wealth at business start of the average entrepreneur. We then compare the two different economies in terms of aggregate entrepreneurial activity and life-cycle patterns of entry into entrepreneurship.

We find that endowing everybody with positive wealth at business start increases the share of entrepreneurs in the economy from 7.4% to 10.9% and decreases the average age at founding from 35 to 26. When instead we endow everybody with the average human capital of the average entrepreneur at business start, the share of entrepreneurs in the economy increases to 24.4% with an average age at business start of 28. Clearly, starting with higher levels of human capital affects the aggregate amount of entrepreneurial activity in the economy and more so compared to starting with higher wealth holdings. This is explained by noting that higher levels of human capital at start not only increase average business productivity, but they also allow aspiring entrepreneurs to relax their financing constraints by earning higher labor income and accumulate more wealth already in early ages. Starting with higher wealth levels, on the other side, only helps to partly undo the negative effects of collateral constraints but does not improve business productivity, in turn having a smaller effect on the decision to start a business.

Interestingly, individuals start businesses earlier in life when they are endowed with higher wealth, than when they are endowed with higher human capital. This happens because being endowed with higher human capital also makes the outside option as worker more attractive implying that individuals wait some additional years to save more wealth and start their business at a scale which generates enough profits to make entrepreneurship more profitable.

6.0.4 Model properties: the role of financial frictions

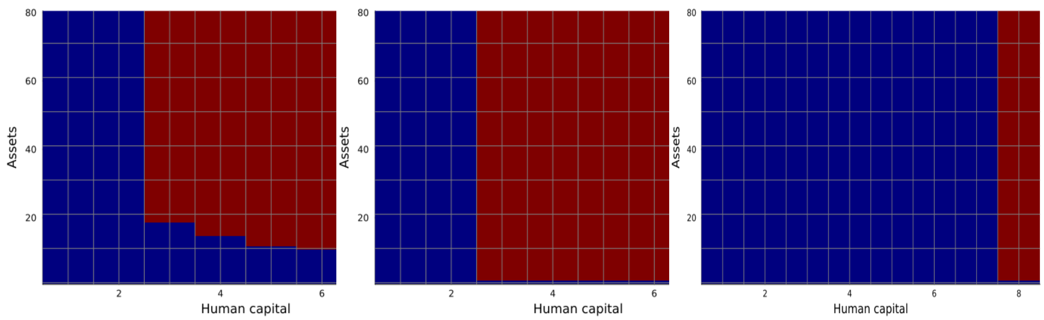
Collateral constraints represent a source of friction in the model. These constraints create inefficiencies on the extensive margin by keeping out from entrepreneurship individuals with high productivity θh, but who have not enough wealth to be able to run the business at a profitable scale. Financial frictions also generate inefficiencies on the intensive margin. In fact, conditional on entry, productive entrepreneurs are limited in the size of the business they can manage by a multiple λ of their wealth holdings.

In this section we quantify the effects that financial frictions have on i) entrepreneurs' extensive and intensive margin decisions ii) how these decisions in turn affect macroeconomic outcomes. We do so by comparing our baseline model to an economy with no financial constraints, where aspiring entrepreneurs can borrow without limits. We analyze the counterfactual economy in partial equilibrium (with fixed prices) and in general equilibrium in which prices (the wage) is allowed to adjust.

Separating the partial equilibrium from the general equilibrium response is instructive to isolate the pure role that collateral constraints have on individual choices from the feedback effect that happens in response to these choices captured by an increase in the equilibrium wage. Figure 11 shows the discrete policy function for becoming an entrepreneur for different combinations of human capital and wealth, at a fixed age and fixed shock θ. The red area represents combinations of the state-space in which individuals decide to become entrepreneurs. The figure shows the same policy function in the baseline economy, in an economy with no financial frictions in which prices are held fixed (PE) and in a an economy with no financial frictions but where prices are allowed to adjust (GE). When the collateral constraint is removed in partial equilibrium, the combinations of human capital and wealth for which agents start a business increase. Specifically, all individuals with high enough human capital - above 2.5 - but with low wealth find it now optimal to start a business as they can borrow capital to operate at a big enough scale and generate profits. This was not the case in the baseline economy. In general equilibrium, however, the individual response is different. The threshold level of human capital at which individuals want to start a business increases and the overall red area shrinks. This is the effect of the wage, which in general equilibrium has to increase to clear the labor market in response to the fact that many more individuals have decided to become entrepreneurs and demand external labor. The higher wage makes the labor costs higher, but more importantly, makes the outside option of being a worker more attractive, reducing the overall number of entrepreneurs in the economy.

