Wealth tax, entrepreneurship and market power*

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Abstract

I study the equity-efficiency trade-off of top wealth taxation in an economy with heterogeneous workers and entrepreneurs, where wealthier entrepreneurs own firms that produce at a larger scale and impose larger markups. Implementing a wealth tax on the wealthiest entrepreneurs only, and uniformly redistributing the tax revenues, reduces aggregate production and equilibrium wage workers receive. Furthermore, the wealth tax reduces the aggregate markup in the economy, increasing the labor share of income accruing to workers. I show that the same top wealth tax induces smaller redistributive effects and higher production losses when entrepreneurs impose homogeneous and constant markups, independent on their firms' scale of production. I quantify the magnitude of these effects in a dynamic framework calibrated to the US economy, in which entrepreneurs accumulate wealth by investing in their own firms. I consider a wealth tax raising 1% of GDP in tax revenues imposed on the wealthiest 1% of US households. Depending on the mechanism generating markups heterogeneity across entrepreneurs the wealth tax determines a wage loss for workers 1-1.5 pp lower than in the economy in which all entrepreneurs impose identical markups.

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1 Introduction

US households' wealth is significantly concentrated and in recent decades this concentration has steadily increased. It is also well established that a large fraction of households at the top of US wealth distribution are entrepreneurs. Thus, to achieve the objective of reducing wealth inequality, academics and policy makers have extensively debated the merits and drawbacks of capital income and wealth taxes to be imposed on these entrepreneurs (Guvenen et al. (2023), Boar and Midrigan (2023)).

The existing wealth taxation literature has always analyzed the effects of wealth tax policies under the assumption that profits and returns that entrepreneurs receive from their own businesses entirely reflect their firms' productivity.

The contribution of this paper is that of reassessing the equity-efficiency trade-off of top wealth taxation in a framework in which this 1-to-1 relationship between entrepreneurs' returns and productivity breaks. In particular, I study the effects of a top wealth tax policy in a setting in which returns that entrepreneurs receive from their own businesses not only reflect the entrepreneur's firm productivity but also his market power.

Indeed, American entrepreneurs own a universe of extremely heterogeneous firms encompassing large multinational companies and family based businesses and recent contributions (Baqaee and Farhi (2020), Edmond et al. (2023)) have shown that this firms' heterogeneity is coupled with large market power heterogeneity.

To study the equity-efficiency trade-off of wealth taxation in a setting with market power heterogeneity across entrepreneurs, I assume market power arises through two alternative mechanisms. The first, consistently with the empirical evidence (Edmond et al. (2023)) and standard models of oligopolistic competition (Atkeson and Burstein (2008)) requires that firms' market power increases with firms' market shares. I call this mechanism *scale dependence*, as the entrepreneur's market power depends on his firm's production scale. Consistently with US Survey of Consumer Finances data showing that wealthier entrepreneurs manage larger firms, in my setting under scale dependence, wealthier (and more skilled) entrepreneurs produce at larger scale and own firms with more market power.

Alternatively, I assume that market power heterogeneity across entrepreneurs arises due to entrepreneurs' (or their product) specific features, independent of their firms production scale. I call this mechanism *type dependence*, since the market power of the entrepreneur in this case solely depends on his type-specific features. In this setting I assume a monotone increasing relationship between the entrepreneur's skills and his market power, which allows me to obtain, as in the model with market power arising through scale dependence, wealthier (and more skilled) entrepreneurs producing at a larger scale and imposing larger markups. In this way I am able to generate two observationally equivalent economies, with wealthier entrepreneurs producing at a larger scale and imposing larger markups, but with different underlying mechanisms generating the observed market power heterogeneity.

How does the equity-efficiency trade-off of top wealth taxation change when profits and returns that entrepreneurs receive reflect not only productivity differences across them but also this market power heterogeneity? To answer this question I study the effects of the same revenue-equivalent top wealth tax policy in three economies with poor workers and wealthy entrepreneurs. In all economies wealthier (and more skilled) entrepreneurs manage firms with larger market shares. However, in the first two economies wealthier entrepreneurs manage larger firms imposing larger markups (arising through scale or type dependence mechanisms). Instead, in the third one, it is assumed that firms impose *homogeneous* and constant markups, independent of their production scale. Taking into account that wealthier entrepreneurs own firms imposing larger markups relaxes the equity-efficiency trade-off of top wealth taxation, with respect to the case in which this market power heterogeneity is neglected. In other words, for any given tax-revenue objective, in the economies where firms impose heterogeneous markups the considered wealth tax induces higher redistribution from rich entrepreneurs to poor workers, at the cost of lower losses in terms of forgone production. The intuition for this result is the following. Taxing the wealthiest entrepreneurs, taking into account that they are the ones imposing the largest markups, means taking away resources not only from the most productive agents, but also from the ones imposing the largest production distortions. This limits losses in labor demand and in wage received by workers as an effect of the tax. Furthermore, redistribution from wealthy entrepreneurs to poor workers is shown to be stronger in the case in which market power arises through *scale* rather than *type* dependence. Indeed, under scale dependence the wealth tax not only shifts away resources from high markups firms but also reduces the markup imposed by them (at the cost of little increases of the markups of small-markups firms). This effect further limits the wage losses suffered by workers as a consequence of the wealth tax.

The starting point of this analysis is to study whether and how entrepreneurs' firms differ across the wealth distribution. In Section 2 I use the 2019 Survey of Consumer Finances data to achieve this objective. First of all, I show that American entrepreneurs are concentrated at the top of the wealth distribution and their entrepreneurial investment is mainly directed towards a single business. Furthermore, the fraction of net wealth that each entrepreneur confers as equity to his own business is increasing across the wealth distribution. The same holds for the number of employees in the entrepreneur's firm. Finally, I show that returns to entrepreneurial investment are also increasing across the wealth distribution.

Section 3 builds a static, general equilibrium model that I will use to study the effects of a top wealth tax policy. In this framework there are two kind of agents: workers supplying labor and entrepreneurs receiving profits from their own firms. Workers differ for their labor supply endowment and receive a wage common to everyone, while entrepreneurs are assumed to differ in their wealth endowment and entrepreneurial skills. Each entrepreneur employs a constant return to scale production function, which uses as inputs labor and the entrepreneur's wealth as capital. Firms owned by entrepreneurs are assumed to operate in *monopolistic competition*: each entrepreneur produces an intermediate differentiated good which is employed as an input for the production of a final consumption good. Final good producers' demand for entrepreneurs' goods determines the mechanism through which market power arises. When the price elasticity of demand is assumed to decrease in the entrepreneur's firm market share, market power arises through scale dependence: entrepreneurs producing at a larger scale impose larger markups. Instead, when the elasticity of demand is constant but differs across entrepreneurs (depending solely on the constant but heterogeneous entrepreneurial skills), market power arises through *type* dependence. When this is the case, I assume a negative relationship between entrepreneurs' skills and the elasticity of demand for their own variety. I show that in both settings wealthier and more skilled entrepreneurs' businesses produce more than the ones of poorer and less productive entrepreneurs and the firms of wealthier and more productive entrepreneurs impose larger markups.

In Section 4 the model is calibrated in the benchmark case of market power arising through type dependence[1] and used to study the effects of a top wealth tax policy on entrepreneurs' production choices and the aggregates of the economy. The calibrated model matches the US entrepreneurial wealth distribution, the observed relationship between markups and market shares across US firms, the aggregate markup in the US economy

[1]This is the most common framework employed by the macro literature to study the effects of fiscal and monetary policies allowing for markups heterogeneity across firms operating in monopolistic competition, e.g. Baqaee et al. (2024), Champion et al. (2023), Boar and Midrigan (2022), among others.

and the estimated returns to entrepreneurship. To reproduce the observed increasing returns to entrepreneurial investment across the wealth distribution I assume a positive correlation between entrepreneurial wealth and skills, which endogenously emerges in the dynamic version of the model analyzed afterwards.

The considered top wealth tax policy is a proportional wealth tax, with tax rate equal to 2%[2], on the wealth in excess of the 90^{th} entrepreneurial wealth percentile threshold. Notice that, since entrepreneurs are concentrated at the top of the wealth distribution, taxing the wealthiest 10% of American entrepreneurs corresponds to taxing the wealthiest 1% of US households. The tax revenues are uniformly lump-sum redistributed across all households, both workers and entrepreneurs.

I show that this tax reduces production, labor demand and markups of the wealthiest (taxed) entrepreneurs and increases production, labor demand and markups of the poorer ones. Since the tax is levied on the wealthiest, but also most productive entrepreneurs, aggregate production, labor demand and hence equilibrium wage fall. Aggregate markup falls as well, determining an increase in the labor share of income accruing to workers.

In Section 5 the model is twice recalibrated so to study the effects of the considered wealth tax policy in two alternative scenarios. First, it is recalibrated so to obtain an economy which is observationally equivalent to the one studied in Section 4, but with markups arising through type dependence. Finally, the model is recalibrated so to match the same moments targeted in the previous economies, apart from markups heterogeneity across entrepreneurs.

The same wealth tax studied in Section 4 is then simulated in these economies and the resulting wealth tax effects are compared. I show that the losses in equilibrium wage and production are the largest in the economy with no markups heterogeneity, with no effects on the aggregate markup and the labor share of the economy. In other words, taking into account that wealthier entrepreneurs own firms with larger market power relaxes the equity-efficiency trade-off of wealth taxation, with respect to the case in which this market power heterogeneity is neglected. Indeed, poor workers receive the same transfer in the three economies, although suffering the largest reduction in equilibrium wage and the largest production loss in the economy with no market power heterogeneity. Furthermore I show that depending on which mechanism generates market power heterogeneity across entrepreneurs the effects of the wealth tax on equilibrium aggregates are quantitatively different. In particular, larger equilibrium wage losses and production losses

[2]This tax rate allows to obtain total tax revenues that worth $\approx 1\%$ of GDP

arise in the model with type dependent markups.

In Section 6 I quantify the described effects of wealth taxation in the three considered economies, taking into account the distortions induced by the tax on entrepreneurs' wealth accumulation. To do that I build a dynamic model with workers and entrepreneurs and neither idiosyncratic nor aggregate uncertainty. Workers differ for their inelastic labor supply endowment, decide how much to invest in a risk-free "market" asset and how much to consume in every period. Entrepreneurs, instead, differ for their entrepreneurial ability and make production and consumption-saving choices. In particular, they invest an exogenous fraction of their wealth in the same "market" asset in which workers invest (receiving an interest rate) and invest the remaining part of wealth in their business (receiving profits). Similarly to the static framework each entrepreneur operates in monopolistic competition and faces a demand curve for his own variety with constant or decreasing price elasticity of demand. Depending on the elasticity of demand features, entrepreneurs find optimal to impose markups arising through scale, type dependence or impose constant and homogeneous markups.

I show that, when this economy is at the steady-state, more skilled entrepreneurs are wealthier and manage firms producing at a larger scale. This implies that under scale and type dependence, wealthier entrepreneurs run firms imposing larger markups. The steady-state of the model is calibrated so to replicate the distribution of overall wealth and the wealth entrepreneurs hold as equity in their firms, which is observed in the SCF data. Beside this, the same moments targeted in the static economy are matched[3]. In this setting I implement a *permanent* wealth tax policy analogous to the one studied in Section 4 and compare the steady-states of the model with and without the tax. Wealthier (taxed) entrepreneurs reduce their steady-state wealth and produce less while poorer entrepreneurs, instead, receiving larger profits as an indirect effect of the wealth tax, accumulate more wealth and produce more. In the benchmark case of market power arising through scale dependence the analyzed wealth tax reduces aggregate production at the steady-state by 4.5% and reduces the steady-state wage by 4.3%. Furthermore, it also reduces the aggregate markups in the economy, similarly to what was happening in the static model, by 0.74%. The effects of the wealth tax are again simulated under the assumption that market power arises through type dependence: when this is the case

[3] Although observed returns to entrepreneurial investment are not a calibration target in the dynamic version of the model they are closely matched in the economies with markups arising through scale and type dependence

the losses in aggregate production due to the tax are almost the same, while equilibrium wages decreases by extra 0.5pp.
Finally, I show that neglecting market power heterogeneity across entrepreneurs induces to overestimate GDP losses generated by the wealth tax by 0.4 percentage points and to overestimate the wage losses by 1.5 percentage points (w.r.t the case in which market power arises through scale dependence).
Section 7 concludes.

Related work: this paper contributes to the stream of literature studying wealth taxation in settings where households receive heterogeneous returns to wealth (which have been shown to be a fundamental driver of wealth inequality (Benhabib and Bisin (2018), Hubmer et al. (2019)). This return heterogeneity both between and within investment opportunities has been largely documented by Bach et al. (2020), Fagereng et al. (2020), Xavier (2021). The focus of this paper is on the effects of wealth taxation on a specific investment opportunity, that is entrepreneurial investment, which is particularly sizable at the top of the wealth distribution where wealth taxes are usually implemented. This work, hence, complements the empirical literature documenting return heterogeneity by estimating returns to entrepreneurial investment (i.e. returns to investment in privately owned, actively managed businesses) across the wealth distribution in US[4].

The recent wealth taxation literature has employed models featuring return heterogeneity across households to generate economies with wealth inequality dynamics consistent with the data where to study the effects of wealth tax policies[5]. However, several different mechanisms have been used to generate return heterogeneity across households: these can be categorized into the classes of *type* and *scale* dependence mechanisms.
Guvenen et al. (2023) and Boar and Midrigan (2023) study the effects of wealth taxation on entrepreneurs' production choices in settings in which entrepreneurs' wealth accumulation is only driven by their *type* (productivity). In these settings return heterogeneity across them is generated by financial frictions (similarly to Cagetti and De Nardi (2006)) which are more or less severe depending on the entrepreneur's productivity type.

[4] Xavier (2021) uses the same SCF data I employ, however she shows how returns to *private equity* investment (i.e. not only entrepreneurial investment) vary across the wealth distribution.

[5] Studying wealth taxation in a setting with returns heterogeneity allows to compare the effects of wealth taxation to these of taxing capital income. When there is no return heterogeneity across households capital income and wealth taxation are equivalent.

Gaillard and Wangner (2021) is the first paper to study top wealth taxation explicitly showing how different mechanisms driving wealth accumulation (type or scale dependence) induce quantitatively different wealth tax effects. In their paper households with different types have inherently different propensities to invest in high-risk and high-return assets. Households with higher types, hence, invest more in high return assets, receive higher returns and accumulate more wealth. Instead, in their paper the scale dependence mechanism indicates that the wealthier the household gets, the more it is prone to invest in high-return assets. Noticeably, in all these settings returns to investment of households and entrepreneurs are assumed to entirely reflect the productivity of the investment opportunity.

