How to Become a Self-Made Billionaire

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Abstract

We develop a heterogeneous-agent model with entrepreneurship in which individuals, supported by VC funding, pursue loss-making projects that have the potential to become highly profitable public firms. Individuals climb to the top of the wealth distribution by creating firms that promise high future profits, consistent with the observed careers of modern self-made billionaires. In contrast, the existing literature explains top fortunes as the result of accumulated past profits. We use this framework to study wealth and unrealized capital gains taxes taking into account entrepreneurs' incentives to initiate projects with high failure risk and the implications for the formation of the corporate sector.

JEL code: D31, G32, H24.

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1 Introduction

The concentration of wealth at the top of distribution has increased substantially over the recent decades (Saez and Zucman, 2016). An interesting feature of this pattern is that many individuals who made to the top did not inherit their wealth but accumulated it themselves starting from the bottom, so called self-made billionaires Guvenen, Kambourov, Kuruscu, Ocampo, and Chen (2023); Atkeson and Irie (2022); Gomez (2023). Understanding the mechanisms behind this wealth accumulation process has important implications for taxation and economic efficiency because many of those self-made billionaires stand behind today's superstar firms. Recent advances in the literature based on heterogeneous agent models with entrepreneurship (Quadrini, 2000; Cagetti and De Nardi, 2006) can generate this pattern of rapid wealth accumulation (see, for example, Guvenen et al. 2023). The underlying mechanism in those models is that some individuals are born with very high productive business ideas, they operate their firms and reinvest the profits to relax the financial constrains and expand their firms further. In other words, the wealth of self-made billionaires is the result of the accumulated profits generated by their firms in the past. A glance at the careers of many self-made billionaires reveals a different pattern of wealth accumulation which motivates us to propose a novel modeling a approach.

Jeffrey P Bezos, the founder of *Amazon*, which became the largest US company by revenue in 2025, first entered the *Forbes 400* list in 1998 at the age of 34 but his company had a negative net income that year and the preceding years as well. *Amazon* continued reporting negative net income up until 2003 (see figure A1). It's net assets were only 138 mln in 1998. A similar story can be told for many other residents of the *Forbes 400* list.[1] Clearly those individuals did not become billionaires by accumulating the profits of their firms. The path to the fortunes of those individuals can be easily explained with the basic tools used in firm valuation analysis. The value of the firm is the present discounted value of its expected profits and the net worth of the individual is that value multiplied by the fraction of the shares that he/she owns in the firm. In this paper we incorporate this simple intuition into a heterogeneous agent model with entrepreneurship and study its implications for policy analysis.

Our point of departure is Guvenen et al. (2023). In that paper the authors develop an overlapping generations model with detailed income dynamics, retirement and bequests. These features seem to be particularly attractive given our interest in self-made fortunes. We closely follow the authors in terms of demographics and labor income process but

[1] It is worthwhile to mention that not all newly-listed firms were loss-making. However, among those with positive profits those profits were too small and their founders too young to enter the *Forbes 400* by saving the dividends of their firms, especially when we take into account that they were not the sole claimants of those dividends.

we make important changes in terms of entrepreneurship, firm dynamics and financing options. In our framework business ideas arrive probabilistically and individuals endogenously decide whether to enter into entrepreneurship or not. There are two types of entrepreneurs in the model. The fist type, which we refer as independent entrepreneurs are businesses run by their owners and financed by loans using owner's assets as a collateral. TFPs of those businesses are fixed at moderate levels and they do not become large. The second type of entrepreneurs are endowed with high growth ideas. They start with a low level of TFP but it increases with some transition matrix. Such firms also need to pay a fixed cost every period. These assumptions mimic the growth environment of modern startups. Most such ventures start with a novel idea which requires R&D expenditures or accumulation of customer base, similar to *Amazon*. This implies that in the early stages such firm are loosing money. Over time the technology improves or the customer base grows and the firm starts generating positive profits. In our model after generating an idea entrepreneurs meet with the Venture Capital (VC) fund which agrees to fund those projects in exchange for a stake in the firm. There is a probability of failure in which case the VC looses money on a given project and the entrepreneurs forgo their wage which they could have earned as workers. In the case of a successful outcome firms get listed on the stock market and both the VC and entrepreneurs exit and split the net of tax value of the IPO according to their ownership shares.

This environment allows us to have individuals, who are born with little assets, to climb to the top of the wealth distribution in a short period of time. At the same time those individuals do not build their wealth by accumulating the profits of their firms. Instead, they sell claims to the future profits of their firms to others.

We use this model to study the implications of different policies. A novel feature of our environment is that the corporate sector is formed endogenously by firms initially created by individuals. In the current literature there are either models where all output is produced by entrepreneurs (Guvenen et al., 2023) or models where there is a corporate sector with entry costs but entrants are risk neutral and do not face financial frictions (Boar and Midrigan, 2023). This means that the tax policy affects the corporate sector through prices. In contrast, we take into account individuals' incentives to pursue projects that will form the corporate sector of tomorrow. Unlike those papers and the rest of heterogeneous agent literature, we consider the role of VCs. This is important because according to the dataset collected by Loughran and Ritter (2004), 46% of firms that were founded after 1990 and later went public were VC backed and this share has increased over time. The presence of the VC funding eliminates misallocation stemming from suboptimal hiring of capital in production. However, there is still substantial misallocation in the model because of the risky nature of the business many individuals prefer to enjoy moderate but less risky

labor income as described by Hall and Woodward (2010). Another interesting feature that our model generates is related to wealth destruction. Figure A2 shows the histogram of wealth changes between two consecutive periods of individuals in *Forbes 400* list. As can be seen, frequently they experience large wealth losses. In existing models with heterogeneous agents the worst outcome an entrepreneur can face is that the profit of the firm drops to zero but the entrepreneur still keeps the assets, so gross returns can never be below one. This suggests that those models may underestimate the level of risk undertaken by entrepreneurs.