Table 7 summarizes the aggregate effects of removing financial frictions. In partial equilibrium, the share of entrepreneurs in the economy doubles and the median age at founding drops from 35 to 33. This is the result of the fact that individuals now only need to have high enough human capital and a good θ to start a business, but do not need any wealth. When the wage increases to restore equilibrium on the labor market, the share of entrepreneurs in the economy is actually lower than in the baseline economy and business owners are on

Figure 11: Discrete policy functions



(a) Baseline case (b) PE response (c) GE response

Notes: The three panels display the discrete policy function for the choice of becoming an entrepreneur. The policy function is shown for a given age (the average age) and given θ. Red areas represent combinations of the state-space for which the individual wants to become an entrepreneur. Panel (a) shows the policy function under the baseline case, panel (b) for an economy with no financial frictions in partial equilibrium and panel (c) for an economy with no financial frictions in general equilibrium.

average older. This happens because individuals wait to acquire high enough skills to generate profits that go beyond their labor market earnings.
Financial frictions have an effect on how efficiently resources are allocated. In partial equilibrium, the absence of financial frictions implies that conditional on entry, every entrepreneur can reach its optimal firm size and is not constraint anymore. This clearly increases efficiency. On the other side, however, when collateral constraints are removed, the cutoff productivity level for entry into entrepreneurship goes down with a consequent inflow of low-productive entrepreneurs in the economy. This has an opposite effect on entrepreneurial efficiency. The table shows that in partial equilibrium the first effect prevails and that aggregate entrepreneurial TFP increases compared to the baseline economy.[15] In general equilibrium the effect on efficiency is even higher with aggregate TFP that increases by approximately 15% compared to the baseline. This is mostly the result of the fact that a higher wage discourages low-productive entrepreneurs to start a business, reinforcing the positive effect on the intensive margin.

The effects that financial frictions have on the productivity of entrepreneurs at business start can be seen from Figure 12. In partial equilibrium, at every age at founding, entrepreneurs are of lower productivity in the counterfactual economy compared to the baseline. In general equilibrium this is not true anymore, with the productivity of aspiring

[15] Aggregate entrepreneurial TFP is compute by summing output, capital and labor of all entrepreneurs of a given age and dividing aggregate output by $(K^{\gamma}L^{1-\gamma})^{\upsilon}$, where K and L are aggregate capital and labor for entrepreneurs of a given age. The final aggregate TFP value is then obtained by aggregating over all ages.

Table 7: Eliminating financial frictions

	Baseline	PE response	GE response
Age at founding			
Average	35	33	40
Share entrepreneurs			
	7.4%	14.9%	4.0%
Aggregate TFP			
	.	+12.9%	+14.6%
Correlation productivity-size			
	0.84	0.99	0.99