This paper departs from this literature in two ways. First of all, heterogeneous returns that entrepreneurs receive not only reflect the productivity of the entrepreneurial investment but also the market power of the entrepreneur.

Furthermore, in this paper type and scale dependence mechanisms take a novel connotation. In particular, type and scale dependence now denote two alternative mechanisms that determine how market power across entrepreneurs arises. Since market power that entrepreneurs have affects their returns, type and scale dependence mechanisms still determine the shape of entrepreneurs' returns.

This paper is also related to the literature documenting heterogeneous product market power across US firms. Although there is no empirical work reporting the extent of market power heterogeneity across American entrepreneurs *only*, the literature showing large markups and markups heterogeneity across firms in the US is ample (e.g. De Loecker et al. (2020), Baqaee and Farhi (2020)). Furthermore, several papers have also highlighted that the distortions induced by market power heterogeneity are sizable (Bilbiie et al. (2019), Autor et al. (2020), Edmond et al. (2023)) and some scholars have studied the redistributive effects of policies that restore production efficiency (Boar and Midrigan (2022)). However, the setting of Boar and Midrigan (2022) crucially differs from mine for having entrepreneurs investing in a common financial intermediary and hence receiving homogeneous returns to their entrepreneurial investment.

Finally, this paper is also related to the literature studying optimal taxation in presence of *rent-seeking* activities. Rothschild and Scheuer (2016) show that whenever heterogeneity in returns reflect heterogeneous rents rather than actual productivity differences, taxing away such gains has efficiency benefits. Gaillard and Wangner (2021) show that taxing wealth becomes more desirable whenever returns to risky assets (which are mostly owned by wealthy households) capture rent extraction motives. Although in my setting entrepreneurs do not perform rent extraction activities, the trade-off faced is similar: the wealthiest entrepreneurs, who are the most productive, are also the ones imposing the largest production distortions. Thus, taxing the wealth of these entrepreneurs on the one hand takes away resources from productive entrepreneurs, but on the other hand reduces the production distortions in the economy.

2 Entrepreneurs across the wealth distribution

In this Section I employ the 2019 *Survey of Consumer Finances* (henceforth SCF) data to document how entrepreneurial activity changes across the US wealth distribution. At higher percentiles of the wealth distribution the fraction of households who are entrepreneurs is higher. Furthermore, the fraction of net wealth that each entrepreneur confers as equity to his business is increasing across the wealth distribution and the number of employees in the business is increasing as well.
Finally, the 2013-2019 waves of the SCF will be used to estimate returns to entrepreneurial investment across the wealth distribution.

2.1 Data and variables definitions

To study the features of entrepreneurial activity across the wealth distribution, the 2019 wave of the Survey of Consumer Finances is employed. The choice of SCF over other surveys is due to two reasons. First of all, SCF contains detailed information on households' personal wealth and on businesses owned by each household (business income, employees, age, sector...). Furthermore, SCF surveys many more households at the very top of the wealth distribution, with respect to what other surveys do (for details on the sampling procedure see for example Kennickell (2008)). For the scope of this analysis this feature is of particular importance, given that entrepreneurial activity is primarily concentrated at the top of US wealth distribution.
The SCF contains several questions which can be used to classify a household as an entrepreneur:

1. "Do you (and your family living here) own or share ownership in any privately-held businesses, including farms, professional practices, limited partnerships, private equity, or any other business investments that are not publicly traded?"

2. “Do you (or anyone in your family living here) have an active management role in any of these businesses?”

3. “Do you work for someone else, are you self-employed or something else?”

The entrepreneurial status of an household depends on how the term entrepreneur is defined. In this paper I define an entrepreneur as an household who responds affirmatively to questions 1., 2. and 3. The requirement of the household actively managing the business is imposed in order to exclude from the class of entrepreneurs those households who act as “investors” but do not contribute to the management of the business. The requirement of being self-employed is instead imposed in order to exclude from the entrepreneurs’ class those households who have a full-time wage-earning job. This definition is consistent with other works in the literature employing SCF data to study entrepreneurship in the US (e.g. Quadrini (2000), Cagetti and De Nardi (2006)). Alternative definitions of entrepreneur employed by the literature consider as an entrepreneur an household responding affirmatively to 1., or 1. and 2. (e.g. Boar and Midrigan (2022)). In any case, the empirical findings I will present do not significantly change when employing alternative definitions of entrepreneur.

2.2 Entrepreneurial activity across the wealth distribution

Do entrepreneurs coincide with the wealthiest US households?
Table 1 shows that net wealth in the US is extremely unequally distributed, with around 37% of total wealth accruing to the wealthiest 1% of households. Noticeably, entrepreneurial wealth (i.e. the wealth invested in actively managed privately owned businesses) is even more unequally distributed, with more than 42% of the overall entrepreneurial wealth owned by the wealthiest 1% of households. The concentration of the entrepreneurial activity at the top of the wealth distribution is further highlighted by Figure 1.
Figure 1 shows that the fraction of households who are entrepreneurs in a given wealth percentile is increasing across the wealth distribution. In particular, around 40% of the wealthiest 10% of US households are entrepreneurs. This number increases up to 82% for the wealthiest 1% of households. However, this figure does not provide any information on the fraction of overall wealth invested in these businesses, compared to other investment opportunities.

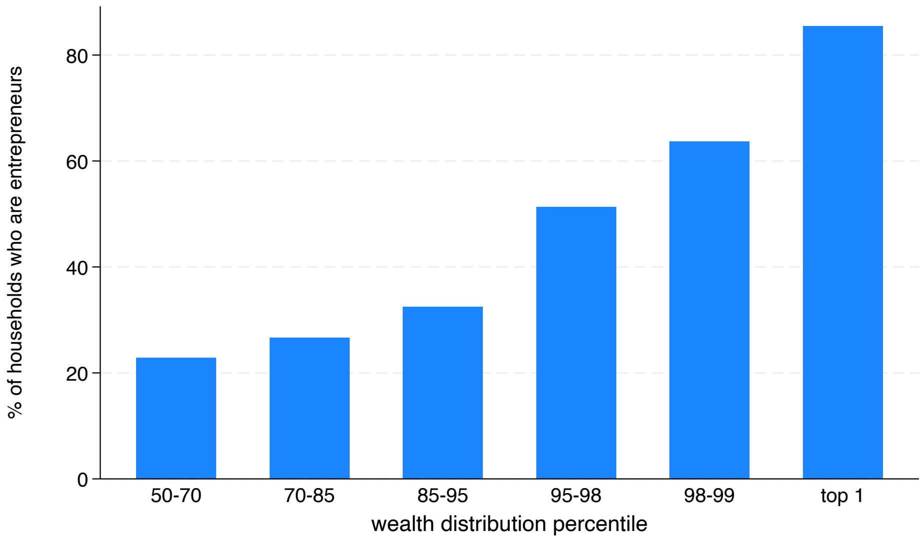
Figure 2 fills this gap by reporting the portfolio share (i.e. fraction of net wealth) that US entrepreneurs hold in actively managed private businesses (blue columns). Notice

TABLE 1. *Net wealth and entrepreneurial wealth distribution: summary statistics*

Percentile	**Net wealth share**	**Entrepreneurial wealth share**
top 10%	76.5%	82.6%
top 5%	64.8%	70.5%
top 1%	37.2%	42.6%
top 0.5%	28.0%	33.4%
top 0.2%	16.4%	23.3%
top 0.1%	12.2%	18.0%

Notes: *column 2 of the table reports the share of net wealth (assets - debts) of US households belonging to different percentiles of the wealth distribution. Column 3, instead, reports the share of wealth invested in directly managed private businesses by the wealthiest x% of US entrepreneurs. For details on the definition of entrepreneur see Section 2.1. Data from 2019 Survey of Consumer Finances.*

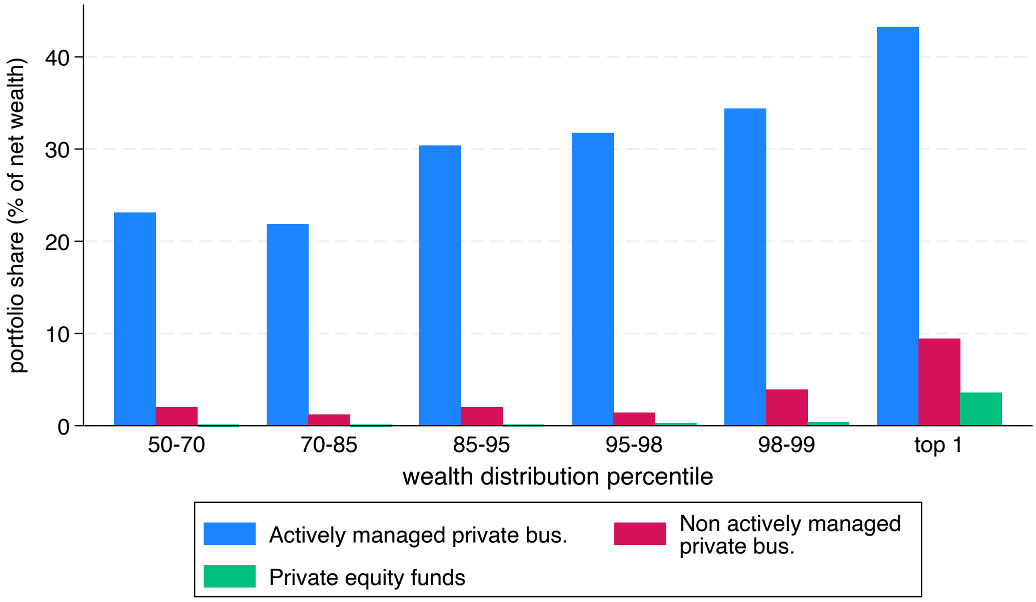
FIGURE 1. *Fraction of US households defined as entrepreneurs across the wealth distribution*



Notes: *the Figure reports the fraction of US households, per given wealth percentiles bin, which satisfy the definition of entrepreneur reported in Section 2.1. Data from 2019 Survey of Consumer Finances.*

that the fraction of net wealth invested in actively managed private businesses is increasing across the wealth distribution and it represents a sizable share of US entrepreneurs' portfolios, especially at the very top of the wealth distribution. Furthermore, the fraction of wealth held in actively managed businesses is significantly larger than the fraction of wealth held in other private equity investment opportunities such as non-actively managed private equity businesses (red columns) or private equity funds (green columns). This evidence shows that households actively managing businesses at the top of the wealth distribution are really entrepreneurs, more than just investors. Figure 2 also

FIGURE 2. *Portfolio shares across entrepreneurs: private equity investments*



Notes: *the Figure reports the fraction of net wealth that US entrepreneurs (entrepreneur is defined according to the definition reported in Section 2.1) invest in different private equity investment opportunities. The total amount of private equity investment is disaggregated into: investment in actively managed businesses (blue), investment in non-actively managed businesses (red), other private equity investment (green, mainly private equity funds). The value of each column is computed by averaging the portfolio shares invested in each private equity investment opportunity across the entrepreneurs belonging to a given wealth percentiles bin. Data from 2019 Survey of Consumer Finances*

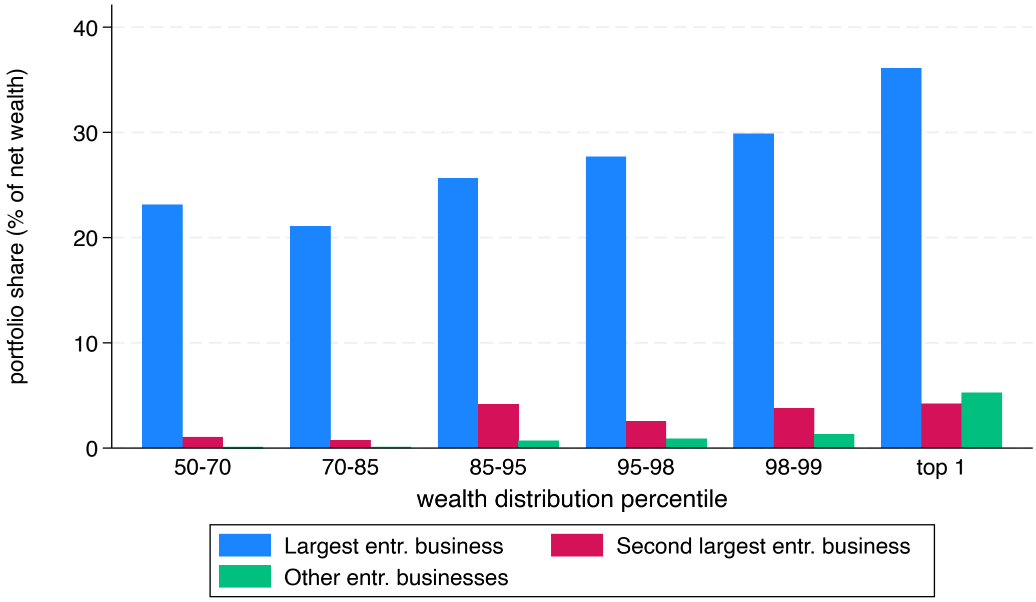
shows that the wealthier the entrepreneur, the more wealth he confers to his own entrepreneurial activities, suggesting that the size of the entrepreneurs' firms, in terms of capital endowment, increases across the wealth distribution. One potential concern on the previous statement is that capital conferred by each entrepreneur is diluted across many entrepreneurial activities. As shown in Figure 3, this is not the case.

Indeed, Figure 3 shows that almost the entire wealth invested in entrepreneurial activities is conveyed towards a single business. Notice that this finding is consistent with the literature arguing that entrepreneurial investment is poorly diversified (Moskowitz and Vissing-Jørgensen (2002)).

However, not only the capital endowment of privately owned businesses is increasing across the wealth distribution, but also their size in terms of number of employees is steeply increasing.

This pattern is reported in Figure 4, which plots the average number of employees in the largest business of each entrepreneur, for several wealth percentiles bins. A similar pattern could be observed when analyzing the number of employees working in the second largest business owned by each entrepreneur, as well as in further businesses.