In our first experiment we replace capital income taxes with a flat wealth tax. As a result of this reform independent entrepreneurs do not pay taxes on the profits of their firms which allows them to accumulate more assets and relax the collateral constraint. This is the main channel in Guvenen et al. (2023). The novel insight in this paper is the effect of the reform on the corporate sector. The reform has no direct effect on the corporate sector because in the experiment we keep the corporate profit tax and the capital gains tax the same, so the response depends on indirect channels. Because of the expansion of the independent entrepreneurial sector wages increase which negatively affects the corporate sector but because entrepreneurs earn more and save more that decreases interest rates. The former effect dominates and the size of a single listed firm decreases. Despite the fact that the firm's size and its IPO value decrease the fraction of population pursuing high risk projects increases, which leads to more IPOs and the overall output produced by the corporate sector increases compared with the economy with capital income taxation. The mechanism behind this result is that individuals accumulate more assets as independent entrepreneurs. These accumulated assets increase the insurance buffer and incentivize individuals to pursue risky projects. It is important to stress that in our model in order to pursue large projects individuals do not need to cover losses made by their startups – those costs are covered by the VC – instead individuals use their accumulated assets to maintain high level of consumption while the project is in the development stage.

In our second exercise we broaden the definition of wealth and assume that it includes the valuations of firms that are still at VC funding stage. In this case the entry into risky entrepreneurship drops sharply generating large aggregate output losses. The key reason is that individuals who own such firms appear to have large wealth but they do not have high income or liquid assets to meet their tax liabilities. In order to keep our quantitative model tractable we assume that firms make losses only at VC funding stage but in practice many firms continue to make losses or generate very little profits even after IPO, similar to the example of Amazon. If the founders need to hold stakes in those listed firms (for reasons we discuss in section 5) wealth taxes still can generate large output losses.

Related literature. In addition to the studies already mentioned there is a large literature that uses quantitative models a la Huggett (1993) and Aiyagari (1994) to study the process of wealth accumulation and its distribution. A non exhaustive list includes Castañeda, Díaz-Giménez, and Ríos-Rull (2003); Conesa, Kitao, and Krueger (2009); Benhabib, Bisin, and Zhu (2011); Kaymak and Poschke (2016); Brüggemann (2021); Hubmer, Krusell, and Smith. (2021); Bhandari and McGrattan (2020); Robinson (2025); Gaillard, Hellwig, Wangner, and Werquin (2024); Hubmer, Halvorsen, Salgado, and Ozkan (2025); Chari, Kehoe, Lopez, Pastorino, and Salgado (2025). Within this literature several studies have considered business sales between agents (Gaillard and Kankanamge, 2020; Mahone, 2023; Guntin and Kochen, 2026). Among these papers only the latter makes an accent on financial frictions as a factor driving sales. Because those papers are interested in a different questions they do not make a particular emphasize on the top of wealth distribution or wealth accumulation dynamics when calibrating the model. Nor they discuss wealth taxes.

Midrigan and Xu (2014) and more recently Peter (2025) allow entrepreneurs to issue equity. In Peter (2025) there is no endogenous entry or choice of technology. In Midrigan and Xu (2014) there are two types of production technologies and the advanced technology requires a fixed cost. There are several important differences however. In our model the advanced technology is more risky and its gains are not materialized immediately upon the adoption.[2] Despite the fact the VC fully covers fixed costs and ensures that the firm can rent the optimal amount of capital each period, entry decisions in our model are substantially distorted because of risk aversion, as in Hall and Woodward (2010). Quantifying the role of this channel in a general equilibrium model with endogenous entry decisions is important as the kind of business creation and financing channel we model became more important in the US economy.[3] Another difference is that in those papers the founders of firms sell a fraction of the firm at market value and buy capital or safe asset but when the authors calculate the wealth of those individuals they ignore the part of the wealth that comes from the fact that the individual has claims on the future profits of the firm through the remaining fraction of equity. By taking into account this fraction of wealth we close the gap between the concept of wealth in the model and the data in

[2] In Robinson (2025) entrepreneurs also make a tradeoff between production technologies with different levels of risk in an economy with only collateral financing.

[3] From the theoretical point of view VC financing is similar or identical to stock market financing. However, VC stage firms are too risky and may require monitoring and more direct engagement from the side of investors. In our model we make a distinction between these two stages and calibrate the model accordingly so that the risk profile of the firm declines over time. Additionally, stock market listing may be associated with higher reporting costs and standards. The latter factor may discourage young firms to go public and reveal information about their nascent technology (Davydova, Fahlenbrach, Sanz, and Stulz, 2022).

particular the figures used by *Forbes*. Finally, we study the role of wealth and unrealized capital gains taxes.

2 Model

We follow Guvenen et al. (2023) in terms of demographics and labor income but make some important changes in terms of entrepreneurship and firm dynamics.

2.1 Environment

Demographics The economy is populated by a large number of individuals who are born as workers. At each age h the individual has a survival probability $q(h)$. In case of death the individual leaves a bequests and derives utility from the bequested assets. Once the individual crosses the age threshold R he/she becomes a pensioner. After death the individual is replaced with a newly born individual who starts his/her life with net of tax inherited assets. Every period with probability η each worker generates a business idea and can choose to become an entrepreneur if that option offers a higher continuation value.

Preferences The lifetime utility of the individual is given by

$$\mathbb{E}_0 \left(\sum_{h}^{H} \beta^{h-1} [q(h)u(c_h) + (1 - q(h))\nu(a)] \right), \tag{1}$$

where β is the discount factor, c is consumption and a is amount of assets hold at the moment of death. Current consumption is evaluated with utility function $u(c)$ and the bequest is evaluated with $\nu(a)$. The individual can live at most H years which is a known number but at each age there is a probability of death.

Labor market productivity. The individual's productivity w_{ih} depends on three components and is given by

$$log(w_{ih}) = \kappa_i + g(h) + e_{ih}, \tag{2}$$

where κ_i is the permanent type of the individual, which does not change over the lifetime, $g(h)$ is the life-cycle component, which depends on age and e_{ih} is the transitory shock. The transitory shock itself follows an AR(1) process:

$$e_{ih} = \rho e_{i,h-1} + \epsilon_{e_{ih}}, \tag{3}$$

with $\epsilon_{e_{ih}} \sim \mathcal{N}(0, \sigma_e^2)$. There is also intergenerational persistence in terms of permanent type which evolves according to

$$\kappa_i^{child} = \rho_\kappa \kappa_i^{parent} + \epsilon_{\kappa_i}, \tag{4}$$

where $\epsilon_{\kappa_i} \sim \mathcal{N}(0, \sigma_\kappa^2)$.

We assume that each individual is endowed with one unit of labor and supplies it inelastically. The aggregate labor supply is given by

$$L = \sum_{i \in W} w_{i,h(i)}, \tag{5}$$

where we expanded the subscript to clarify that $h(i)$ refers to the age of individual i in the current year. Using $\overline{w}$ to denote the wage per efficiency unit. The labor income of individual i is $y_{ih} = \overline{w} w_{ih}$.