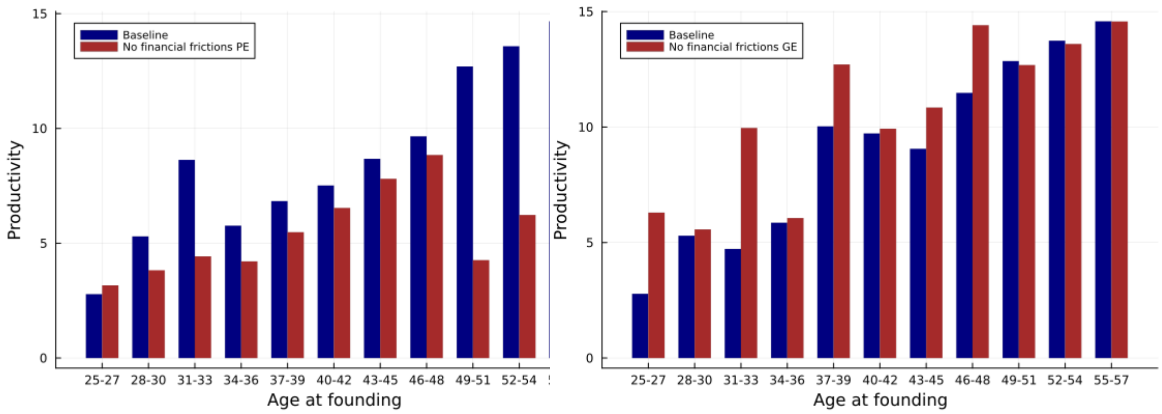
Notes — The table displays average statistics of the baseline economy and an economy with no collateral constraints ($\lambda \rightarrow \infty$). It does so by splitting the effect of removing financial frictions into a partial and general equilibrium response.

entrepreneurs being higher in younger and middle ages and almost the same after age 50. Most of the productivity gains come from the fact that young and middle-aged individuals start businesses with higher levels of human capital. This effect tappers off after age 50 in which even in the presence of collateral constraints high human capital individuals were making high enough profits to prefer starting a business than stay workers. Consequently, while the collateral constraint is still binding on the intensive margin for old entrepreneurs, it does not affect the threshold level of human capital on the extensive margin at which old agents decide to start a business.

Figure 13 compares the average level of human capital and θ at business start in the two economies to understand the sources of the increase in overall productivity when financial frictions are removed. We see most of the increase in productivity comes from the fact that individuals start with higher levels of human capital, which implies that high skilled individuals can start bigger and more profitable firms. This effect explains the overall increase in business productivity at start.

The effect that collateral constraints have on firm size (distortion on the intensive margin) is captured by Figure 14. The figure plots the association between the entrepreneur's initial productivity - θh - and his initial number of employees at business start. In an economy with no financial frictions, firm size is pinned down by productivity. In fact, in panel b) of Figure 14 we see that for every level of productivity there is only one optimal level of employment. In the presence of financial frictions, however, there are multiple possible initial firm sizes for a given level of productivity which depend upon the entrepreneur's wealth.

Figure 12: Average entrepreneur's productivity at business start by age at founding

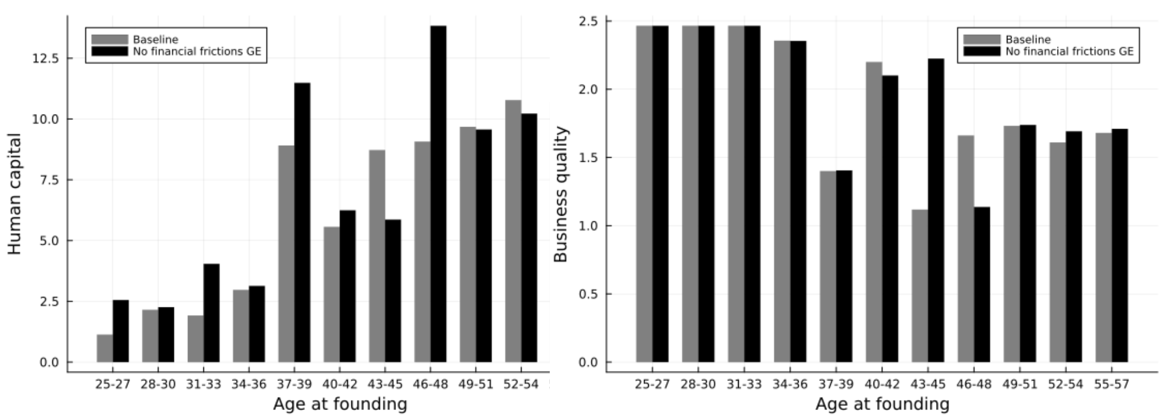


(a) Baseline vs no financial frictions in PE

(b) Baseline vs no financial frictions in GE

Notes: The two panels compare the average entrepreneur's productivity measured as the product θh for different ages at founding. Panel a) compares the baseline economy with an economy with no financial frictions in partial equilibrium while panel b) compares the baseline to an economy with no financial frictions in general equilibrium.