FIGURE 3. *Portfolio shares across entrepreneurs: actively managed private businesses*



Notes: *the Figure reports the fraction of net wealth that US entrepreneurs (entrepreneur is defined according to the definition reported in Section 2.1) invest in different privately owned actively managed businesses. The total amount of privately owned actively managed business investment is disaggregated into: investment in the largest actively managed businesses (blue), investment in the second actively managed business (red), investment in other privately held businesses (green). The value of each column is computed by averaging the portfolio shares invested in first/second/other actively managed private business across the entrepreneurs belonging to a given wealth percentiles bin. Data from 2019 Survey of Consumer Finances*

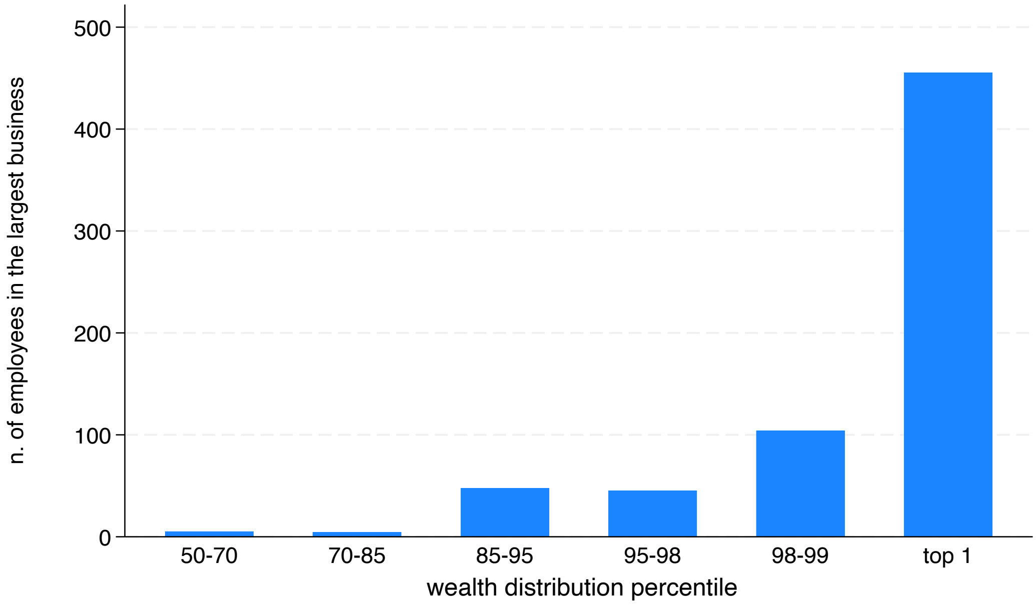
2.3 Returns to entrepreneurship

In this section I complement the previous evidence showing that beside owning heterogeneous firms (both in terms of capital endowment and employees), entrepreneurs across the wealth distribution receive heterogeneous returns to their entrepreneurial investment. In order to estimate returns to entrepreneurship I use the three latest waves of the SCF, namely the 2013, 2016 and 2019[6]. The following variables are employed:

- GI = *directly managed private business* pre-tax (gross) income reported the year preceding the survey date

[6]Returns to entrepreneurship across the wealth distribution are pretty volatile. This motivates my choice of using more than one survey wave for the estimation of returns. On the other hand, using too many waves would induce me to compare returns across the wealth distribution with significantly different underlying wealth distributions. These considerations motivate my choice of using the waves in the period 2013-2019 only, in which wealth inequality in the US has remained pretty stable.

Figure 4. *Employees in largest (private) actively managed business*



Notes: *the Figure reports the average number of employees in the largest private actively managed business across the wealth distribution. The value of each column is computed by averaging the number of employees in the largest actively managed business across entrepreneurs belonging to the same wealth percentile bin. The definition of entrepreneur is reported in Section 2.1. Data from 2019 Survey of Consumer Finances*

- EV = value of the *directly managed private business* equity owned by the household at the date of the survey. It is the answer to the following survey question: "what is the net worth of (your share) of this business?"

The reported pre-tax income has to undergo two major transformations to reflect the perceived capital income obtained through entrepreneurial investment. First of all, taxes paid by each firm are subtracted from gross income. The applied tax adjustment is assumed to be 36% of gross income for C-corporation and 0% for S-corporations[7]. The 36% tax rate is an estimate for the effective corporate tax rate and is chosen consistently with Bhandari and McGrattan (2021). They obtain this figure as a weighted sum of the marginal tax rates on firm earnings.

Furthermore, to identify capital income separately from labor income, a salary is imputed to all entrepreneurs not reporting any. The imputed salary represents the fraction of gross income net of taxes which accrues to labor income. This term is subtracted from gross

[7] A C-corporation is a legal form for a company in which the owners are taxed separately from the entity. C-corporations are subject to corporate income taxation and the net profits distributed to owner also undergo personal taxation. An S-corporation, instead, is a business legal form that allows to pass its taxable income directly to its shareholders, hence is not subject to corporate income taxation

income net of taxes to obtain net capital income (NI):

$$\begin{aligned} NI &= GI \times 0.64 - \text{ imputed salary} && \text{for C-corp.} \\ NI &= GI - \text{ imputed salary} && \text{for S-corp.} \end{aligned}$$

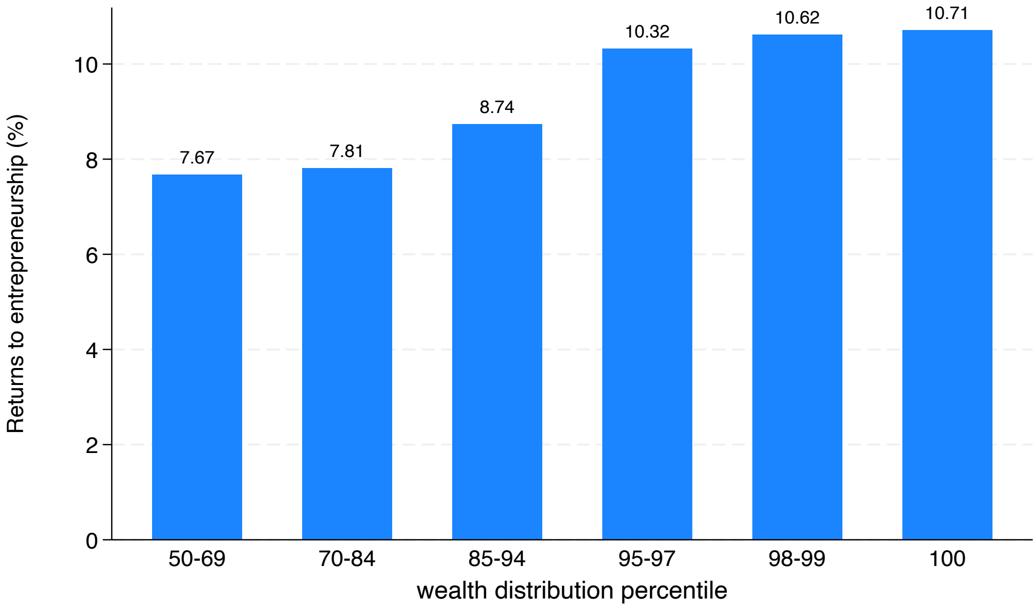
To obtain the imputed salaries I first run a regression (over households reporting a positive salary) of household-level wage over a constant, age, age squared, a dummy for graduating college and a dummy for gender. I then use the estimated coefficients to compute the fitted wage for those entrepreneurs not reporting any salary. Finally, I obtain the imputed yearly salary by multiplying the wage rate for the total hours worked in a year. This imputation procedure is consistent with other works employing the SCF data in order to obtain estimates of returns to private equity investment (Moskowitz and Vissing-Jørgensen (2002), Kartashova (2014), Xavier (2021)).
Employing the constructed measure of *net capital income* (NI), I now compute the *annualized returns* to entrepreneurship across the wealth distribution. To do so, for each household i and survey wave $t = \{2013, 2016, 2019\}$ I compute:

$$R_i^t = \left(1 + \frac{3NI_i^t}{EV_i^t}\right)^{\frac{1}{3}} - 1$$

notice that this is the same measure of annualized (SCF is a triennial survey) returns to private equity investment computed by Moskowitz and Vissing-Jørgensen (2002), Kartashova (2014), Xavier (2021) using the SCF data. The returns to entrepreneurship are computed for each household i. Then, by averaging R_i^t across households belonging to the wealth percentile bin $p \in \{50-70, 70-85, 85-95, 95-98, 98-99, \ top\ 1\}$ I obtain the returns to entrepreneurship at wealth percentile bin p and survey wave t: R_p^t. Finally, averaging R_p^t across the three survey waves employed (2013, 2016, 2019) I obtain returns to entrepreneurship at wealth percentile bin p: R_p. The returns estimated through this procedure are reported in Figure 5.

Figure 5 shows that returns to entrepreneurship are increasing across the wealth distribution. In particular, the wealthiest 5% of US households receive returns in the ballpark of 10%, reaching 10.7% at the very top of the wealth distribution. The households below the top 5% receive returns to entrepreneurship around 8.7% while those at lower percentiles around 7.7%. Xavier (2021) analyzes the returns to private equity investment (i.e. returns to investment in all private businesses, not only those actively managed,

FIGURE 5. *Returns to entrepreneurship across the wealth distribution*



Notes: *the Figure reports the returns to investment in actively managed private businesses across the wealth distribution. For details on the procedure employed see Section 2.3. Data from 2019 Survey of Consumer Finances*

and private equity funds) across US wealth distribution. She reports increasing returns to private equity investment across almost the entire wealth distribution, although she highlights a drop of returns for the wealthiest 3% of US households. For the top 5% she reports returns to private equity investment in the range 14%-16%, although she highlights that around 20-25% of these returns are due to capital gains (which I have not taken into account in my procedure) rather than realized income. Fagereng et al. (2020), using Norwegian administrative data still report a positive relationship between private equity returns and net wealth of the entrepreneur, consistently with my findings for the US.

3 Static model

In this section I build a static, general equilibrium model with workers supplying labor and entrepreneurs receiving profits from their own firms. This will be the baseline framework to study the equity-efficiency trade-off of top wealth taxation in the following Sections of the paper.

3.1 Setup

Let's consider an economy populated by a continuum of households indexed by $i \in [0,1]$. Each of these households is born either as worker or as an entrepreneur and cannot choose its occupation. For simplicity, assume that households $i \in [0,\omega)$ are workers and households $i \in [\omega, 1]$ are entrepreneurs, where the measure of workers, ω, is exogenously given.

Workers: are heterogeneous in the amount of labor they inelastically supply. In particular, each worker i supplies e_i units of labor, drawn from a distribution with cdf $G(e)$. All workers receive the same wage, denoted with w, and use their labor income to consume the amount of final good $c_i = we_i$. The preferences of each worker i over the final good can be represented by a standard CRRA utility function: $u(c_i) = \frac{c_i^{1-\theta}}{1-\theta}$.

Entrepreneurs: each entrepreneur i is endowed with wealth k_i and entrepreneurial ability z_i. In the static version of the model both k_i and z_i are exogenous and for the moment no assumptions are made on the correlation between the two.

Consistently with the evidence of poor diversification of entrepreneurial investment presented in Section 2, I assume that each entrepreneur owns one firm only. Furthermore, I assume that each entrepreneur invests all his wealth in his own unique entrepreneurial activity. This choice allows to abstract from portfolio composition effects that wealth taxation may induce[8]. Finally, I also assume that each entrepreneur's firm cannot borrow, so the capital employed for production coincides with the wealth of the entrepreneur k_i.

Each entrepreneur i receives profits from his own firm π_i and derives utility from consumption of a final good. The amount consumed is $c_i = \pi_i$. The preferences of each entrepreneur i over final good consumption can be represented by a CRRA utility function $u(c_i) = \frac{c_i^{1-\theta}}{1-\theta}$.

Entrepreneurs' firms: each entrepreneur i runs a firm which operates in monopolistic competition. In particular, each entrepreneur produces a differentiated product variety over which he has monopoly power. Hence, each entrepreneur's production choices

[8] Although relevant, see Gaillard and Wangner (2021) and Cremonini (2023), analyzing the portfolio composition effects of wealth taxation goes beyond the scope of this analysis.

affect the price of the good he sells. At the same time these firms are atomistic, thus their choices do not affect the aggregates of the economy. Each product variety will be demanded and employed by final good producers as an input, in order to produce the final good used for consumption by entrepreneurs and workers.
To produce these differentiated varieties each entrepreneur i employs the following constant return to scale production function:

$$y_i = z_i k_i^{\nu} n_i^{1-\nu}$$

where it is assumed that $0 < \nu < 1$. Notice that y_i indicates the production of entrepreneur's i firm, which is carried on using own capital k_i and workers hired from the labor market, denoted as n_i, at wage w.

Final good production: final good (to be used for consumption) is produced by identical final good producers. Differently from the intermediate goods producers, I assume that final good producers operate under perfect competition, taking as given the prices of intermediate good varieties p_i which they use as inputs.
First of all, let's assume they have a constant return to scale production function $f(\cdot)$ to produce the amount of final good Y. To do that they use as factors of production the intermediate goods y_i produced by entrepreneurs' firms, i.e. $Y = f(\{y_i\}_{i\in[\omega,1]})$.
The function $f(\cdot)$ is chosen to be flexible enough so to derive demand curves for entrepreneurs' varieties with both variable and constant price elasticity of demand. This allows me to have a general enough framework so to study the effects of wealth taxation when entrepreneurs impose constant and homogeneous markups or heterogeneous markups arising through type or scale dependence mechanisms.
In particular, when all entrepreneurs face the same demand curve for their own variety with constant price elasticity of demand they find optimal to impose the same constant markup over their marginal cost of production, independently on their production scale.
Consider now the case in which each entrepreneur faces a different demand function for his own variety, each featuring a different but constant price elasticity of demand, depending solely on his productivity z_i. In this case the entrepreneurs in the economy will be imposing constant, but heterogeneous, markups (market power arises through type dependence mechanism).
If entrepreneurs, instead, face a demand curve for their own variety featuring price elasticity of demand varying with their production scale, they find optimal to impose

markups dependent on their firm's production scale (market power arises through scale dependence mechanism).

To have a framework which allows me derive all these kind of demand curves for entrepreneurs' varieties, I assume the production function $Y = f(\{y_i\}_{i\in[\omega,1]})$ is the Kimball (1995) production function. This is implicitly defined by all the inputs-output pairs $(\{y_i\}_{i\in[\omega,1]}, Y)$ satisfying:

$$\int_{\omega}^{1} \Upsilon_i \left(\frac{y_i}{Y}\right) di = 1 \tag{1}$$

where $\Upsilon_i(\cdot)$ is assumed to be a continuous and twice differentiable function, $\Upsilon_i'(\cdot) > 0$ and $\Upsilon_i''(\cdot) < 0$ for all i. The assumption $\Upsilon_i'(\cdot) > 0$ guarantees that $f(\cdot)$ is increasing in each y_i, while $\Upsilon_i''(\cdot) < 0$ ensures quasi-concavity of $f(\cdot)$[9]
Notice that if $\Upsilon_i(\cdot) = \Upsilon(\cdot)$ for all i and $\Upsilon(\cdot)$ is a power function, the production function (1) takes well-known *CES* form.