Firms. There are two types of firms in the economy both operating similar decreasing returns to scale technologies $z(k^\alpha l^{1-\alpha})^\mu$, where z is the level of productivity, k and l denote capital and labor inputs, α the share of labor and μ the returns to scale parameter. All parameters are common across both types of firms but the evolutions of productivity levels differ. We refer to the first group as corporations and the second group independent entrepreneurs. In addition, to productivity levels these two groups differ in several dimensions. First, the corporate firm pays a per period fixed cost f scaled by wage. Second, the corporate firm pays a corporate profit tax τ_c. Third, the corporate firm can borrow freely and chooses its inputs optimally, while the independent entrepreneur faces a collateral constraint and can borrow up to a multiple $\lambda > 1$ of the assets of the individual who owns it. Depending on the level of z the corporate firm can be either in the stage of VC financing, in which case it is jointly owned by the entrepreneur and the VC fund, or be listed on the stock market in which case it is owned by a competitive and diversified investment fund. We use z^{VC} to denote the productivity of the firm in the VC stage and $\overline{z}$ for listed firms. Profits of the corporate firm are given by

$$\pi(z) = (1 - \tau_c)[z(k^\alpha l^{1-\alpha})^\mu - (r + \delta)k - \overline{w}(l + f)], \tag{6}$$

where r is the rental rate of capital, δ is the depreciation rate. The corporate firm may have negative profits if it is on the development stage, in which case the firm does not pay a profit tax.

The profit function of the independent entrepreneur is similar but it does not pay a profit tax and the fixed cost, also it has a different level of productivity denoted by z^{EI}.

We use $\pi(z^{EI})$ to denote the profit function of the independent entrepreneur. Fixed cost in our context captures R&D expenditures which are an important component both for high-growth startups and for large corporations but not for small firms without big ambitions and potential. In principle we can introduce fixed costs for the independent entrepreneur as well as long as the firm remains profitable.

Venture Capital. When a business idea arrives, with probability η, the individual decides whether to pursue the project or not. If he/she decides to do so the nature reveals whether the idea has a great potential, with probability p^{VC}, or is of medium quality, with probability 1-p^{VC}. The VC is interested in funding only ideas with great potential and it does so in exchange for a stake in the firm. A firm with a VC funding has a corporate form and with its per period profits given by equation 6 with productivity z^{VC}. We assume that the VC obtains a $1-s$ fraction of the shares of the firm and the remaining shares continue to be owned by the entrepreneur. The VC commits to inject money into the firm if profits are negative and pay a per period salary of $\underline{w}$ to the entrepreneur. This wage is weakly lower than the wage the entrepreneur can earn as a worker. In practice such policies serve as a screening device and allow VCs to filter out entrepreneurs with good ideas who are committed to their projects and are wiling to exert maximal effort (Hall and Woodward, 2010). In our model there is no unobservable endogenous effort choice and there are no entrepreneurs with bad ideas that need to be screened out by the VC. Our assumption on $\underline{w}$ results from those frictions but we do not model them directly. Similarly, consistent with real-world practices, the entrepreneur does not directly receive funds from the VC (other than the modest wage). This is different from equity financing or firm sales models mentioned in the literature review section. By not awarding money directly to the entrepreneur or equivalently not allowing partial equity sales the market selects only good projects. If the entrepreneur receives a monetary transfer for the value of the project he/she will endogenously choose to quit the project end become a worker. Our model generates such a behavior for individuals with relatively low levels of wealth even without introducing bad ideas and information asymmetries.[4]

Firms backed by the VC can hire the optimal amount of capital and labor and are not subject to a borrowing constraint. The firm with a great potential project starts with an initial productivity of z^{VC} and every period there is probability that the productivity jumps to $\bar{z}$. We model only two states but we can also consider a case where the productivity increases gradually. While the firm is in the development stage it faces an exit probability every period denoted by ρ^{VC}. The possibility of exit and the fact that the firm initially has

[4]This counterfactual is conducted in a partial equilibrium setting under the assumption that the firm's success chances remain the same after the entrepreneur quits the project.

negative profits means that the VC may not recover its expenses on a given project but in expectation it breaks even.

Once the VC backed firm reaches the $\bar{z}$ level its productivity stays at that level permanently. At this stage there is no longer asymmetric information and the entrepreneur sells his/her stake in the firm to public markets. After being listed the firm continues to face an exit probability denoted by ρ^C which is lower compared with the exit probability while the firm was in the development stage. The listed corporation also does not face financial constraints and chooses its inputs optimally. One can also introduce a stochastic component in the evolution of the productivity of listed firms but that will not change implications of the model. Under these assumptions the IPO value of the firm is

$$V^F(\bar{z}) = \frac{\pi(\bar{z})(1+r)}{r+\rho^C}. \tag{7}$$

The VC obtains $(1-\tau_g)(1-s)$ of the IPO value, where τ_g denotes the capital gains tax. We assume that the VC sector is competitive and s is determined in such a way that the revenues made from the IPO exactly offset negative profits and entrepreneurial wage the VC has to cover during the growth stage of successful and failed firms.

As a result of the IPO the firm is acquired by a representative investment fund. The fund borrows from households at rate r and acquires newly listed firms. It receives the net of tax profits of firms and uses these proceeds to repay the interest on its debt. So, households do not have a direct ownership in the listed firms.

Government The government in the model collects taxes on sales/consumption τ_s, on labor income τ_l, on capital income τ_i, on capital gains τ_g, on bequests τ_b and on corporate profits τ_c. As already highlighted, independent entrepreneurs do not pay a corporate tax but their profits are subject to capital income tax. Corporate firms, in contrast, are subject to double taxation. They first pay the corporate profit tax and after that households also need to pay capital income tax. Since we model indirect ownership through borrowing, the capital income tax in our model also plays the role of the dividend tax.

The government uses the tax revenue to fund the Social Security pensions and some other expenditures, which do not enter into the utility function. After retirement each individual receives a pension given by

$$y^R(\kappa, e_{R-1}) = \Phi(\kappa, e_{R-1})\overline{y}, \tag{8}$$

where $\overline{y}$ is the average labor income and $\Phi(\kappa, e_{R-1})$ is the pension replacement rate function, which depends on the worker's permanent type κ and the transitory component of

labor productivity in the last year of working age (age $R-1$). This function is adopted from Guvenen et al. (2023).