Figure 13: Disentangling the sources of productivity



(a) Human capital

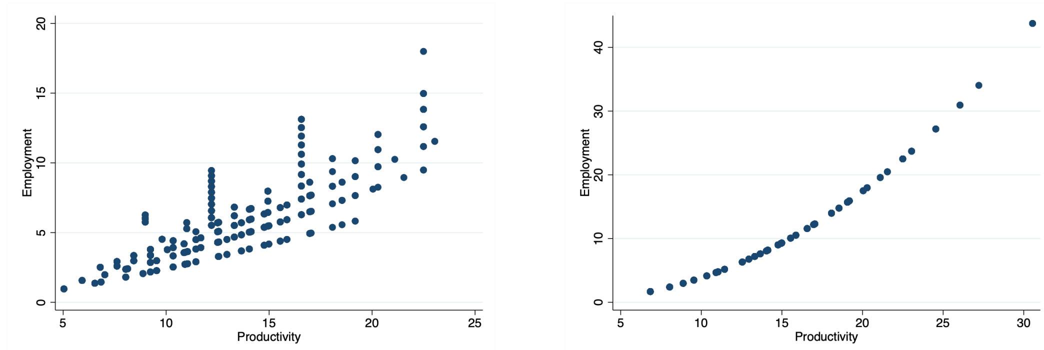
(b) Quality of business idea

Notes: The two panels show the average entrepreneur's human capital at business start under the baseline and no frictions economy. Panel (b) does the same of the quality of the business idea.

Given that aspiring entrepreneurs can have the same productivity levels but different wealth holdings, either because they accumulate human capital at different speeds or because they are hit by a good business idea in different moments of the life-cycle, we get dispersion in initial firm size every time the borrowing constraint is binding. Even at high productivity levels, collateral constraints can be binding as the optimal firm size is increasing in overall business productivity. Getting rid of these frictions implies that firms are started bigger and produce more output for the same productivity level, with clear efficiency gains.

To sum up, we find that most efficiency gains of eliminating financial frictions come from the intensive margin, meaning that high human capital entrepreneurs can operate at a bigger scale. On the extensive margin, the higher wage that results in general equilibrium acts as an additional selection mechanism on the type of businesses that are created since it pushes up the threshold level of human capital at which agents want to become entrepreneurs, improving entrepreneurial productivity.

Figure 14: Scatter productivity-size



(a) Baseline

(b) No financial frictions

Notes: Panel (a) displays a scatter plot between initial productivity (θh) and initial size- measured by employment- under the baseline economy. Panel (b) shows the same scatter plot for the economy with no financial frictions. Both plots show economies when general equilibrium effects are taken into account.

6.0.5 Comparison with a model with no human capital

To gain a better understanding of how financial constraints interact with human capital accumulation in affecting resource allocation and entrepreneurial TFP, we compare the predictions of our baseline economy to an alternative model in which entrepreneurs do not need human capital to run a firm.

Specifically, we assume that entrepreneurs only need good business ideas and wealth to run a business. Individuals still accumulate human capital, which determines labor income as a worker, but it has no value in entrepreneurship. In this alternative framework entrepreneurs are endowed with the following production function:

$$y = \theta_j \left(k_j^{\gamma} (n_j)^{1-\gamma}\right)^{v},\ v \in [0,1)$$

We rescale the process of θ such that we match the same share of entrepreneurs in the economy, but leave otherwise all parameters to the same values as in the baseline model. We then eliminate collateral constraints form the alternative model with no human capital and check what this implies for i) aggregate entrepreneurial activity in the economy, ii) aggregate entrepreneurial TFP and resource mis-allocation. We isolate the partial equilibrium response from the general equilibrium one. Table 8 compares the effects of eliminating financial frictions across the two models. We see that when financial constraints are eliminated, the share of entrepreneurs in the economy increases less compared to the baseline economy. The share of entrepreneurs rises from 7.4% to 12.1% in the alternative model, whereas it increases to 14.9% in the model with human capital. The higher responsiveness in the baseline model can be explained by the fact that while in a model with no human capital financial frictions only prevent individuals with good business ideas but little wealth from starting a business, in the baseline model there is an additional group of individuals- those with relatively high human capital, average business ideas and few assets- that are prevented from selecting into entrepreneurship.
Eliminating collateral constraints increases entrepreneurial TFP both in partial and general equilibrium in both models and the general equilibrium efficiency gains are also higher in both cases. Interestingly, however, the increase in entrepreneurial TFP when financial frictions are removed is much stronger in a model with human capital than without. The reason for this result is that the fraction of undercapitalized entrepreneurs- and their distance to the optimal size- is larger in the model with human capital than in the one without. This is a consequence of the fact that in the baseline economy entrepreneurs accumulate human capital while running their firm, which implies that- conditional on the same quality of the business idea- the target firm size increases as firms and entrepreneurs become older.[16] In a model with no human capital there is less scope for business growth, implying that there are also less intensive margin efficiency gains from eliminating borrowing constraints. Given that most efficiency gains in terms of higher entrepreneurial TFP in the baseline model come from the intensive margin - allowing productive entrepreneurs to run bigger firms- this explains why accounting for human capital used in entrepreneurship pre-

[16] The optimal firm size- and hence revenues and profits- can still decrease over time as θ is a stochastic process, whose realizations can improve or worsen.

dicts higher efficiency losses arising from financing constraints.

The correlation between productivity and size is lower in a model with no human capital than in the baseline model. In the baseline model individuals selecting into entrepreneurship have good business ideas and are positively selected in terms of human capital, implying they will have on average also more assets stemming from higher past labor income, with a consequent positive correlation between assets and human capital. When, instead, only ideas are needed to run a business, it is more likely that entrepreneurs have lower wealth as business ideas and assets are uncorrelated. In turn, this implies that misallocation of productive resources at business start is higher in a model with no human capital. Over time, however, the distance to the optimal size is reduced faster in a model with no human capital than in the baseline framework.

Table 8: Comparing the models

	Model with human capital			Model with no human capital		
	Baseline	PE response	GE response	Baseline	PE response	GE response
Share of entrepreneurs	7.4%	14.9%	4.0%	7.4%	12.1%	5.3%
Aggregate entrepreneurial TFP	.	+12.9%	+14.6%	.	+2.1%	+2.5%
Correlation productivity-size	0.84	0.99	0.99	0.78	0.99	0.99

Notes — The table compares statistics of the baseline economy and a model with no human capital when financial constraints are removed. The PE columns show the effects of removing collateral constraints in partial equilibrium. The GE columns take the general equilibrium response into account.

7 Policy Reform

In this section we use the calibrated model to evaluate the efficiency and welfare properties of a tax reform, which in policy settings is often advocated as a mean to incentivize entrepreneurship and business creation by young people. We consider a tax policy reform in which young entrepreneurs below the age of 30 are exempted from paying income taxes. We first ask if and by how how much the average tax rate τ_y has to increase to keep the budget balanced and how the reform affects efficiency. Second, we compare welfare of a newborn individual in the two different steady states using the consumption-equivalent variation (CEV) measure to trace out who wins and who looses from the policy reform.