Demand for intermediate goods: Final good producers, taking input prices as given, choose how much to produce of the final good Y and the best input combination $\{y_i\}_{i\in[\omega,1]}$ for doing that. Define the minimal cost of producing Y given prices $\{p_i\}_{i\in[\omega,1]}$ as:

$$\begin{aligned} &C(Y, \{p_i\}_{i\in[\omega,1]}) = YC(1, \{p_i\}_{i\in[\omega,1]}) \\ &\text{where} \quad C(1, \{p_i\}_{i\in[\omega,1]}) := \min_{\{q_i\}_{i\in[\omega,1]}} \int_{\omega}^{1} p_i q_i di \quad \text{s.t.} \quad \int_{\omega}^{1} \Upsilon_i(q_i) di = 1 \end{aligned}$$

where $q_i := y_i/Y$ is the relative demand for input i. The optimal input combination chosen by the identical final good producers can be characterized by:

$$p_i = \lambda \Upsilon_i'(q_i) \qquad \text{for all} \quad i \in [\omega, 1] \tag{2}$$

where λ is the multiplier associated to the technological constraint (Kimball production function) faced by final good producers. Now, normalize to unit the price of the final

[9]To show that the Kimball production function is constant return to scale multiply all inputs by a positive constant $a > 0$. To have equation (1) still holding final output must be aY.

good. The profit maximization problem of final good producers writes:

$$\max_{Y} \quad Y - YC(1; \{p_i\}_{i\in[\omega,1]})$$

Combining the solution to this problem with (2) allows to retrieve the expression of the multiplier λ:

$$1 = C(1; \{p_i\}_{i\in[\omega,1]}) = \lambda \int_{\omega}^{1} \Upsilon_i'(q_i) q_i di \quad \Rightarrow \quad \lambda = \frac{1}{\int_{\omega}^{1} \Upsilon_i'(q_i) q_i di} \tag{3}$$

Combining eq. (2) and (3) I obtain the demand function $p_i(\cdot)$ for the intermediate good produced by each entrepreneur $i \in [\omega, 1]$:

$$p_i(q_i, P) = P\Upsilon_i'(q_i) \tag{4}$$

where the price aggregator P is defined as:

$$P := \left(\int_{\omega}^{1} \Upsilon_i'(q_i)\, q_i di\right)^{-1}$$

Notice that the subscript i in $p_i(\cdot)$ highlights that if the function $\Upsilon_i(\cdot)$ is assumed to be heterogeneous across entrepreneurs, then entrepreneurs will face different demand functions for their own varieties. Furthermore $\Upsilon_i'(\cdot) > 0$ and $\Upsilon_i''(\cdot) < 0$ ensure that the demand schedule for each intermediate good i is positive and downward sloped. Besides, notice that the price to be paid for intermediate good produced by entrepreneur i negatively depends on the *relative production* of that good $q_i := y_i/Y$.

The elasticity of demand for the intermediate good produced by entrepreneur i takes the form:

$$\mathcal{E}_i^d(q_i) := \left|\frac{\partial \ln(q_i)}{\partial \ln(p_i)}\right| = -\frac{\Upsilon_i'(q_i)}{q_i \Upsilon_i''(q_i)} \tag{5}$$

When modeling entrepreneurs imposing markups independent on their firms' scale of production (either homogeneous or heterogeneous) I choose a functional form for $\Upsilon_i(\cdot)$ so that $\frac{\partial \mathcal{E}_i^d(q_i)}{\partial q_i} = 0$ for all i and q_i. Instead, to achieve the objective of modeling firms with larger market shares having more market power and imposing larger markups, I assume the elasticity of demand $\mathcal{E}_i^d(q_i)$ to be decreasing in the relative quantity produced by the entrepreneur (i.e. $\frac{\partial \mathcal{E}_i^d(q_i)}{\partial q_i} < 0$). Hence, throughout the whole paper the following Assumption will hold:

Assumption 1. *Assume that the function $\Upsilon_i(q)$ satisfies:*

$$\frac{\partial}{\partial q}\left[-\frac{\Upsilon_i'(q)}{q\Upsilon_i''(q)}\right] \leq 0 \qquad \forall\, q > 0 \qquad \forall\, i \in [\omega, 1]$$

Entrepreneur's problem: each entrepreneur $i \in [\omega, 1]$ maximizes his own utility defined over final good consumption. In order to consume he employs profits received from his own firm, π_i, after hiring n_i workers from the labor market to produce. Formally, each entrepreneur $i \in [\omega, 1]$ solves:

$$\begin{aligned}
\max_{c_i, p_i, y_i, n_i} \quad & \frac{c_i^{1-\theta}}{1-\theta} \\
\text{s.t.} \quad & c_i = \pi_i \\
& \pi_i = p_i y_i - w n_i \\
& p_i = P\Upsilon_i'\left(\frac{y_i}{Y}\right) \\
& y_i = z_i k_i^{\nu} n_i^{1-\nu} \\
& z_i,\ k_i \text{ given}
\end{aligned} \tag{E}$$

3.2 Optimal entrepreneurs' production choices

Taking the first order conditions of each entrepreneur's $i \in [\omega, 1]$ problem (E) and combining them it is possible to obtain the following equation which characterizes the production choices of each entrepreneur:

$$\underbrace{P\Upsilon_i'(q_i^*)}_{p_i^*} = \underbrace{\frac{\mathcal{E}_i^d(q_i^*)}{\mathcal{E}_i^d(q_i^*) - 1}}_{\text{markup}} \cdot \underbrace{\frac{wY^{\frac{1}{1-\nu}}}{(1-\nu)}\left(\frac{q_i^{*\nu}}{z_i k_i^{\nu}}\right)^{\frac{1}{1-\nu}}}_{\text{marginal cost}} \tag{6}$$

Each entrepreneur i sets a price for his own variety p_i^* larger than its marginal cost of production, where the wedge between the two is the markup $\mu_i(q_i^*) = \frac{\mathcal{E}_i^d(q_i^*)}{\mathcal{E}_i^d(q_i^*)-1}$. First of all, notice that the markup chosen by each entrepreneur can be written as a function $\mu_i(q_i)$ of the relative quantity produced q_i. Assumption 1 guarantees that the markup function $\mu_i(q_i)$ is non-decreasing in relative production q_i. In particular, if the elasticity of demand is strictly decreasing in relative production, firms producing at a larger scale face a more rigid demand and choose higher markups. On the other hand, if the elasticity

of demand is constant, the markup function is a constant as well and markups imposed by firms do not depend on their production scale.
Equation (6) also shows that the optimal relative quantity q_i^* chosen by each entrepreneur depends on his wealth k_i, his skills z_i, as well as on the aggregates w, Y, P. Let's define the optimal relative quantity function $\mathcal{Q}_i^*(z_i, k_i, w, P, Y)$ which associates to each wealth level k_i, skills z_i and aggregates w, Y, P the optimal relative quantity q_i^* which solves equation (6). The properties of this function are summarized by the following Lemma:

Lemma 1. *Assume Assumption 1 holds and let $\mathcal{Q}_i^*(z_i, k_i, w, P, Y)$ be the function which associates to each vector (z_i, k_i, w, P, Y) the optimal relative quantity chosen by entrepreneur i, q_i^*, which solves (6). It holds:*

$$\frac{\partial \mathcal{Q}_i^*(\cdot)}{\partial z_i} > 0 \qquad \frac{\partial \mathcal{Q}_i^*(\cdot)}{\partial k_i} > 0 \qquad \frac{\partial \mathcal{Q}_i^*(\cdot)}{\partial w} < 0 \qquad \frac{\partial \mathcal{Q}_i^*(\cdot)}{\partial P} < 0 \qquad \frac{\partial \mathcal{Q}_i^*(\cdot)}{\partial Y} < 0$$

Proof: see Appendix A.

Lemma 1 shows that the higher the entrepreneurial ability z_i or the wealth of the entrepreneur k_i, the larger will be the optimal relative quantity chosen to be produced by the entrepreneur. This holds irrespectively of whether the markup imposed depends or not on the entrepreneur's production scale. The reason is that wealthier and more skilled entrepreneurs own firms that have lower marginal costs of production, allowing them to produce at a larger scale. Lemma 1 also shows that whenever the wage to be paid to workers w increases (keeping aggregates P, Y unchanged) marginal costs of production increase and hence entrepreneur i finds optimal to produce less. Finally, whenever the aggregate production Y is larger, keeping other aggregates unchanged, the optimal relative production of entrepreneur's i firm decreases.

Now, denote with $\mathcal{N}_i^*(z_i, k_i, w, P, Y)$ the function which associates to each vector (z_i, k_i, w, P, Y) the labor needed by entrepreneur i to produce the optimal relative quantity $\mathcal{Q}_i^*(z_i, k_i, w, P, Y)$ (i.e. the labor demand which solves entrepreneur's i problem (E)):

$$\mathcal{N}_i^*(z_i, k_i, w, P, Y) = \left(\frac{\mathcal{Q}_i^*(z_i, k_i, w, P, Y) \cdot Y}{z_i k_i^{\nu}} \right)^{\frac{1}{1-\nu}}$$

Differently from what happens for optimal relative quantity, Assumption 1 is not enough to guarantee a monotonic (increasing) relationship between optimal labor demand and entrepreneur's wealth k_i and skills z_i. The reason is the following. Whenever the entrepreneur gets wealthier or more productive he wants to produce more (Lemma 1) and to do that he could either hire more labor or just exploit his increase in productivity while employing less labor. However, it is possible to derive a sufficient condition on the function $\Upsilon_i(\cdot)$ which guarantees that optimal labor demand of each entrepreneur i is monotone increasing in his wealth k_i and skills z_i:

Assumption 2. *The function $\Upsilon_i(q)$ satisfies:*

$$-\frac{\Upsilon_i'(q)}{q\Upsilon_i''(q)} > 3 + \frac{q\Upsilon_i'''(q)}{\Upsilon_i''(q)} \quad \forall q > 0,\ \forall i$$

Assumption 2 requires that the price elasticity of demand (left-hand side) faced by each entrepreneur is sufficiently large so that an entrepreneur, in response to a 1% increase in productivity, finds optimal to expand his production by more than 1%. To do that the entrepreneur must complement his productivity or capital increase with an increase in labor demand. Notice that Assumption 2 will be satisfied by the functional forms for $\Upsilon_i(\cdot)$ that I will use in the following Sections of the paper. Lemma 2 summarizes the properties of the function $\mathcal{N}_i^*(\cdot)$:

Lemma 2. *Let Assumption 1 and 2 hold and let $\mathcal{N}_i^*(z_i, k_i, w, P, Y)$ be the function which associates to each vector (z_i, k_i, w, P, Y) the labor demand which allows entrepreneur i to produce $\mathcal{Q}_i^*(z_i, k_i, w, P, Y)$ (i.e. the labor demand which solves entrepreneur's i problem (E)). It holds:*

$$\frac{\partial \mathcal{N}_i^*(\cdot)}{\partial z_i} > 0 \qquad \frac{\partial \mathcal{N}_i^*(\cdot)}{\partial k_i} > 0 \qquad \frac{\partial \mathcal{N}_i^*(\cdot)}{\partial w} < 0 \qquad \frac{\partial \mathcal{N}_i^*(\cdot)}{\partial P} < 0 \qquad \frac{\partial \mathcal{N}_i^*(\cdot)}{\partial Y} > 0$$

Proof: see Appendix A

The profits of each entrepreneur i when making his optimal production choices $\mathcal{Q}_i^*(z_i, k_i, w, P, Y)$ and $\mathcal{N}_i^*(z_i, k_i, w, P, Y)$ are:

$$\Pi_i^*(z_i, k_i, w, P, Y) := p_i(\mathcal{Q}_i^*(z_i, k_i, w, P, Y), P) \cdot \mathcal{Q}_i^*(z_i, k_i, w, P, Y) \cdot Y - w\mathcal{N}_i^*(z_i, k_i, w, P, Y)$$

where $p_i(\cdot)$ denotes the demand function for the intermediate good produced by the entrepreneur i derived in (4). Using the FOC of the entrepreneur (6) and rearranging, optimal profits re-write as:

$$\Pi_i^*(z_i, k_i, w, P, Y) = \left(\frac{\mu_i(\mathcal{Q}_i^*(z_i, k_i, w, P, Y))}{1-\nu} - 1 \right) w\mathcal{N}_i^*(z_i, k_i, w, P, Y) \tag{7}$$

where $\mu_i(q) = \mathcal{E}_i^d(q)/(\mathcal{E}_i^d(q) - 1)$ is the markup function. The profits that each entrepreneur makes are the product of two terms: the one in parenthesis indicates the marginal profit per dollar of input purchased from the market. The second term $w\mathcal{N}_i^*(z_i, k_i, w, P, Y)$, instead, indicates the total value of inputs purchased from the market by the entrepreneur. The following Lemma summarizes the properties of the profits function:

Lemma 3. *Let Assumption 1 and 2 hold and let $\Pi_i^*(z_i, k_i, w, P, Y)$ be the function which associates to each tuple (z_i, k_i, w, P, Y) the profits entrepreneur i makes when producing $\mathcal{Q}_i^*(z_i, k_i, w, P, Y)$. It holds:*

$$\frac{\partial \Pi_i^*(\cdot)}{\partial z_i} > 0 \qquad \frac{\partial \pi^*(\cdot)}{\partial k_i} > 0 \qquad \frac{\partial \Pi_i^*(\cdot)}{\partial w} < 0 \qquad \frac{\partial \Pi_i^*(\cdot)}{\partial P} < 0 \qquad \frac{\partial \Pi_i^*(\cdot)}{\partial Y} > 0$$

Proof: see Appendix A

Wealthier and more skilled entrepreneurs make larger profits. Furthermore profits are decreasing in the equilibrium wage to be paid to workers and increasing in aggregate production Y. The profit function previously obtained allows to define the average returns to entrepreneurial investment of each entrepreneur i:

$$\mathcal{R}_i^*(z_i, k_i, w, P, Y) = \frac{\Pi_i^*(z_i, k_i, w, P, Y)}{k_i} \tag{8}$$

Notice that the return function inherits most of the properties from the optimal profit function, that is returns to entrepreneurial investment are increasing in the skills of the entrepreneur and in aggregate production Y while decreasing in the aggregates w, P. However, whether returns increase with the wealth of the entrepreneur depends on whether profits increase more or less than 1-to-1 with entrepreneurial wealth.