2.2 Decision problems

We describe the problem of the worker only. The problem of the pensioner is similar with the differences that labor income is replaced with pension income (described in equation 8) and the probability of the arrival of a new business idea drops to zero but the pensioner still can run the business started when he/she was young. We use $b = (1-\tau_b)a'$ to denote the net of tax bequest.

Workers An individual who is a worker and does not get a chance to choose to become an entrepreneur solves the following problem:

$$V^W(a,w,h) = \max_{a'\geq 0} u(c) + \beta[q(h')[\eta \mathbb{E}V^{WO}(a',w',h') + (1-\eta)\mathbb{E}V^W(a',w',h')] \\ +(1-q(h'))\nu(b)] \tag{9}$$

subject to

$$(1+\tau_s)c + a' \leq (1-\tau_l)\overline{w}w + (1+r(1-\tau_i))a, \tag{10}$$

where $V^{WO} = \max\{V^E, V^W\}$ is the value of choosing between being an entrepreneur and a worker, τ_s is the sales or consumption tax, τ_i is the capital income tax and τ_l is the labor income tax. Following the literature we assume that borrowing is not allowed.

Entrepreneurs The value of an individual who chooses to become an entrepreneur after the arrival of the business idea depends on the type of the project. We use V^{EVC} and V^{EI} to denote the value functions of the entrepreneur with VC funding and without, respectively. The type is determined with an exogenous probability p^{VC}. It follows that V^{EI} is given by

$$V^E(a,h) = p^{VC}V^{EVC}(a,z^{VC},h) + (1-p^{VC})V^{EI}(a,z^{EI},h) \tag{11}$$

The independent entrepreneur does not have a growth potential and its productivity level is fixed at z^{EI}. The entrepreneur uses his/her assets as a collateral and borrows up to $\lambda > 1$ multiple to rent capital for production. The problem of this type of entrepreneur

is given by

$$V^{EI}(a, z^{EI}, h) = \max_{a' \geq 0} u(c) + \beta[q(h')[\rho^{EI}\mathbb{E}V^{W}(a, w', h') + (1-\rho^{EI})\mathbb{E}V^{EIO}(a', z^{EI}, h')] \\ +(1-q(h'))\nu(b)] \tag{12}$$

subject to

$$(1+\tau_s)c + a' \leq (1-\tau_i)\pi(z^{EI}, k) + (1+r(1-\tau_i))a, \tag{13}$$

$$k \leq \lambda a, \tag{14}$$

where $V^{EIO} = \max\{V^{EI}, V^{W}\}$ is the value of choosing between being an independent entrepreneur and a worker. Every period the independent entrepreneur faces an exogenous exit probability ρ. As we noted earlier the independent entrepreneur does not pay a corporate profit tax but the profits of the firm are taxed as a capital income. Following Guvenen et al. (2023) we apply the same tax rate as to the income generated from the riskless asset.

The problem of the entrepreneur with VC funding is given by

$$V^{EVC}(a, z, h) = \max_{a' \geq 0} u(c) + \beta[q(h')[\rho^{C}\mathbb{E}V^{W}(a, w', h') + (1-\rho^{C})\mathbb{E}V^{EVCO}(a', z', h')] \\ +(1-q(h'))\nu(b)] \tag{15}$$

subject to

$$(1+\tau_s)c + a' \leq (1-\tau_l)\overline{w}\underline{w} + (1+r(1-\tau_i))a, \tag{16}$$

where $V^{EVCO} = \max\{V^{EVC}, V^{W}\}$ is the value of choosing between being an entrepreneur with VC financing and a worker. We make two remarks. First, the entrepreneur with VC funding can receive dividends in which case we need to add $(1-\tau_i)s\pi(z^{VC})$ term to the right hand side of the budget constraint but under our calibration such firms will not make profits, so we do not include it. Second, we allow the entrepreneur to choose whether he/she wants to pursue the project or become a worker.

Once the firm reaches the $\bar{z}$ stage, then at the beginning of the period (before receiving profits) the firm is listed, the entrepreneur receives $(1-\tau_g)sV^{F}(\bar{z})$, where τ_g is the capital gains tax. The VC fund receives the remaining fraction $1-s$. The value function of the entrepreneur in the IPO period is given by

$$V^{EVC}(a, \bar{z}, h) = \max_{a' \geq 0} u(c) + \beta[q(h')\mathbb{E}V^{W}(a', w', h') + (1-q(h'))\nu(b)] \tag{17}$$

subject to

$$(1+\tau_s)c + a' \leq (1-\tau_g)sV^F(\bar{z}) + (1+r(1-\tau_i))a. \tag{18}$$

2.3 Discussion

Although in our model there is a VC which covers the fixed costs of running a business and helps firms to rent optimal amount of capital which seems to eliminate all financial frictions faced by the firm, there is still a powerful force that discourages individuals to enter into risky entrepreneurship. The reason is that during the development stage the entrepreneur earns lower income than what he/she can earn as a worker. Despite the fact that in expectation rewards from running a project are much higher entrepreneurs with low levels of assets are not willing to sacrifice their current consumption for a sequence of periods in exchange for a very large rewards that arrive with a small probability. The strength of this force depends on the initial level of wealth of the individual making an entry decision. As the wealth increases the entrepreneur starts caring less about the difference between entrepreneurial and his/her wage as a worker and more about the the future reward.

3 Parametrization

We calibrate the model to the US data. Since we build on Guvenen et al. (2023) we borrow many parameters from their study particularly in terms of demographics and the evolution of labor income.

Demographics. Because in the model there is no childhood individuals are born at age 20. The retirement age is set to 64 (45 in the model). Individuals live at most 100 years (81 periods in the model). Survival probabilities ($q(h)$) are age-specific and are taken from the replication files provided by Guvenen et al. (2023).

Preferences and technology. We assume a standard CRRA utility function with a coefficient of $\sigma = 2$, which is a common value in the literature.

$$u(c) = \frac{c^{1-\sigma}}{1-\sigma}.$$

We set the discount factor to $\beta = 0.99$ which allows us to obtain a capital-to-output ratio of 3.04. In our model there are also age-dependent survival probabilities and this fact should be taken into account when comparing our choice of β with models populated by

infinitely lived agents. In the production function we set $\alpha = 0.33$ and the depreciation rate $\delta = 0.06$, both of which are commonly used in the literature. We set $\mu = 0.8$ which implies a profit rate of 20%. This value is in the middle of the range of markups reported by Edmond, Midrigan, and Xu (2023).