7.1 Efficiency of the policy reform

The first question we ask is whether eliminating taxes for young business owners is a sustainable policy for the government or whether taxes have to be raised for other categories to maintain the budget balanced. There are two different forces at play when taxes are removed. On one side the government gives up the revenues it was collecting from young entrepreneurs, which negatively affects the government budget. On the other side, however, eliminating taxes increases the value of entrepreneurship in young ages as individuals can earn higher net profits than before. This entails that more individuals will find it optimal to start a business, although this effect is in part mitigated in general equilibrium as wages have to increase to clear the labor market. A third positive effect for the government budget is that by eliminating taxes for young entrepreneurs, individuals that create firms in young ages can generate more profits for the same amount of inputs and accumulate more wealth. This in turn means that individuals who started a business between the age of 20 and 30 will have more resources to pledge as collateral and will on average run bigger businesses even in older ages. Running bigger businesses also means that profits are higher and that tax revenues for the government increase compared to the status quo.

We find that under our calibration eliminating taxes for young entrepreneurs is a self-financing policy in which the government can eliminate taxes for young entrepreneurs below the age of 30 without having to increase taxes for others. This finding is explained by the fact that the second and especially the third effect described above dominate. Table 9 shows that the policy reform increases aggregate entrepreneurial TFP by 2.2%, mainly because eliminating taxes helps young entrepreneurs to relax the borrowing constraint and generate more output for the same productivity level, improving resource allocation on the intensive margin. In this sense, the policy reform helps to in part undo the negative role of financial frictions in the economy.

7.2 Welfare effects

We compute the welfare effects of the policy reform by comparing the life-time expected utility of a newborn under the two tax regimes. Newborns start with the same level of assets and human capital, but with a different quality of the business idea θ and a different learning ability ξ. To measure how much newborns would gain or loose from the policy reform we use the consumption-equivalent variation (CEV) welfare measure. This statistic measures how much consumption growth an individual in a given state would be willing

Table 9: Policy reform

	Baseline	Policy Reform
Share entrepreneurs		
	7.4%	10.0%
Aggregate TFP		
	.	$+2.2\%$
Equilibrium wage		
	.	$+24\%$

Notes — The table displays statistics of the baseline economy and the new economy under the policy reform.

to accept or give-up to make him indifferent between the status quo and the reform. The CEV is thus a function of the state-space and one can show that under CRRA utility it can be computed as:

$$\omega(a,\theta,h,\xi) = \left[\frac{V_0(a,\theta,h,\xi)}{V^*(a,\theta,h,\xi)}\right]^{\left(\frac{1}{1-\sigma}\right)} - 1 \tag{23}$$

where $V^*(a,\theta,h,\xi)$ is the value function under the baseline steady-state and $V_0(a,\theta,h,\xi)$ is the value function under the policy-reform.

By comparing the CEV of a newborn under the two alternative tax regimes we ask whether an individual with given θ and given learning ability ξ would prefer- in expectation- to be born in an economy with one or the other tax regime.

For a newborn the CEV is a function of (θ,ξ) only, given he is the same along the other dimensions. In Table 10 below we report the CEV of newborns with different combinations of θ and ξ.

We see that the CEV is positive for all combinations of θ and ξ, ranging from 9% to 27%. This means that newborns, under the veil of ignorance, would prefer to be borne under the new tax regime. In other words, a newborn would require between 9% to 27%- depending on initial conditions- consumption growth under the status-quo to be indifferent with the alternative tax policy. Interestingly, the CEV is very different depending on the initial quality of the business idea θ and on the learning ability ξ. Individuals with low quality of the business idea know that their likelihood of becoming entrepreneurs in young ages and benefit from the tax exemption is lower compared to individuals with good business ideas. This implies that in expectation they gain less from the reform. However, one has to keep

Table 10: Welfare effects for newborn individuals

Business quality (θ)	Learning ability (ξ)				
	1	2	3	4	5
1	9.8%	9.7%	9.6%	9.4%	9.7%
2	9.8%	9.7%	9.5%	9.4%	9.7%
3	9.9%	9.9%	9.9%	10.5%	12.4%
4	22.8%	23.3%	23.7%	24.6%	27.6%

Notes — This table reports the CEV of a newborn individual for different combinations of θ and ξ. Both θ and ξ are reported in terms of indexes. Higher values of the index imply higher values of θ and ξ.