3.3 Equilibrium

The equilibrium of this static economy is a set of aggregates $\{w^*, Y^*, P^*\}$, a vector of quantities consumed by each household (workers and entrepreneurs) $\{c_i^*\}_{i\in[0,1]}$, relative quantity functions $\mathcal{Q}_i^*(z_i, k_i, w, P, Y)$, labor demand functions $\mathcal{N}_i^*(z_i, k_i, w, P, Y)$, profit functions $\Pi_i^*(z_i, k_i, w, P, Y)$ such that:

- Each worker $i \in [0, \omega]$ consumes his labor income $c_i^* = w^* e_i$
- Given the aggregates $\{w^*, Y^*, P^*\}$ the functions $\mathcal{Q}_i^*(z_i, k_i, w^*, P^*, Y^*)$, $\mathcal{N}_i^*(z_i, k_i, w^*, P^*, Y^*)$, $\Pi_i^*(z_i, k_i, w^*, P^*, Y^*)$ solve entrepreneur's i problem (E)
- Each entrepreneur $i \in [\omega, 1]$ consumes his own profits: $c_i^* = \Pi_i^*(z_i, k_i, w^*, P^*, Y^*)$
- Labor market clears:

$$\int_0^\omega e_i di = \int_\omega^1 \mathcal{N}_i^*(z_i, k_i, w^*, P^*, Y^*) di$$

- Kimball aggregator is satisfied:

$$\int_\omega^1 \Upsilon_i \left(\mathcal{Q}_i^*(z_i, k_i, w^*, P^*, Y^*)\right) di = 1$$

4 Wealth tax policy effects with scale dependent markups

In this Section, I calibrate and simulate the static model presented in Section 3 assuming that the mechanism through which entrepreneurs' market power arises is *scale dependence*. That is, the larger entrepreneurs' firm market share, the larger the market power and the markup imposed by the entrepreneur. In this setting I analyze the effects of a top wealth tax policy on entrepreneurs' production decisions and on the aggregates of this economy.

This Section will serve as a benchmark case to compare the effects of the same revenue-equivalent wealth tax in two alternative economies. First, the economy in which market power arises through *type dependence* (i.e. different entrepreneurs impose heterogeneous but constant, markups independent of the entrepreneur's production scale) and then in an economy in which all entrepreneurs impose the same (constant) markup.

4.1 Calibration

First of all, let's set the fraction of workers in this economy to be $\omega = 0.88$. This number is obtained by computing the fraction of households in the 2019 SCF satisfying the definition of entrepreneur reported in Section 2 (0.12) and considering as workers all those

households not defined as entrepreneurs.
Assume that each entrepreneur $i \in [\omega, 1]$ draws his entrepreneurial skills z_i from a Pareto distributed random variable $Pa(x_z, \eta_z)$, where x_z and η_z represent, respectively, the scale and shape parameters of the entrepreneurial skills distribution, which will be appropriately calibrated to capture the observed return heterogeneity across entrepreneurs presented in Section 2. In a dynamic setting in which entrepreneurs make consumption-saving choices and accumulate their own wealth (see Section 6) the correlation between entrepreneurial skills and their wealth arises endogenously. In this static setting in which the wealth of each entrepreneur is exogenous, instead, it has to be assumed[10]. In particular, I assume that the wealth of each entrepreneur is a monotone increasing (and deterministic) function of his skills, that is $k_i = k(z_i) = \alpha_0 z_i^{\alpha_1}$ with $\alpha_0, \alpha_1 > 0$. In other terms, entrepreneurs with higher skills are also wealthier entrepreneurs. Two remarks are due. First of all, a positive relationship between skills and wealth is needed in order to replicate the increasing shape of returns to entrepreneurship across the wealth distribution observed in the data. Furthermore, the functional form $k(\cdot)$ is chosen so to transform the entrepreneurial skill distribution (Pareto) into another Pareto distribution (with different scale and shape parameters). This choice is needed so to replicate the shape of the observed entrepreneurial wealth distribution which, displaying a thick upper tail, is well fit by a Pareto distribution (Benhabib and Bisin (2018), Vermeulen (2018)). The parameters characterizing the entrepreneurial skill distribution x_z and η_z are calibrated so to minimize the sum of squared errors between simulated and empirical returns to entrepreneurship across the following wealth groups: $\{50{-}70p., 70{-}85p., 85{-}95p., 95{-}98p., 98-99p., top\ 1\}$. The estimated values for the parameters are reported in Table 2. The parameter ν is chosen so to match 2019 US labor share of 60%. However, notice that in this setting in which entrepreneurs operate under monopolistic competition and impose markups, $1-\nu$ is not equal to the labor share of the economy. To see this, define the aggregate labor demand: $N := \int_\omega^1 \mathcal{N}_i^*(z_i, k_i, w, Y, P)di$. The first order condition (6) characterizing the choices of all entrepreneurs $i \in [\omega, 1]$ can be rearranged and integrated

[10] In this setting there is no distinction between overall wealth of the entrepreneur and wealth held as capital in the business (i.e. "entrepreneurial wealth"). However, the calibration target is the "entrepreneurial wealth" distribution (rather than the overall entrepreneur's wealth). The reason of this choice is that the focus of this Section is on the effects of wealth taxation on entrepreneur's production choices, rather that on overall wealth accumulation.

across all entrepreneurs to get:

$$w = \frac{1}{\mathcal{M}}(1-\nu)\frac{Y}{N} \quad \Rightarrow \quad \frac{wN}{Y} = \frac{1-\nu}{\mathcal{M}} \tag{9}$$

where the *aggregate markup* $\mathcal{M}$ is defined as:

$$\mathcal{M} := \int_{\omega}^{1} \mu_i(\mathcal{Q}_i^*(z_i, k_i, w, P, Y))\frac{\mathcal{N}_i^*(z_i, k_i, w, P, Y)}{N}di$$

that is the aggregate markup is an input-weighted arithmetic average of firm-level markups. Hence, since all markups are greater than one, it holds $\mathcal{M} > 1$. Edmond et al. (2023) survey the empirical literature on markups in the US economy and report that $1.05 < \mathcal{M} < 1.35$. I calibrate my model in order to target the aggregate markup in the middle of the presented range, i.e. $\mathcal{M} = 1.2$. Under this choice, by using equation (9) it is possible to show that by setting $\nu = 0.28$ I can replicate the targeted labor share of 60%.

In this Section of the paper I assume that market power arises through *scale dependence*, in particular, the larger the relative production (w.r.t aggregate production) of the entrepreneur's firm, the larger the market power and markup imposed. Thus, it is crucial that my model replicates an empirically plausible relationship between firm size and its market power. To do that, I choose a functional form for $\Upsilon_i(\cdot)$ which allows me to match the empirically observed firm-level relationship between markups and market shares of US firms. To achieve this objective, for all entrepreneurs i, I assume the Klenow and Willis (2016) functional form for $\Upsilon_i(\cdot)$:

$$\Upsilon_i(q;\sigma,\psi) = \Upsilon(q;\sigma,\psi) = 1 + (\sigma-1)e^{1/\psi}\psi^{\frac{\sigma}{\psi}-1}\left[\Gamma\left(\frac{\sigma}{\psi},\frac{1}{\psi}\right) - \Gamma\left(\frac{\sigma}{\psi},\frac{(q)^{\frac{\psi}{\sigma}}}{\psi}\right)\right] \tag{10}$$

with $\sigma > 1$ and $\psi \geq 0$, and where $\Gamma(s,x)$ denotes the function:

$$\Gamma(s,x) := \int_x^{\infty} t^{s-1}e^{-t}dt$$

To have a clearcut interpretation of the parameters σ and ψ let's use equation (5) to obtain the elasticity of demand and markup functions with the chosen $\Upsilon_i(\cdot)$ for all i (for details, see Appendix B):

$$\mathcal{E}_i^d(q_i) = \sigma(q_i)^{-\frac{\psi}{\sigma}} \qquad \mu_i(q_i) = \frac{\mathcal{E}_i^d(q_i)}{\mathcal{E}_i^d(q_i)-1} = \frac{\sigma}{\sigma - q_i^{\frac{\psi}{\sigma}}} \tag{11}$$

Notice that σ captures the level of the elasticity of demand when $q_i = 1$. Instead, the parameter ψ identifies the sensitivity of the elasticity of demand to changes in q_i. In other words, ψ regulates the concavity of the demand function for the intermediate good produced by entrepreneur i (again, see Appendix B for details).

In this setting it is possible to show that the ratio of parameters $\frac{\psi}{\sigma}$ corresponds to the coefficient in a regression of (a monotone increasing transformation of) firms' markups on firms' market shares[11]. Exploiting this relationship, Edmond et al. (2023) use 1972-2012 US Census of Manufacturers data to estimate $\frac{\psi}{\sigma}$ across 3-digits NAICS sectors and obtain: $0.081 < \frac{\psi}{\sigma} < 0.242$. They also argue that the regression coefficients they estimate perform very well in fitting the empirical relationship between firm level markups and market shares. Therefore, I choose to target $\frac{\psi}{\sigma} = 0.162$ (which is the mid-point of the Edmond et al. (2023) parameter estimates range).

In order to calibrate the two parameters σ and ψ, thus, I have two targets: the aggregate markup $\mathcal{M} = 1.2$ and $\frac{\psi}{\sigma} = 0.162$. By setting $\sigma = 11.75$ and $\psi = 1.9$ I match these targets.

Finally, I assume that time worked by each worker e_i is drawn from a Log-Normally distributed random variable $E \sim LogNorm(-\frac{\sigma_e^2}{2}, \sigma_e^2)$, with $\mathbb{E}(E) = 1$ and variance determined by the parameter σ_e^2. The parameter σ_e^2 is calibrated so to match a Gini coefficient for income inequality in the US of 0.59 in 2019 (World Inequality Database). Table 2 summarizes the parameter choices described above and Figure 6 shows that the calibrated model closely replicates the observed returns to entrepreneurial investment.

Simulation results: Figure 7 shows the simulated relative quantities $q_i^* = \mathcal{Q}_i^*(z_i, k_i, w^*, P^*, Y^*)$, markups $\mu_i(\mathcal{Q}_i^*(z_i, k_i, w^*, P^*, Y^*))$ and labor demand $n_i^* = \mathcal{N}_i^*(z_i, k_i, w^*, P^*, Y^*)$ chosen by entrepreneurs across the wealth distribution. Entrepreneurial choices are reported starting from the 50^{th} wealth percentile only to better focus on the behavior of the curves at the top of the wealth distribution where 99% of the total entrepreneurial wealth is concentrated. Notice that, since entrepreneurial ability z_i is assumed to be positively correlated with entrepreneurial wealth k_i, relative quantity q_i^* is strictly increasing across the wealth distribution (as shown by Lemma 1). The markup $\mu_i(q_i^*)$ follows the same kind of behavior. Finally, notice that labor demand of entrepreneurs across the wealth distribution replicates very closely the observed pattern of the number of employees in entrepreneurs' firms across the wealth distribution (see Figure 4).

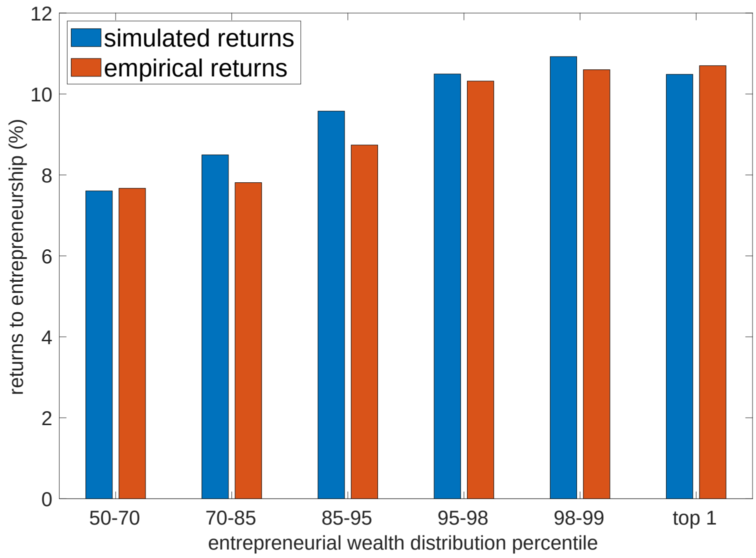
[11] A proof of this statement is provided in Appendix B of Edmond et al. (2023).

Table 2. *Model calibration: summary*

Par.	Description	Value	Target
ω	fraction of workers	0.88	non-entrepreneur household in SCF
ν	capital exponent prod.	0.28	labor share = 0.6
x_z	scale par. entr. ability dist.	0.12	observed returns to entrepreneurship
η_z	shape par. entr. ability dist.	5.0	observed returns to entrepreneurship
σ	demand elasticity when $q = 1$	11.75	$\mathcal{M} = 1.2$
ψ	shape par. demand elasticity	1.90	$\psi/\sigma = 0.16$
α_0	$k_i = k(z_i) = \alpha_0 z_i^{\alpha_1}$	383	min. wealth = 1
α_1	$k_i = k(z_i) = \alpha_0 z_i^{\alpha_1}$	3.97	tail par. ent. wealth 1.25
σ_e^2	variance labor supply dist.	1.1	Gini coeff. income inequality = 0.59

Notes: *the Table summarizes the calibrated model's parameters values. The first column indicates the symbol used to identify the parameter in the model, the second column the parameter description, the third column the chosen value for the parameter, the fourth column the moment targeted to calibrate each parameter.*

Figure 6. *Simulated vs empirical returns to entrepreneurship*

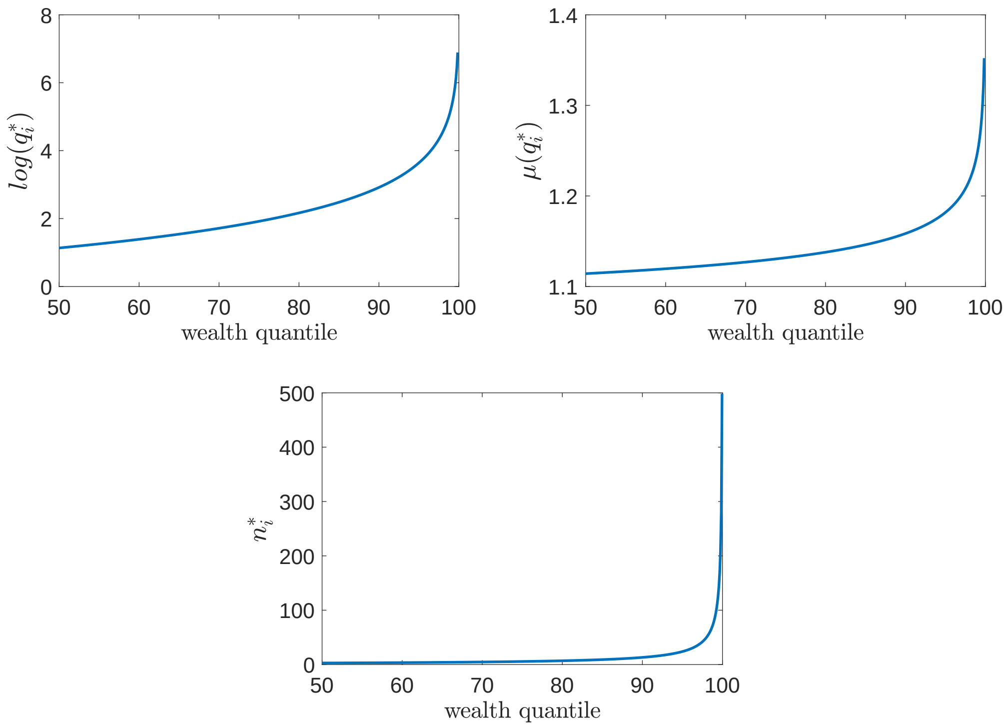


Notes: *the Figure reports the simulated returns to entrepreneurship (blue) and the estimated returns to entrepreneurship (orange). The simulated returns are computed by averaging across wealth percentiles bins the returns obtained as in (8) (for calibration details see Table 2). The estimated returns are those reported in Figure 5.*