The bequest function is given by

$$\nu(b) = \chi \frac{(b + b_0)^{1-\sigma}}{1-\sigma},$$

where χ is the relative weight of bequest compared with utility and b_0 measures the degree to which bequests are luxury goods. The former parameter is chosen to target bequest/wealth ratio and the latter to target the 90th percentile of bequest distribution. Data moments are taken from De Nardi and Yang (2016).

Tax system. For those taxes that are present both in our model and in Guvenen et al. (2023) we use the values reported in their study. The sales tax is $\tau_s = 0.075$. The capital income tax and business income tax for the independent entrepreneur is $\tau_i = 0.25$. In our context this tax indirectly also captures the dividend tax. The labor income tax is $\tau_l = 0.224$. The bequest tax is $\tau_b = 0.4$. In addition to those taxes we have two more types of taxes. First, we have a corporate profits tax which is $\tau_c = 0.21$. Second, we also have a capital gains tax, which we set to $\tau_g = 0.15$.

Labor market productivity. The deterministic life-cycle part of the labor income $g(h)$ is a quadratic polynomial peaking at age 51. The parameters of the function are taken from Guvenen et al. (2023). The transitory component has an autocorrelation coefficient of $\rho_e = 0.9$ and a standard deviation of $\sigma_e = 0.2$. The process governing the transmission of the individual type across generations has an autocorrelation $\rho_\kappa = 0.5$ and a standard deviation of $\sigma_\kappa = 0.309$. As in Guvenen et al. (2023), in the numerical implementation grids for both the transitory and permanent types have five points. Finally, to map model wealth levels to their data counterparts, we scale the model's unit of wealth to a GDP per capita of \$101,000, which is approximately total U.S. GDP divided by the population aged 16 and over.

Independent entrepreneurs. Since in Guvenen et al. (2023) and Boar and Midrigan (2023) entry into entrepreneurship is not endogenous and they do not target entry and exit rates. We turn to Brüggemann (2021) for those moments. In that study the share of exiting entrepreneurs is 22%, the share of entering entrepreneurs is 2.3% and the share of entrepreneurs relative to working-age population is 7%. In our model in addition to

exogenous entry opportunities and exit shocks there is also endogenous entry and exit, thus there is no direct mapping between those data moments and parameters. We jointly calibrate our entry, exit and productivity parameters to meet the targets mentioned above and some additional ones.

Entrepreneurial ideas arrive at rate $\eta = 0.35$, this parameter affects the entry rate but entry in the model is endogenous, so not all opportunities are taken. Among those who decide to become entrepreneurs, a fraction $p^{VC} = 0.04$ have an idea that VC finds worth funding. For the independent entrepreneur we have only two states: high and low, which are equally likely. The productivity of the independent entrepreneur in the low state is $z^{IL} = 2.88$ and in the high state $z^{IH} = 4.0$. By choosing these parameter our key objective is to match the 37% share of total sales generated by entrepreneurial firms and 63% generated by corporate firms, which we take from Boar and Midrigan (2023). We split independent entrepreneurs into two groups because following the literature we also want to match the share of wealth owned by entrepreneurs in top 1%. There are too few individuals who become wealthy through the IPO channel to match that target. The type of the entrepreneur does not change over time, however they face an exit shock ρ described above. In our calibration the exit shock for high type independent entrepreneur is lower than for the low type. As we mentioned above, high types enter into the top 1% of wealth distribution, so this calibration allows them to accumulate more capital to reach that target. It is also reasonable to assume that larger businesses have higher survival rates. Thus, high type entrepreneurs have the same exit shock as corporate firms, which we take from the data $\rho^{IH} = 0.05$ (see the next paragraph). The exit rate for the low type is calibrated internally and set $\rho^{IL} = 0.08$.

VC backed entrepreneurs. We set the productivity of firms with VC funding before IPO at the same level as for low type independent entrepreneur. Since firms with VC funding do not generate profits, we set the fixed cost $f = 0.36$ so that those firms are losing money. The productivity of a listed corporate firm is set to $\bar{z} = 14$. This parameter determines firm's profits and thus its value. We choose it in such a way so that at the moment of IPO the entrepreneur who starts his/her life with 0 assets crosses the $ 2 billion threshold and can be classified as a self-made billionaire. Note that the entrepreneur does not own the entire firm and also needs to pay a capital gains tax, so the firm value needs to be above $ 2 billion. The average exit rate in Compustat between 1990 and 2020 is 6.7%. We set $\rho^{C} = 0.05$ because firms may drop from Compustat as a result of M&A or go private, while in our case exit means bankruptcy. The exit rate for firms in the VC stage is much higher as in reality. We calibrate that parameter internally ($\rho^{VC} = 0.35$).

Azevedo, Scheuer, Smetters, and Yang (2025) report that the average VC backed firm that exits through IPO is 7 years old at exit. To match this moment we set the transition probability from z^{VC} to $\bar{z}$ $p(\bar{z}, z) = 0.05$. Note that with this transition probability on average it takes 20 years to transition from z to $\bar{z}$ but because in our model there is also a high exit rate the realized IPO rate is much lower than 20 years.

Entrepreneurial wage. In our model entrepreneurs whose projects are backed by the VC receive a wage. As we discussed in Section 2 by setting a low wage VCs can filter candidates and select only those who are genuinely committed to pursuing their ideas and are willing to forgo the wage that they can earn as workers. In the calibrated model the entrepreneur with VC backing earns the lowest level of wage that he/she can earn as a worker given the permanent type and age. In other words, we set the transitory component of the wage (e_{ih}) to its lowest level in a five point grid.

Another choice we need to make relates to the wage when entrepreneurs exit and become workers. We assume that such individuals start at the lowest wage ladder of their type. We adopt this approach to make sure that individuals do not use entrepreneurship as a lottery to improve their future wage. For example, if we assume that the wage of an individual transitioning from entrepreneurship to worker is driven from the invariant distribution, then workers at low levels of labor income will have incentives to enter into entrepreneurship and exit, which in expectation will allow them to improve their labor income. As a result entry and exit into entrepreneurship will artificially increase.

Financial sector. The borrowing constraint of the independent entrepreneur is set to $\lambda = 1.57$ to match the average debt-to-capital ratio of 0.35, which we take from Boar and Midrigan (2023).

In Panel A of Table 1 we summarize the parameter values calibrated outside the model and in Panel B parameters calibrated internally. In Table 1 we displays the performance of the model along the targeted and some untargeted moments and data equivalents. We obtain wealth-to-GDP ratio from the FRED Data for the period 1990-2020.