in mind that under the new policy regime also workers benefit as they receive higher wages as a consequence of the general equilibrium effects. Hence, also newborn individuals who have an ex-ante very low probability of opening a business, would still be better off under the new tax policy than the status-quo. The newborns that gain the most from the reform are individuals with great business ideas and high learning abilities. Clearly these individuals will open a business early in life and benefit from the exemption of paying taxes for longer time-periods. For newborns with good business ideas, initial differences in learning abilities matter more than for newborns with low θ. As an example, for an individual with the highest θ, the difference in CEV between having the highest and lowest learning ability is around 5 percentage points, which corresponds to almost half of the CEV of a low θ, low ξ individual. The learning ability generates differences in CEV as it impacts the timing of when individuals open a business. For the same θ, high learning ability agents open a firm earlier in life and can benefit from the policy reform for more years and generate more profits.

We compute the aggregate welfare change by aggregating $\omega(\theta,\xi)$ using the initial distribution of newborns- $\lambda(\theta,\xi)$- over θ and ξ. Assuming that we weigh welfare of every individual in the same way we can express the aggregate welfare change Ω as:

$$\Omega = \int \omega(\theta,\xi) d\lambda(\theta,\xi) \tag{24}$$

Under an utilitarian social welfare function as above, the aggregate welfare change expressed in consumption equivalent variation is 13.2%, which is a weighted average of the CEV displayed in Table 10.

As a final note, we want to point out that our welfare analysis is based on comparing expected utilities of newborns under two steady states. A full welfare analysis, examining whether generations currently alive would be in favor or against the reform, would require taking into account the transition towards the new equilibrium after the introduction of the tax reform. The third effect described above and induced by the reform, namely that firms would be bigger and generate more profits for the same productivity level, would not happen immediately but would take time as wealth accumulation is a slow process. This in turn might imply that in some periods along the transition the government would run a negative deficit. Still, if the government had access to debt it could run a balanced budget period by period and repay the debt back in the new steady state. If, however, access to debt is not possible, then the government would have to raise taxes for some categories in the first years along the transition, with potentially ambiguous welfare effects.

8 Conclusions

In this paper we use Danish administrative data to provide new evidence on the fact that entrepreneurs are positively selected in terms of different measures of human capital. To study how the accumulation process of human capital and financial constraints interact in driving entrepreneurial decisions at different stages of individuals' life-cycle, we propose a general equilibrium life-cycle model with human capital accumulation, occupational choices and financial frictions. A key property of the model is that good business ideas are critical in making individuals select into entrepreneurship at young ages, while skills are more important as individuals get older. Removing financial frictions, which are a source of inefficiency in our model, decreases the share of entrepreneurs in the economy, but increases their average productivity. This result is a consequence of better resource allocation on the intensive margin and on a higher threshold level of human capital required to become an entrepreneur on the extensive margin. We evaluate the efficiency and welfare effects of a reform that eliminates income taxes for young entrepreneurs, which in policy settings is often advocated a mean to incentivize business creation. We find that exempting young entrepreneurs up to the age of 30 to pay income taxes is a self-financing and efficient policy under our calibration. The major efficiency gains come from the fact that lower income taxes help to partly undo the negative effects of financial frictions and allow a better use of productive resources.

Our paper makes two main contributions. On the empirical side, we highlight the importance of studying the process of entrepreneurial human capital accumulation for the understanding of the determinants of business formation, which in prior work has been largely unexplored and neglected. On the theory side, we make the point that accounting for human capital accumulation in quantitative models of entrepreneurship changes our conclusions on how financial frictions distort entrepreneurial choices and how these then translate into macroeconomic outcomes. We see different fruitful avenues for future research. On one side we need to deepen our understanding of which skills entrepreneurial human capital is composed of, how individuals accumulate it and how the skill set of workers differs from the one of entrepreneurs. A second interesting line of research is to further explore the role of human capital versus wealth as a source of insurance against negative business outcomes and how these two interact over the business cycle in explaining business creation during economic downturns.

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