4.2 Top wealth tax policy

Only three OECD countries currently levy a tax on a comprehensive measure of wealth, that is Norway, Switzerland and Spain. The wealth taxes implemented in these countries share the common feature of being proportional wealth taxes on the wealth in excess of a given threshold (e.g. it is taxed the wealth in excess of the top 1% wealth threshold). The wealth tax policy I study will have these features. Formally, let's consider the proportional wealth tax, with tax rate $\tau > 0$, on the wealth in excess of an exogenously

FIGURE 7. *Simulated entrepreneurs' choices across the wealth distribution*



Notes: *the Figure reports the simulated relative quantities q_i^*, markups $\mu(q_i^*)$, and labor demand n_i^* for entrepreneurs at different quantiles of the wealth distribution when the static model presented in Section 3, calibrated as described in Table 2, is simulated.*

given threshold $\underline{k} > 0$. Furthermore, also assume that the tax revenues collected are uniformly redistributed to all households (workers and entrepreneurs) through a lump-sum transfer T. Each worker $i \in [0, \omega]$, once the tax policy is implemented, consumes $c_i = we_i + T$. The problem of each entrepreneur $i \in [\omega, 1]$, now becomes:

$$\begin{aligned}
\max_{c_i, p_i, y_i, n_i} \quad & \frac{c_i^{1-\theta}}{1-\theta} \\
\text{s.t.} \quad & c_i = \pi_i + T \\
& \pi_i = p_i y_i - w n_i \\
& p_i = P\Upsilon_i'\left(\frac{y_i}{Y}\right) \\
& y_i = z_i \left(k_i - \mathbb{I}_{k_i \geq \underline{k}} \tau (k_i - \underline{k})\right)^{\nu} n_i^{1-\nu} \\
& z_i, \; k_i \text{ given}
\end{aligned}$$

where $\mathbb{I}_{k_i \geq \underline{k}}$ is the indicator function taking value one when $k_i > \underline{k}$ and zero otherwise, $p_i = P\Upsilon_i'(y_i/Y)$ is the demand for the good produced by the entrepreneur i derived in equation (4) and the lump sum transfer T satisfies:

$$T = \int_{k_i > \underline{k}} \tau(k_i - \underline{k}) di$$

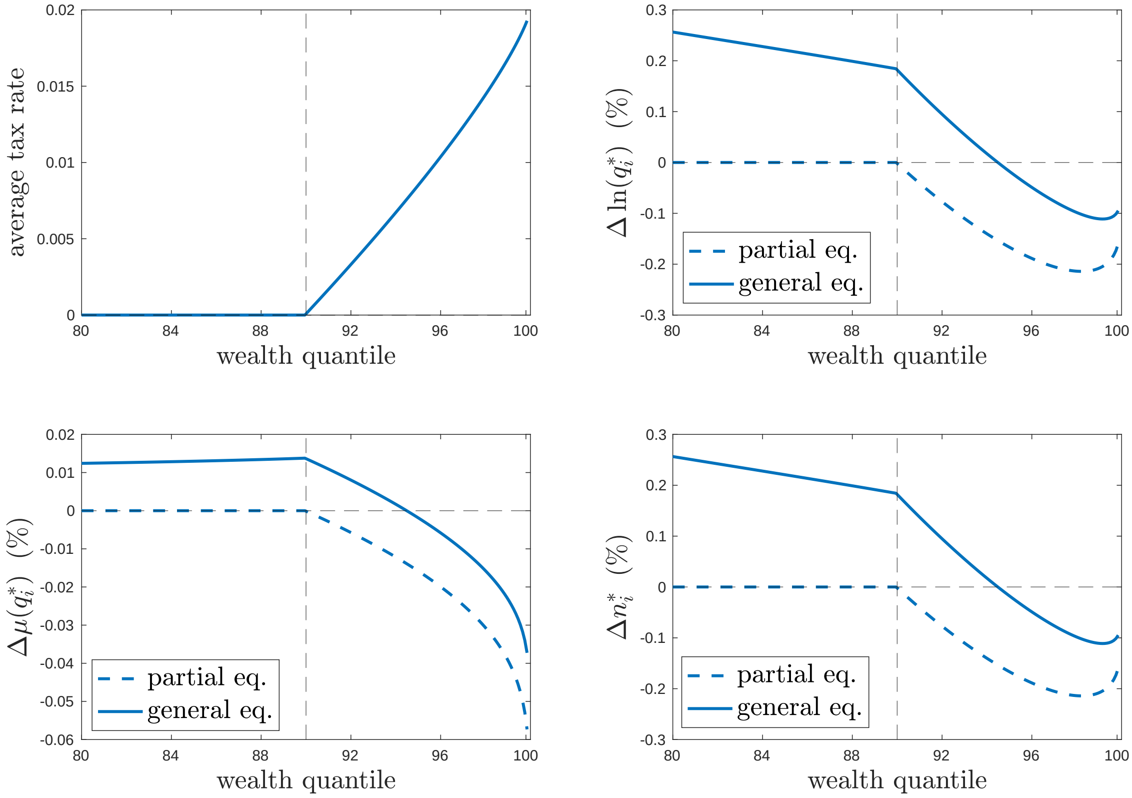
As an illustrative exercise to study how wealth taxation imposed at the top of the wealth distribution affects entrepreneurial choices, consider a wealth tax that is implemented on the wealthiest 1% of US households. As argued in Section 2.2 entrepreneurs are extremely concentrated at the top of the wealth distribution. Using the SCF 2019 data I can show that a wealth tax imposed on the wealthiest 1% of US households, actually falls on the wealthiest 10% of US entrepreneurs. In my setting this is equivalent to set $\underline{k}$ corresponding to the 90^{th} percentile of the entrepreneurial wealth distribution. Furthermore, I assume $\tau = 2\%$ so that wealth tax revenues amount approximately to 1% of GDP, a reasonable figure for a top wealth tax absent tax evasion effects (Saez and Zucman (2022)).

Effects on entrepreneurial choices: The panels of Figure 8 show the partial equilibrium (i.e. keeping w, Y, P unchanged) and general equilibrium effects of the previously described wealth tax on the choices of entrepreneurs across the wealth distribution. The first panel on the left shows the average tax rate, that is the total amount of taxes paid over total wealth of each entrepreneur i. Notice that the average tax rate becomes positive at the 90^{th} percentile of the entrepreneurial wealth distribution and is increasing, reaching a maximum average tax rate of 2% at the very top.

First of all, consider the effects of the wealth tax (dotted blue lines) in partial equilibrium. Untaxed entrepreneurs, in partial equilibrium, do not change their production choices, while taxed entrepreneur, experiencing a decrease in their wealth endowment decrease their relative production, the markup they impose and also their labor demand. The wealth tax hence, by taking away resources from productive entrepreneurs and redistributing them as lump-sum transfers reduces aggregate production and aggregate labor demand. Since aggregate labor supply is inelastic the decrease in labor demand induces a decrease in equilibrium wage so to have labor market clearing.

In general equilibrium (solid blue lines) untaxed entrepreneurs increase their relative quantity produced due to the decrease in aggregate production and equilibrium wage (see Lemma 1). The markups they impose, depending solely on the relative quantity produced increase. Finally, their labor demand increases as well (the positive effect on labor demand determined by the reduction in w outweighs the negative effect on labor

Figure 8. *Wealth tax simulation: effect on entrepreneurs' choices*



Notes: *the Figure represents the effects of the wealth tax described in Section 4.3 with $\tau = 0.02$ on the model calibrated as described in Section 4.2. The first panel indicates the average tax rate (total taxes paid/ total wealth). The other panels represent the differences between entrepreneurs' choices (relative quantities, markups, labor demand) when the tax policy is implemented and the same quantities when the tax policy is not in place. Dotted lines indicate the partial equilibrium effects of the wealth tax (i.e. keeping fixed w, P, Y). Solid lines indicate the effect of the wealth tax on entrepreneurs' choices taking into account general equilibrium effects.*

demand induced by the reduction in Y). Furthermore, notice that entrepreneurs between the 90^{th} and 95^{th} wealth percentile, although being taxed, experience an increase in their relative production, markups and labor demand due to the general equilibrium effects previously described. Finally, entrepreneurs beyond the 95^{th} wealth percentile still decrease their relative quantity, markups and labor demand, although in a lower extent with respect to what was happening in partial equilibrium.

Effects on aggregate variables: it is possible to write aggregate production Y as:

$$Y = ZK^{\nu}N^{1-\nu}$$

where $K := \int_{\omega}^{1} k_i di$, $N := \int_{\omega}^{1} \mathcal{N}_i^*(z_i, k_i, w, P, Y)di$ and aggregate productivity is defined as:

$$Z := \left(\int_{\omega}^{1} \frac{\mathcal{Q}_i^*(z_i, k_i, w, P, Y)}{z_i} di\right)^{-1} \tag{12}$$

In particular, notice that it is possible to interpret aggregate productivity Z as the *harmonic weighted average* of the entrepreneurial productivities z_i, where the individual weights are given by the relative quantities q_i produced by each entrepreneur i.
The considered wealth tax unambiguously reduces aggregate production by reducing both the aggregate stock of capital available for production (i.e. K decreases) and also shifting production from high productive entrepreneurs to low productive entrepreneurs (i.e. aggregate productivity decreases). In particular, the considered wealth tax (whose revenues amount to approximately 1% of GDP) determines a reduction of GDP of 0.25% ($\Delta Y = -0.25\%$) and a reduction in equilibrium wage of 0.21% ($\Delta w = -0.21\%$).
Furthermore, the considered wealth tax by reducing the markups of the wealthiest entrepreneurs and increasing the markups of the poorest ones determines a decrease in the aggregate markup of 0.04%. As highlighted by equation (9) the aggregate markup in this economy depresses the labor share of income. Hence, the considered wealth tax at the cost of an efficiency loss not only raises tax revenues to be redistributed from wealthy entrepreneurs to poor workers, but also increases the share of aggregate income accruing to workers ($\Delta wN/Y = -\Delta \mathcal{M} = 0.04\%$).

5 Wealth tax policy effects with constant markups

In the previous Section I simulated the effects of a wealth tax policy in an economy where entrepreneurs producing on a larger scale were imposing larger markups and hence imposing larger production distortions. How does the equity-efficiency trade-off of wealth taxation change if entrepreneurs still impose heterogeneous but constant (independent of production scale) markups? What if, instead, this market power heterogeneity is neglected? This Section answers these questions by studying the effects of the same wealth tax policy studied in Section 4 in these two alternative scenarios.

5.1 Calibration

Constant and heterogeneous markups (type dependence): if market power arises through type dependence, each entrepreneur i imposes a constant markup, whose size depends on the entrepreneur's features and not on the firm production size. To model this mechanism, I assume that each entrepreneur faces a demand function for his own variety featuring constant elasticity of demand (heterogeneous across entrepreneurs). To this aim I assume that for each entrepreneur i:

$$\Upsilon_i(q) = q^{\frac{\sigma_i - 1}{\sigma_i}}$$

with $\sigma_i > 0$ for all i. Under this assumption the demand curve faced by entrepreneur i is:

$$p_i(q) = q^{-\frac{1}{\sigma_i}}$$

Now each entrepreneur i produces up to the point in which the price of his good equalizes his marginal cost of production times a markup $\frac{\sigma_i}{\sigma_i - 1}$ which is independent of the production size and heterogeneous across entrepreneurs (under the assumption of heterogeneous σ_i). I calibrate this model so to match the same targets matched in the economy with variable markups analyzed in Section 4.

The parameters of the entrepreneurial skills distribution $Pa(x_z, \eta_z)$ from which the skills of each entrepreneur are drawn, are recalibrated so to match the same moments of the return distribution targeted before. The parameters of the function $k(z_i) = \alpha_0 z_i^{\alpha_1}$ which associates to each entrepreneur i with skills level z_i the level of wealth $k_i = k(z_i)$ is recalibrated so that the entrepreneurial wealth distribution of this economy remains the same as the one of the economy with variable markups. Finally, I assume the elasticity of demand σ_i of entrepreneur i to be a monotone increasing polynomial function of the entrepreneur's skills: $\sigma_i = \sigma(z_i)$. In particular the functional form for $\sigma(\cdot)$ is chosen so that the entrepreneur belonging to wealth (and skill) distribution quantile x imposes the same markup imposed by the entrepreneur at the x quantile of the wealth distribution in variable markup model. In this way I perfectly replicate the markup distribution across entrepreneurs obtained in the variable markup model. Notice that, although not targeted, the aggregate markup in this economy still remains $\mathcal{M} = 1.2$ since the markup distribution, production and labor demand choices of entrepreneurs replicate extremely closely the ones of the model with variable markups presented in Section 4. All the other parameters of the model remain unchanged as you can see in Table 5 (Appendix C), which summarizes the calibration choices. Figure 16 (Appendix C) shows that the calibrated model closely replicates the observed distribution of returns to entrepreneurship.