4 Wealth tax

We start by considering a specification where the capital income tax τ_i is replaced with a linear wealth tax which we denote by τ_w. The capital income tax is paid by all individuals on their asset holdings. Additionally, independent entrepreneurs pay it on their business income. We rewrite the budget constraint of independent entrepreneurs (equation 13) for the specification with wealth taxes to demonstrate the difference between both

Table 1: Parameters

Panel A: Parameters calibrated outside of the model		
Annual persistence for indiv. labor efficiency	ρ_e	0.9
Std. dev. of innovations to indiv. labor efficiency	σ_e	0.2
Interg. correlation of labor fixed effect	ρ_κ	0.5
Std. dev. of innovations to indiv. interg. fixed effect	σ_κ	0.309
Curvature of utility function	σ	2
Maximum (model) age	H	81
Retirement (model) age	R	45
Decreasing returns to scale %	μ	0.8
Capital share vs labor	α	0.33
Depreciation rate	δ	0.06
Exit shock to VC entrepreneurs	ρ^{VC}	0.35
Exit shock to listed firms	ρ^{C}	0.05
Exit shock to high independent entrepreneurs	ρ^{IH}	0.05
Panel B: Parameters calibrated (jointly) inside the model		
Discount factor	β	0.99
Strength of bequest motive	χ	2
Utility shifter for bequest ($)	b_0	1
Productivity of independent entrepreneur	z^{IL}, z^{IL}	2.9, 4.0
Productivity of listed firm	$\bar{z}$	14.0
Fixed cost	f	0.36
Collateral	λ	1.57
Arrival of a business idea	η	0.35
Fraction of ideas backed by VC	p^{VC}	0.04
Exit shock to low independent entrepreneurs	ρ^{IL}	0.08
Probability of IPO in a given period	$p(\bar{z}, z)$	0.05

regimes.

$$(1+\tau_s)c + a' \leq \pi(z^{EI}, k) + (1+r)a - \tau_w a. \tag{19}$$

For individuals in other stages the budget constraints change analogously with the difference that they do not have business income. So for them only the last two terms on the right-hand side of equation 19 are relevant. This change does not affect the capital gains tax.

We implement a revenue neutral counterfactual. In other words, we choose the level of τ_w in such a way so that the total amount of taxes collected by the government are the same as in the baseline economy, keeping all other tax rates the same.

To compare the consequences of the tax reform we look at main aggregates, such as GDP, capital, and the composition of firms and welfare. In order to calculate welfare in certainty equivalents we introduce some additional notation. Let $S = (a, w, z, status)$ de-

Table 2: Moments

	Data	Model
Panel A: Targeted moments		
Capital-to-output ratio	3.0	3.1
Bequest/wealth	0.009	0.007
90th percentile of bequest distribution	4.34	3.65
Top 1% wealth share	36	40
Share of self-made billionaires	54	60
Population share of entrepreneurs in top 1%	65	66
Wealth share of entrepreneurs	42	41
Income share of entrepreneurs	31	28
Average debt-to-capital ratio	0.35	0.35
Sales share of corporate firms	63	66
Share of exiting entrepreneurs	22	27
Share of entering entrepreneurs	2.3	2.2
Share of entrepreneurs	7	7.4
VC backed newly listed firms age (years)	7	6
Panel B: Untargeted moments		
Wealth-to-output ratio	4.4	4.5
Wealth Gini	0.82	0.76

note a vector that describes an individuals level of assets, labor efficiency, entrepreneurial productivity and its status. The latter indicates whether the individual is a worker, independent entrepreneur (low, high) or VC backed entrepreneur. We also introduce the value function $W(S,h)$ and $\Pi(S,h)$ as the invariant distribution of individuals and over vector S and age (h). With this notation welfare change is expressed in certainty equivalents and is calculated as

$$1+CE=\left[\frac{\sum_S W_c(S,1)\Pi_c(S,1)-B_b(S,1)\Pi_b(S,1)}{\sum_S W_b(S,1)\Pi_b(S,1)-B_b(S,1)\Pi_b(S,1)}\right]^{\frac{1}{1-\sigma}}, \tag{20}$$

where subscripts b and c denote baseline and counterfactual economies and $B_b(S,1)$ is discounted value of the utility payoff of bequest for newborn agents.

Table 3 present the changes of the key variables relative to the benchmark economy. As can be seen GDP increases by 4%. The interest rate decreases, as a result which both capital-to-GDP ratio and wealth-to-GDP ratios increase. In our economy output is produced by independent entrepreneurs and by the corporate sector, so in order to understand the mechanism that leads to the increase in aggregate output we separately look at both sectors. It turns out, that output in both sectors expands. In the case of entrepreneurial sector this outcome is rather straightforward because lower tax on profits

makes it more attractive for individuals to become entrepreneurs. For the corporate sector the mechanism is more complicated.[5] The expansion of the independent entrepreneurial sector increases wages and negatively affects the profits of corporate firms. Lower interest rates, in contrast, decrease the cost of capital and increase profits. Lower interest rates also increase the value of the IPO because future profits are discounted less heavily. This increases the individual's incentives to pursue risky projects. In Table 3 we present the value of the firm which is lower in the economy with wealth taxes, which means that negative forces dominate.

Table 3: Counterfactual

	Baseline	Wealth tax	Wealth tax on top 1%	Wealth tax including VC firms
Output per capita	\$101,000	1.040	1.102	0.820
Entrepreneurial output per capita	\$44,000	1.079	1.119	1.835
Corporate output per capita	\$57,000	1.014	1.091	0.128
Capital-to-GDP	3.1	1.041	1.059	0.789
Wealth-to-GDP	4.5	1.020	1.041	0.593
Consumption per capita	\$62,000	1.037	1.098	0.819
Wage $\overline{w}$		1.097	1.118	0.925
Interest rate r		0.969	0.963	0.763
$V^F(\bar{z})$ (\$ billions)	2.00	0.746	0.731	1.378
Share of entrepreneurs	7.4%	8.6%	8.94%	16.2%
Share of self-made billionaires	60%	81%	66.7%	0%
Top 1% wealth share	40%	37%	33%	17%
Wealth Gini	0.77	0.75	0.73	0.76
CE (%)		4.2	10.6	-10.2
Wealth tax (τ_w)	0	0.7	1.25	4.5

Notes: Baseline values are reported in levels or as shares. Wage is reported in model units. In the counterfactual economies, all non-share variables are shown as a ratio relative to baseline ($\frac{\text{Counterfactual}}{\text{Baseline}}$). The Gini coefficient is reported as a level in all columns. CE is calculated according to equation 20 and expressed in percentages.

However, There are two additional factors that affect the individual's incentive to become an entrepreneur. First, wages, in addition to having a negative effect on firm profits also increase the costs of financing high risk firms from the perspective of the VC because it has to spend more on wages and fixed costs which are scaled by the wage rate. To compensate for this the VC needs a larger stake in the firm, which decreases the entrepreneur's expected IPO proceeds. This factor is rather weak and can be ignored.

Second, the incentives to pursue risky projects depend on the savings of individuals. Although the VC covers the fixed cost of running a risky project, for many workers with

[5]Note that in the counterfactual the corporate sector continues to pay profit tax and successful entrepreneurs pay capital gains tax.

high wages the prospect of pursuing a promising project is not attractive enough if their wealth level is low. Because such workers can enjoy higher current consumption by earning a wage. Among workers with relatively high wages only the ones with sufficiently high levels of wealth pursue risky projects because they can maintain high levels of consumption while the project is in the development stage. The abolishment of the tax on the profits of independent entrepreneurs increases their share in the population and this group maintains higher levels of assets, due to the collateral constraint. When those individuals have an exit shock they do not immediately deplete their assets. Thus, if they receive a new entry opportunity into entrepreneurship and it turns out to be the VC track they are more likely to pursue it because they have higher levels of assets. In our quantitative exercise this force turns out to be very strong. In Table 3 we can see that the fraction of self-made billionaires increases substantially. This is happening because many individuals start their careers with little assets, then enter into independent entrepreneurship, where they accumulate assets which allows them to pursue high risk opportunities later on. As a result, despite the fact that the value of the firm decreases, the entry into risky entrpreneurship increases and those who enter are less likely to endogenously exit over time because they have higher levels of assets which they can consume. This lead to a higher number of IPOs and increases the output produced by corporate firms. Note that the relative share of output produced by corporate firms decreases because, as was already mentioned, independent entrepreneurs benefit directly from the new tax regime. The fact that the initial wealth accumulated as a independent entrepreneur increases chances to pursue a risky project is reflected not only in the increased numbers of such entrepreneurs but also in their average asset holdings when they enter into risky entrepreneurship. In the economy with wealth taxes the average VC backed entrepreneur holds three times more assets one period after entry compared with their counterparts in the economy with capital income taxation.

It is worthwhile discuss our results in the context of the literature. First, our model delivers results that bear some resemblance to Midrigan and Xu (2014). In that paper the authors argue that firms can overcome collateral constraints by accumulating their profits and reach the optimal size but fixed costs deter firms from entering and reduce aggregate output. In our case fixed costs are paid by the VC but there is an opportunity cost of pursuing a risky project in the form of forgone wage. This mechanism has been also studied by Hall and Woodward (2010) in a partial equilibrium context. They show that even for moderate levels levels of risk aversion (same as in our calibration) and moderate wealth levels, entrepreneurs prefer to be employed as workers rather than start a project that can lead to an IPO or acquisition with potentially a high reward.

Second, Boar and Midrigan (2023) emphasize that the difference in the results between

their study and Guvenen et al. (2023) is partly driven by the fact that in their model entrepreneurs internally accumulate capital and overcome borrowing constraints. So, the persistence of productivity shocks plays an important role. In our calibration the types of independent entrepreneurs do not change, so they are very persistent. Of course, we have exit shocks but we set them at rather low levels especially for the high type entrepreneur. Since the high type entrepreneur is more likely to operate at suboptimal scale, the low exit shock gives the entrepreneur sufficient time to accumulate funds internally. Thus, it does not seem that our calibration is designed to generate too much misallocation because of the collateral constraint.

5 Private firms and wealth taxation

In the previous section we described an environment in which the base of the wealth tax is asset holdings of individuals which are indirectly invested in physical capital and value of listed firms. However, recent proposals intend to tax also the wealth of individuals invested in private firms particularly those backed by VC (see, for example The Economist, 2026). We use our framework to assess the implications of such polices. Note, that this tax affects only venture capital backed entrepreneurs not independent entrepreneurs. This approach is motivated by the policy debate mentioned above also perhaps both in the model and in reality it is easier to asses the value of VC backed firms as funding rounds provide information about firm value and thus entrepreneur's wealth.

In order to implement this exercise we first need to redefine the concept of wealth for the VC backed entrepreneur. Specifically, the wealth of the entrepreneur includes not only a but also $sV^F(z^{VC})$ where the latter denotes the value of the firm in the VC stage and can be calculated recursively using the value of the listed firm and the probability of getting listed every period discounted using the risk free rate r. In a regime where this wealth is also taxed the budget constraint of the VC backed entrepreneur 16 becomes

$$(1+\tau_s)c + a' \leq (1-\tau_l)\overline{w}\underline{w} + (1+r)a - \tau_w(a + sV^F(z^{VC})). \tag{21}$$

If the definition of individual wealth also includes the value of non-listed firms, then aggregate wealth and its distribution changes somewhat. However, in conducting this exercise we keep all calibrated parameters the same as in the baseline, so the only difference between this taxation regime and the one considered in the pervious section is the tax base.

The results are reported in the third column of table 3. As can be seen there are very large changes. The key difference is that the corporate sector shrinks dramatically and

the independent entrepreneurial sector expands, however not sufficiently to offset the effect of the former. The resulting decline in total output is about 18%. This result is not surprising because it makes VC entrepreneurship a very unattractive activity. As we already discussed in the previous section the entrepreneur undertakes a large risk by engaging in a venture with the VC by forgoing current consumption. By taxing the wealth of the entrepreneur that also includes the value of the firm in development imposes a huge cost. The value of the firm in this stage, although small compared with the listed firm, is still substantial and the entrepreneur needs to pay a tax on that wealth. If the project fails, then the entrepreneur ends up paying large amounts of taxes in exchange for nothing. Even if the entrepreneur is confident that the project will succeed then he/she may not be able to afford engaging in the development of the project because he/she may not have sufficient wealth when taxes are due. This logic is also reflected in our simulations from which we can see that the fraction of self-made billionaires drop to zero. This is happening because only individuals with initially high wealth can afford to pay the wealth tax on the value of the firm in the VC stage.