Constant and homogeneous markups: To model entrepreneurs choosing the same (constant) markups I assume they now face a demand function for their own variety with constant elasticity of demand common across everybody. To do that assume for all entrepreneurs i:

$$\Upsilon_i(q) = \Upsilon(q) = q^{\frac{\sigma-1}{\sigma}}$$

with $\sigma > 1$. When this is the case the demand curve faced by each entrepreneur i derived in (4) takes the following form:

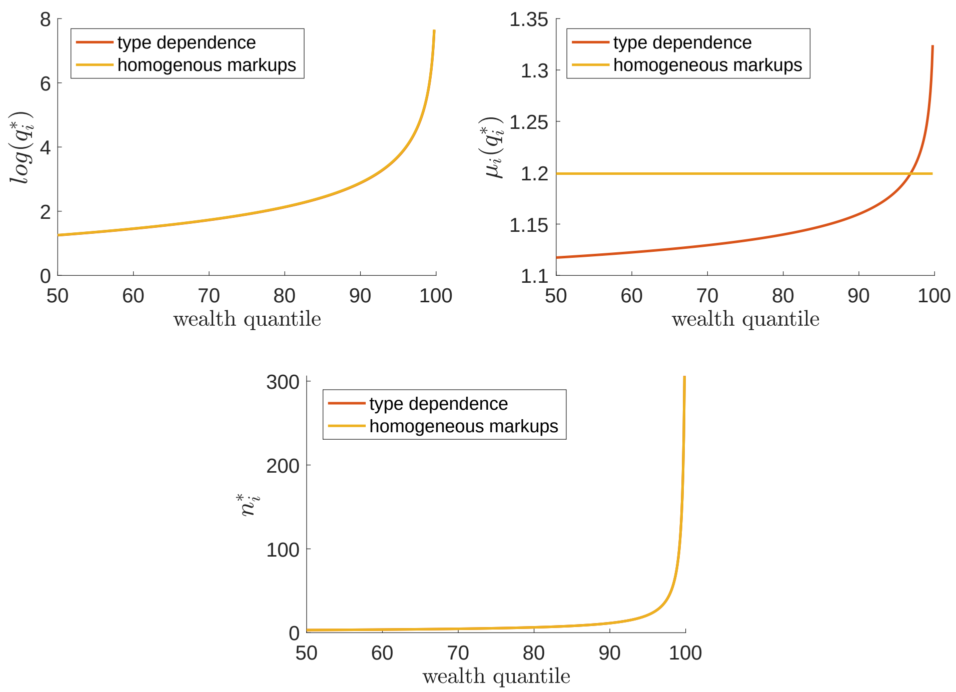
$$p_i(q) = q^{-\frac{1}{\sigma}}$$

Now each entrepreneur i imposes the same, constant markup $\frac{\sigma}{\sigma-1}$. I calibrate this model so to match the same targets matched in the economies with heterogeneous markups, apart from markups heterogeneity.

First of all, the elasticity of demand parameter $\sigma = 1.2$ is calibrated so to match the same aggregate markup $\mathcal{M} = 1.2$ targeted in the economy with variable markups. Notice, hence, that all entrepreneurs now impose a markup equal to the aggregate markup. Again, the parameters of the entrepreneurial skills distribution $Pa(x_z, \eta_z)$ are recalibrated so to match the observed return distribution. Finally, the parameters of the function $k(z_i) = \alpha_0 z_i^{\alpha_1}$ are recalibrated so to obtain the same entrepreneurial wealth distribution of the economy with variable markups. All the other parameters of the model remain unchanged as you can see in Table 6 (Appendix C), which summarizes the calibration choices. Figure 17 (Appendix C) shows that the calibrated model is able to closely replicate the observed return distribution.

Figure 9 reports the simulated choices of entrepreneurs across the wealth distribution in the two calibrated economies. In both cases, wealthier entrepreneurs (being also more skilled) produce at a larger scale and demand more labor. In the economy with market power arising through type dependence markups are heterogeneous across entrepreneurs while in the other one markups are homogeneous across everyone. Notice, however, that markups are constant (independent of entrepreneur's production scale) in both economies.

FIGURE 9. *Simulated entrepreneurs' choices across the wealth distribution: constant markups model*

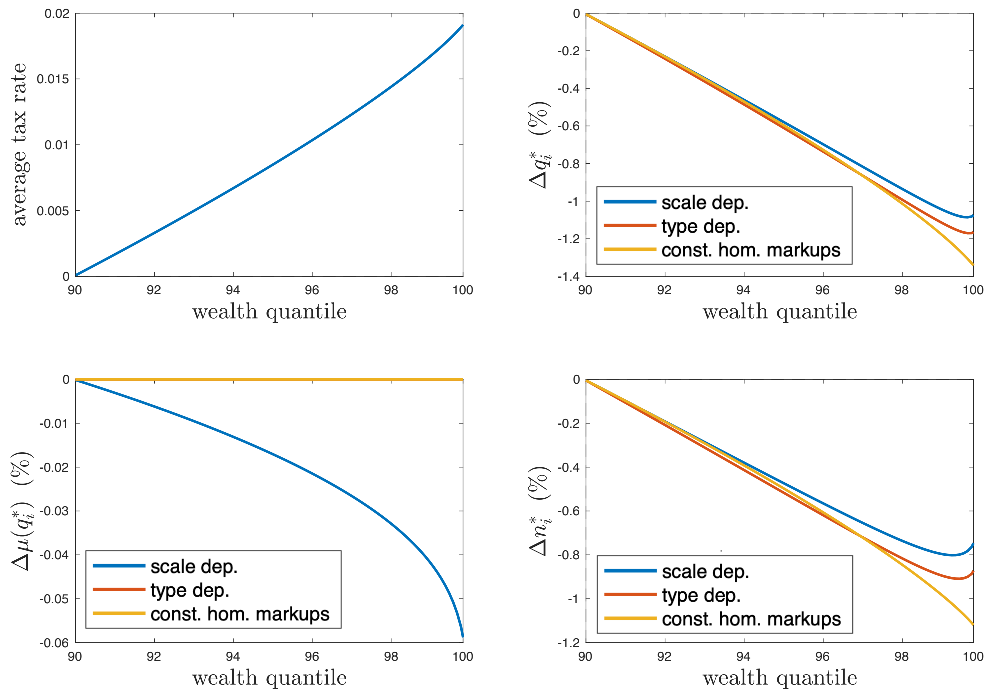


Notes: *the Figure reports the simulated relative quantities q_i^*, markups $\mu_i(q_i^*)$ and labor demand n_i^* for entrepreneurs at different quantiles of the wealth distribution. The curves in red are derived from the simulated model when entrepreneurs have heterogeneous and constant markups (type dependence) and the yellow lines when entrepreneurs have the same (constant) markups. Calibration details in this Section.*

5.2 Wealth tax policy: effects comparison

How does the equity-efficiency trade-off of top wealth taxation change when I assume that all entrepreneurs impose constant and homogeneous markups rather than markups increasing with their market share? What if, instead the mechanism generating markups heterogeneity across entrepreneurs is *type-dependence* rather than *scale-dependence*? To

FIGURE 10. *Wealth tax effects comparison: partial equilibrium*



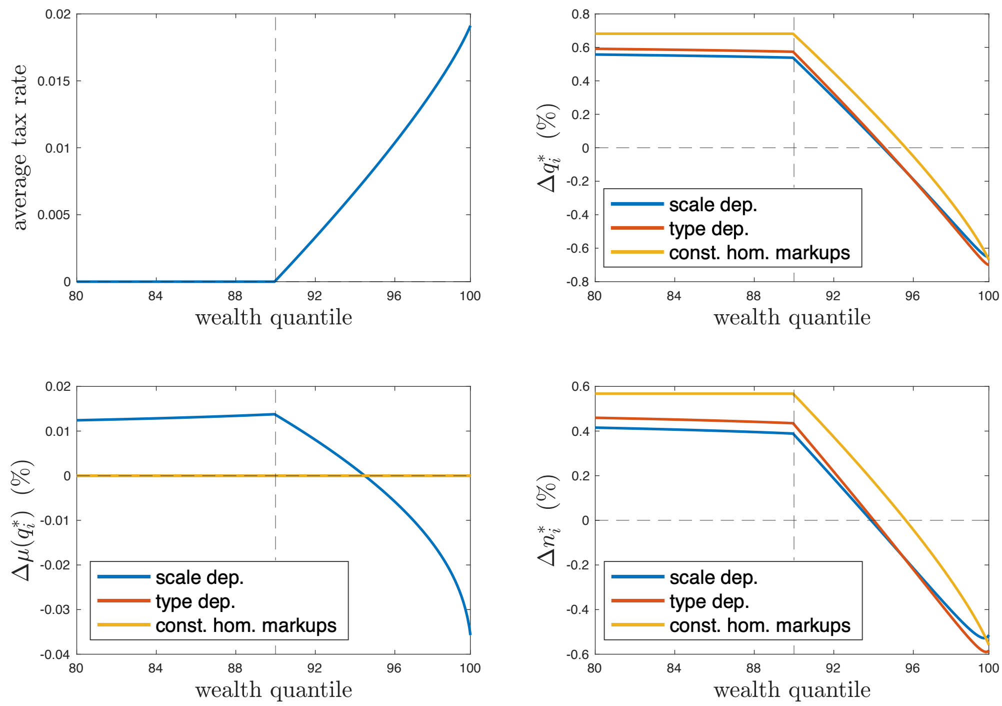
Notes: *Figure represents the partial equilibrium effects (i.e. keeping w, Y, P fixed) of the wealth tax described in Section 4.2 with $\tau = 0.02$ on entrepreneurs' production choices. Blue lines represent the effects of the wealth tax in the economy in which market power arises through scale-dependence. Orange lines represent the effects of the wealth tax in the economy in which market power arises through type dependence. Yellow lines represent the effects of the tax when entrepreneurs impose homogeneous and constant markups. The first panel indicates the average tax rate. The other panels represent the differences between entrepreneurs' choices (relative quantities, markups, labor demand) when the tax policy is implemented and the same quantities when the tax policy is not in place.*

answer these questions I implement the same (revenue equivalent) wealth tax studied in Section 4.2, in the calibrated economies in which entrepreneurs impose constant and heterogeneous or constant and homogeneous markups. The effects of the considered wealth tax on the choices of entrepreneurs in the three economies are reported in Figures 10 and 11.

Let's start by comparing the partial equilibrium effects of the wealth tax reported in Figure 10. In all economies taxed entrepreneurs (i.e. those from the 90^{th} percentile onward) in partial equilibrium, reduce their production and decrease their labor demand. The same revenue equivalent wealth tax, however, has *quantitatively* different effects in the three economies. The reason behind this quantitative difference relies on the shape of entrepreneurs' marginal revenue curve.

First, let's focus on the difference between the economy in which market power arises through type dependence (orange curves) and the one in which entrepreneurs impose homogeneous markups (yellow curves). In the economy with markups arising through

FIGURE 11. *Wealth tax effects comparison: general equilibrium*



Notes: *Figure represents effects of the wealth tax described in Section 4.3 with $\tau = 0.02$ on entrepreneurs' production choices in general equilibrium. Blue lines represent the effects of the wealth tax in the economy in which entrepreneurs face Kimball demand (and impose heterogeneous markups). Orange lines represent the effects of the wealth tax in the economy in which entrepreneurs face CES demand for their own goods (and impose constant markups). The first panel indicates the average tax rate. The other panels represent the differences between entrepreneurs' choices (relative quantities, markups, labor demand) when the tax policy is implemented and the same quantities when the tax policy is not in place.*

type dependence entrepreneurs at the very top of the wealth distribution (beyond 97^{th} wealth percentile) impose an above the average markup, larger than the one imposed by entrepreneurs with the same wealth in the economy with homogeneous markups. This is the case because entrepreneurs beyond 97^{th} wealth percentile face a more rigid demand schedule for their own variety in the economy with type dependent markups. Notice that if an entrepreneur faces a more rigid demand function for his own variety, his marginal revenue and marginal profit functions are steeper. Hence, the entrepreneurs with wealth beyond 97^{th} wealth percentile have steeper marginal profits functions in the economy with type dependent markups.

Now, suppose that one of these extremely wealthy entrepreneurs receives a negative wealth shock due to the wealth tax. This induces the entrepreneur to decrease his own production up to the point in which his marginal profits are zero. The size of this reduction in production depends on the steepness of the marginal profits curve. In particular, the considered wealth shock induces a larger decrease in production when the entrepreneur has a steeper marginal profit function. This explains why the reduction in labor demand and production of taxed entrepreneurs beyond the 97^{th} wealth percentile is larger in the economy with homogeneous markups than in the economy with type dependent markups.

Now consider the difference between the economies in which market power arises through scale dependence and type dependence. In the two economies entrepreneurs across the wealth distribution impose the same markups. However, in the economy in which markups depend on firm's production scale the reduction in quantity produced by the taxed entrepreneur is associated with a reduction in their firm's markup. This induces a counterbalancing effect which limits the reduction in production and labor demand of taxed entrepreneurs with respect to the case in which markups arise through type dependence (i.e. when markups are constant).

As a result, the largest drop in aggregate labor demand and hence in equilibrium wage is the one in the economy with homogeneous markups, and the smallest in the economy with markups arising through scale dependence.

Hence workers, although receiving the same transfer in the three economies, experience a lower reduction in their equilibrium wage in the economy where entrepreneurs impose heterogeneous markups that arise through scale dependence mechanism. The redistributive effect of the wealth tax is thus larger in that case. The reduction of equilibrium wage is simulated to be -0.21% in the economy with scale dependent markups -0.24% in the economy with type dependent markups and -0.28% in the economy where entrepreneurs impose equal markups.

Figure 11 reports how the wealth tax affects entrepreneurs' choices in the three economies in general equilibrium. The output loss in the economy with markups arising through scale dependence is the lowest (-0.25% in the economy with scale dependent markups, -0.27% in the economy with type dependent markups and -0.28% in the economy with homogeneous markups). The reason is that in spite of the same drop in capital stock, aggregate productivity falls less in the economy with scale dependent markups. Indeed, in this the wealth tax induces the smallest reallocation of production from wealthy and more productive entrepreneurs to poorer and less productive ones.

In other words, in the economies where wealthier (and more productive) entrepreneurs impose larger markups the equity-efficiency trade-off of the wealth tax is relaxed with respect to the case in which all entrepreneurs impose the same markups. Indeed, for any desired level of tax revenues the wealth tax in the economies with heterogeneous markups induces lower losses in terms of aggregate production and equilibrium wage paid to poor workers. The wage and production losses are the smallest under the assumption that markups imposed by entrepreneurs depend on the production scale of the entrepreneur's firm.

6 Dynamic model

I now study a dynamic model of wealth accumulation in which entrepreneurs not only decide how much to produce and which markups to impose, but also make consumption-saving choices. My objective is that of building a dynamic model whose steady-state, once calibrated, is able to reproduce the level of wealth inequality in the US and the fraction of overall wealth entrepreneurs hold in their private businesses vs other investment opportunities.

In this setting top wealth taxation reduces taxed households' incentives to save, downward distorting their wealth accumulation and production choices. Poorer entrepreneurs, instead, receiving larger profits due to the general equilibrium effects of the wealth tax, accumulate more wealth and produce more. In this Section I quantify these effects first under the assumption that entrepreneurs impose markups increasing in their firm's market share (scale dependence). Then, I compare these effects to the case in which entrepreneurs markups arise through type dependence and then when it is assumed that entrepreneurs impose constant and homogeneous markups.

6.1 Dynamic setup

The model is infinite horizon. Assume there is a continuum of households indexed by $i \in [0,1]$. A fraction ω of households are workers (no occupational choice) and a fraction $1-\omega$ are entrepreneurs.

Furthermore in this dynamic economy there is neither idiosyncratic nor aggregate uncertainty.

Workers: each worker i in every period t supplies e^i units of labor receiving a wage w_t for that. Differently from the static model workers hold a positive wealth level. Since the focus of this section is to study the effects of wealth taxation on wealthy entrepreneurs choices, I assume for simplicity that all workers have the same initial wealth $a_0^i = a_0$.