A key assumption in our model is that the entrepreneur cannot sell his/her shares during the development stage. This assumption is consistent with real-world practices. Many founders hold large stakes in their firms and are exposed to high levels of risk. In figure A2 we plot the histogram of wealth changes of the *Forbes 400* billionaires, which shows that they frequently experiences very large negative shocks. The question why some individuals decide to be exposed to such high levels of risk has been asked in the literature (see for example, Moskowitz and Vissing-Jørgensen, 2002). One explanation is based on the idea that the entrepreneur's stake in the firm makes sure that he/she exerts sufficient effort (Aghion and Tirole, 1994). More recently Chari et al. (2025) put this idea in a quantitative model with entrepreneurship. A related concept is modeled in Peter (2025) in which investors need to undertake costly monitoring to make sure that the entrepreneur exerts sufficient effort and as the entrepreneur's share declines more monitoring needs to be done. Our preferred argument is that the entrepreneur has more information about the projects' potential than the VC and some of the projects are bad. In order to screen out those entrepreneurs the VC does not pay directly to entrepreneurs but commits to finance the costs of the project and pay a modest salary while the project is in the development stage. As a result potential entrepreneurs who have bad projects have no incentives to convince the VC that their projects are good. Modeling this approach explicitly is possible.

In our model the concepts of failure, success, development stage and mature firm are clearly defined. In practice the firm's development stage is not so easy to define and both its private and market values can oscillate violently as in figure A1. We assumed

that after the listing the founder sells his/her entire stake in the firm. In reality founders continue to hold substantial stakes and play an important role in the management of the company, understanding that they are exposed to a high level of risk. One key reason for that is that the founders' superior knowledge about the business continues to play a role after IPO. SEC Form 144 requires to disclose the sales of securities by insiders. Such sales get mentioned in financial news and are perceived as a negative signal. This means that information asymmetries exist not only for firms under VC ownership but also for listed firms. Consequently, the results of the exercise in which wealth taxes are applied to VC firms only may extend to the founders of some listed firms as well and generate negative consequences.

An important point deserving discussion is that, both in policy circles and in the academic literature, there are measures that can address the disincentives created by wealth taxes among liquidity constrained entrepreneurs. Azevedo et al. (2025) study the problem of the VC and entrepreneur with unrealized capital gains taxes. In their model the VC needs to make a larger initial investment because it is responsible not only for the initial investment cost (negative profits in our context) and entrepreneurial wage but also for the unrealized capital gain tax liabilities of the entrepreneur. They conclude that the entrepreneur prefers unrealized capital gains tax regime compared with realized one because in the case of business failure the entrepreneur receives back tax credits which serve as an insurance. Our general equilibrium model with endogenous exit allows us to shed some light on the shortcomings of this arrangement. In the appendix of the paper the authors consider the possibility of moral hazard and adverse selection but do not incorporate those channels into the quantitative model. Our model shows that even without moral hazard concerns when entrepreneurs earn tax credits in the period of entry which they can use in the case of business failure, they prefer to endogenously exit and use their tax credits instead of pursuing risky projects with low probability of success. This behavior dramatically increases the financing costs of the VC and eliminates VC financing in the equilibrium.

Another form of paying unrealized capital gains or wealth taxes is to hand over shares to the government. That arrangement will eliminate the disincentive problem due to liquidity constraints but it also does not provide the risk insurance benefits discussed by Azevedo et al. (2025). If the government keeps those shares and sells them at IPO, then this arrangement does not differ from the realized capital gains taxation. However, as Azevedo et al. (2025) mention the implementation of this arrangement requires the creation of shares with different voting rights to make sure that the management of the firm is not distorted, which involves additional legal complications and costs.

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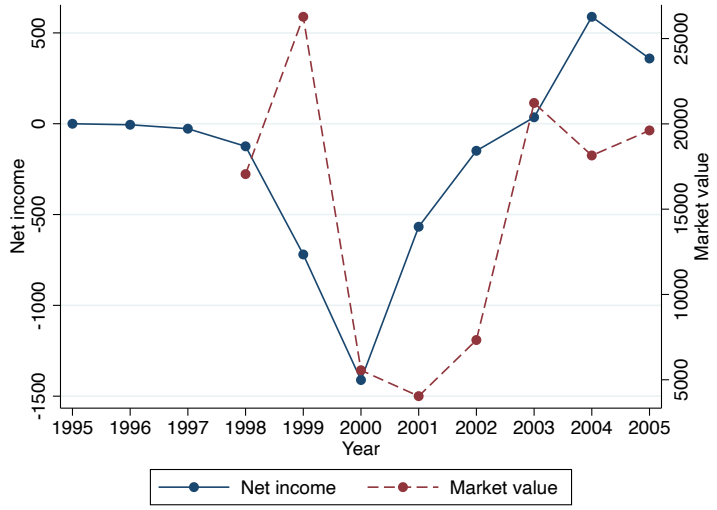
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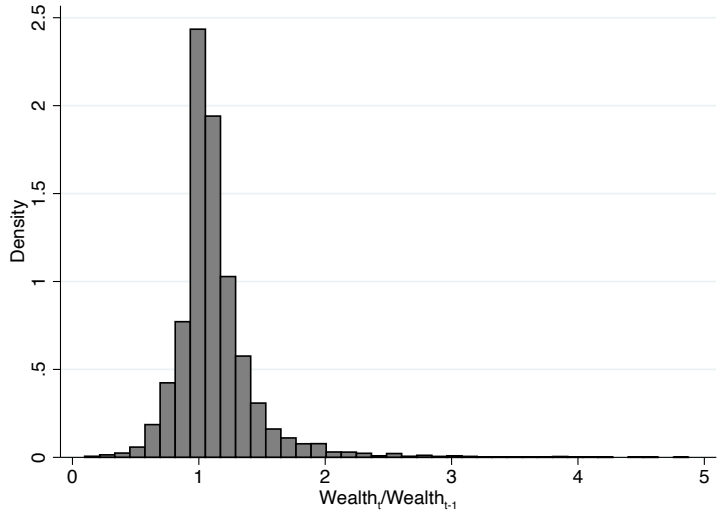
Appendix

Figure A1: Net income and market value of Amazon



Notes : *This figure plots the dynamics of the net income and market capitalization of Amazon.com (USD in millions) based on Compustat data. Jeffrey P Bezos first entered the Forbes 400 list in 1998. The company was founded in 1994 and went public in 1997. The values of net income are negative 1995 and 1996 but not visible on the figure because of the scale. Net assets of the company were 138 millions in 1998.*

Figure A2: Change in net worth



Notes : *This figure plots the histogram of the change in net worth of Forbes 400 billionaire between two consecutive years defined as* $Wealth_t / Wealth_{t-1}$.