Workers do not own firms, so beside supplying labor in every period they can only decide how much to consume of their wealth and how much to invest of it in the only (risk-free) asset available. This will be called, henceforth, "capital market" asset, providing an interest rate r.

Entrepreneurs: they are heterogeneous in their persistent entrepreneurial skills z^i. Entrepreneurs accumulate wealth either by investing in their own entrepreneurial activity or in the same "capital market" asset in which workers invest too. Each entrepreneur has his own preference for how much of his wealth he invests in his own entrepreneurial business rather than in other market opportunities. To be more specific, I assume that each entrepreneur i in every period t invests a constant fraction of wealth $\phi^i = \phi(z^i)$ in his entrepreneurial business from which he receives profits. The remaining wealth fraction $1 - \phi^i$ is instead invested in the "capital market" asset receiving the interest rate r. This modeling choice is aimed at accounting in a parsimonious way for the heterogeneity in portfolio composition across entrepreneurs observed in the data presented in Section 2.

Firms owned by entrepreneurs, as in the static model, compete in monopolistic competition and employ the constant return to scale production technology $y_t^i = z^i(k_t^i)^\nu(n_t^i)^{1-\nu}$ to produce differentiated intermediate goods. Notice that now, differently from the static model, there is a distinction between overall wealth of the entrepreneur a_t^i and capital used for production in the entrepreneur's firm: $k_t^i = \phi(z^i)a_t^i$. Furthermore, I still assume that entrepreneurs' firms are unable to borrow, hence they only employ the capital provided by the entrepreneur for producing.

The timing of each entrepreneur choices is the following. At the beginning of every period t entrepreneur i knows that his capital available for production is $\phi^i a_t^i$ while his market investment amounts to $(1 - \phi^i)a_t^i$. Given that, entrepreneur i chooses his optimal production y_t^i and how much labor n_t^i to hire from the market at wage w_t. Production takes place and each entrepreneur i receives the profits π_t^i of his own firm. He also receives returns from investment in the market sector $r(1 - \phi^i)a_t^i$. Assume that wealth used as capital for production depreciates at a rate $0 < \delta < 1$ while wealth invested in the market sector does not depreciate. At the end of each period t, each entrepreneur decides how much to consume and how much to save, knowing that even in the following period he will use the fraction of wealth ϕ^i as capital endowment for his own firm production.

Final good producers: this economy is made by two sectors: an "entrepreneurial" sector and a "market" sector. Goods produced in the two sectors are assumed to be perfectly substitutable so that final production at time t, Y_t, writes: $Y_t = Y_t^M + Y_t^E$ where Y_t^M indicates the total production of the "market" sector and Y_t^E indicates the total production of the entrepreneurial sector.

I assume that in the market sector operates a continuum of perfectly competitive producers employing only capital to produce. Capital is rented from households (both workers and entrepreneurs) and its aggregate is denoted by K_t^M. Assuming a constant return to scale technology the problem solved by producers operating in the market sector is:

$$\max_{K_t^M} AK_t^M - rK_t^M$$

where A indicates the (time invariant) aggregate productivity of this sector. The solution of this problem shows that as long as $r = A$ any amount of capital rented from households clears the capital market.

The second sector of this economy is the "entrepreneurial sector": in this sector operates a continuum of perfectly competitive producers who combine intermediate goods produced by entrepreneurs to produce the good Y_t^E. To do that they employ the same constant return to scale Kimball (1995) production function analyzed in Section 3 (see (1)). The problem that each final good producer operating in this sector solves is:

$$\max_{Y_t^E, \{y_t^i\}_{i \in [\omega,1]}} Y_t^E - \int_\omega^1 p_t^i y_t^i di \qquad \text{s.t.} \quad \int_\omega^1 \Upsilon_i \left(\frac{y_t^i}{Y_t^E} \right) di = 1$$

which, as showed in Section 3, when solved delivers the demand curve for each entrepreneur's variety: $p_i(q_t^i) = P_t \Upsilon_i'(q_t^i)$ where q_t^i now indicates y_t^i / Y_t^E, that is the relative production of entrepreneur i with respect to the aggregate production of the entrepreneurial sector.

Dynamic problems: assume that all households have the same CRRA preferences for final good consumption and $\beta(1 + r) = 1$. The dynamic problem that each worker

$i \in [0, \omega)$ solves, taking as given the sequence of wages $\{w_t\}_{t=0}^{\infty}$ and the interest rate r is:

$$
\begin{aligned}
\max_{\{c_t^i, a_{t+1}^i\}_{t=0}^{\infty}} \quad & \sum_{t=0}^{\infty} \beta^t \frac{(c_t^i)^{1-\theta}}{1-\theta} \\
\text{s.t.} \quad & c_t^i + a_{t+1}^i = (1+r)a_t^i + e^i w_t \qquad\qquad (W) \\
& c_t^i, \ a_{t+1}^i \geq 0 \\
& a_0^i \text{ given}
\end{aligned}
$$

Combining the first order condition of the problem and the period-by-period budget constraints it is possible to show that:

$$
c_t^{i*} = \min \left\{ (1+r)a_t^i + e^i w_t, \ r a_0^i + \frac{r}{1+r} \sum_{j=0}^{\infty} \frac{e^i w_{t+j}}{(1+r)^j} \right\} \tag{13}
$$

which shows that if the no-borrowing constraint of the worker is not binding, each worker consumes in every period his permanent income.

Now, consider the entrepreneur's problem. Taking as given the sequence of aggregate quantities $\{w_t, P_t, Y_t^E\}_{t=0}^{\infty}$ the dynamic problem solved by each entrepreneur $i \in [\omega, 1]$ writes:

$$
\begin{aligned}
\max_{\{c_t^i, a_{t+1}^i, p_t^i, y_t^i, n_t^i\}_{t=0}^{\infty}} \quad & \sum_{t=0}^{\infty} \beta^t \frac{(c_t^i)^{1-\theta}}{1-\theta} \\
\text{s.t.} \quad & c_t^i + a_{t+1}^i = (1+r)(1-\phi^i)a_t^i + (1-\delta)\phi^i a_t^i + \pi_t^i \\
& \pi_t^i = p_t^i y_t^i - w_t n_t^i \\
& p_t^i = P_t \Upsilon_i \left(\frac{y_t^i}{Y_t^E} \right) \qquad\qquad (E) \\
& y_t^i = z^i (\phi^i a_t^i)^{\nu} (n_t^i)^{1-\nu} \\
& c_t^i \geq 0, \ a_{t+1}^i \geq 0, \ \phi^i = \phi(z^i) \\
& a_0^i, \ z^i \text{ given}
\end{aligned}
$$

By combining the FOCs of each entrepreneur's i problem it is possible to obtain two equations characterizing the optimal entrepreneurial choices. The first one is a static condition, which characterizes the entrepreneur's production choices given the available capital for production. The second equation, instead, is the Euler equation,

which captures the intertemporal trade-off of the entrepreneur between consumption today and investment in his own business for producing (and consuming) tomorrow.
Let's start from the static condition which characterizes the entrepreneurial production choices. To save on notation let's denote capital used for production as $k_t^i = \phi^i a_t^i$:

$$\underbrace{P_t \Upsilon_i'\left(q_t^{i*}\right)}_{p_t^{i*}} = \underbrace{\frac{\mathcal{E}_i^d(q_t^{i*})}{\mathcal{E}_i^d(q_t^{i*}) - 1}}_{\text{markup}} \times \underbrace{\frac{w_t {Y_t^E}^{\frac{\nu}{1-\nu}}}{(1-\nu)} \left(\frac{(q_t^{i*})^\nu}{z^i (k_t^{i*})^\nu}\right)^{\frac{1}{1-\nu}}}_{\text{marginal cost}} \tag{14}$$

notice that this condition is equivalent (6), characterizing the entrepreneurial production choices in the static model.
Analogously to what done in Section 3, equation (14) can be solved to obtain the optimal relative quantity to be produced by entrepreneur i in each period:

$$q_t^{i*} = \mathcal{Q}_i^*(z^i, k_t^{i*}, w_t, P_t, Y_t^E)$$

where the function $\mathcal{Q}^*(\cdot)$ is the same one derived in the static model of Section 3 and characterized via Lemma 1, while k_t^{i*} indicates capital available for production at time t. The labor demand to produce relative quantity $\mathcal{Q}_i^*(z^i, k_t^{i*}, w_t, P_t, Y_t^E)$ is:

$$n_t^{i*} = \mathcal{N}_i^*(z^i, k_t^{i*}, w_t, P_t, Y_t^E) = \left(\frac{q^*(z^i, k_t^{i*}, w_t, P_t, Y_t^E)}{z^i (k_t^{i*})^\nu}\right)^{\frac{1}{1-\nu}} {Y_t^E}^{\frac{1}{1-\nu}}$$

where the function $\mathcal{N}_i^*(\cdot)$ is the same one studied in Lemma 2. Finally, optimal profits when producing $\mathcal{Q}_i^*(z^i, k_t^{i*}, w_t, P_t, Y_t^E)$ will be:

$$\pi_t^{i*} = \Pi_i^*(z^i, k_t^{i*}, w_t, P_t, Y_t^E) = \left(\frac{\mu_i(\mathcal{Q}_i^*(z^i, k_t^{i*}, w_t, P_t, Y_t^E))}{1-\nu} - 1\right) w_t \mathcal{N}_i^*(z^i, k_t^{i*}, w_t, P_t, Y_t^E) \tag{15}$$

where the function $\Pi_i^*(\cdot)$ is the same one studied in Lemma 3 and $\mu_i(q) = \mathcal{E}_i^d(q)/(\mathcal{E}_i^d(q) - 1)$ the markup function. The Euler equation characterizing the entrepreneur's consumption-saving choices is:

$$\frac{u'(c_t^{i*})}{\beta u'(c_{t+1}^{i*})} = \left(1 + r - \phi^i(r+\delta) + \frac{\partial \pi_{t+1}^{i*}}{\partial k_{t+1}^{i*}} \phi^i\right) \tag{16}$$

where $\pi_{t+1}^{i*} = \Pi_i^*(z^i, k_{t+1}^{i*}, w_{t+1}, P_{t+1}, Y_{t+1}^E)$. The Euler equation shows that in equilibrium the intertemporal marginal rate of substitution between consumption today and tomorrow is equated to the marginal return to investment. The latter is equal to a weighted average between marginal return to investment in the entrepreneurial activity (net of depreciation) and in the "market" asset.

6.2 Steady-state definition and calibration

Let's focus on the deterministic steady-state of this economy, where the wealth of each household (workers and entrepreneurs) is constant. To have that assume $\beta(1+r)=1$. Notice that starred variables without time subscript indicate steady-state quantities.
It is immediate to see from the worker's consumption choices (13) that at a steady-steady with constant wage w worker's i consumption is constant: $c^{i*} = r^* a_0 + e^i w^*$, and his wealth is $a^{i*} = a_0$. Hence, $a_0\omega$ will be the aggregate steady-state wealth accumulated by workers.

Now, let's focus on the entrepreneurs' problem. The Euler equation (16) at the steady-state where wealth (and consumption) of each entrepreneur is constant re-writes as:

$$r+\delta = \frac{\partial \Pi_i^*(z^i, k^{i*}, w^*, P^*, Y^{*E})}{\partial k^{i*}} \tag{17}$$

By solving this equation it is possible to compute the steady-state level of capital that each entrepreneur employs for production, k^{i*}, as a function of his own skills and the steady-state aggregates of the economy, that is:

$$k^{i*} = k_i^{ss}(z^i, w^*, P^*, Y^{*E}) \tag{18}$$

where $k_i^{ss}(\cdot)$ indicates the function which associates to each entrepreneur i, with skills z^i, his steady-state level of capital k^{i*}, obtained solving the Euler equation at the steady-state (17). Notice that the steady-state level of wealth of entrepreneur i can be obtained by using his portfolio choice rule: $a^{i*} = k^{i*}/\phi^i$

Steady-state equilibrium definition: take as given the exogenous time-invariant skill dist. $\{z^i\}_{i\in[\omega,1]}$, the fraction of wealth each entrepreneur invests in his own business $\{\phi^i\}_{i\in[\omega,1]}$ and aggregate labor supply $N = \int_0^\omega e^i di$. The steady-state of this economy consists of a vector of consumption and wealth $\{c^{i*}, a^{i*}\}_{i\in[0,1]}$, an entrepreneurial capital distribution $\{k^{i*}\}_{i\in[\omega,1]}$, relative quantity , labor demand, profits $\{q^{i*}, n^{i*}, \pi^{i*}\}_{i\in[\omega,1]}$ of entrepreneurs and a set of aggregates $r^*, w^*, P^*, Y^{E*}, Y^{M*}, Y^*$ such that:

- Each worker i consumes his steady-state income $c^{i*} = r^* a_0 + w^* e^i$ and $a^{i*} = a_0$.

- The steady state level of capital of each entrepreneur i, k^{i*}, solves the Euler equation at the steady state (17), i.e.:

$$k^{i*} = k_i^{ss}(z^i, w^*, P^*, Y^{E*})$$

- Relative quantity produced by each entrepreneur i solves equation (14) given the steady-state level of wealth k^{i*} and aggregates w^*, Y^{E*}, P^*. That is:

$$q^{i*} = \mathcal{Q}_i^*(z^i, k^{i*}, w^*, P^*, Y^{E*})$$

labor demand and profits are the ones which allow to produce $\mathcal{Q}_i^*(z^i, k^{i*}, w^*, P^*, Y^{E*})$, that is:

$$\begin{aligned} n^{i*} &= \mathcal{N}_i^*(z^i, k^{i*}, w^*, P^*, Y^{E*}) \\ \pi^{i*} &= \Pi_i^*(z^i, k^{i*}, w^*, P^*, Y^{E*}) \end{aligned}$$

- Each entrepreneur consumes his own profits: $c^{i*} = \Pi_i^*(z^i, k^{i*}, w^*, P^*, Y^{E*})$ and has steady-state wealth $a^{i*} = k^{i*}/\phi^i$.

- Kimball aggregator holds:

$$\int_\omega^1 \Upsilon_i(q^{i*})di = 1$$

- Labor market clears:

$$\int_0^\omega e^i di = \int_\omega^1 n^{i*} di$$

- Capital market clears:

$$A = r^*$$

- Market sector production function is satisfied:

$$Y^{*M} = A\left(\int_\omega^1 (1-\phi^i)a^{i*}di + \int_0^\omega a^{i*}di\right)$$

- Aggregate production is:

$$Y^* = Y^{M*} + Y^{E*}$$

Calibration with scale dependent markups: the model is calibrated assuming that the economy is at the steady-state in 2019, so the statistics are targeted for that year. The calibration choices are summarized in Table 3.

Most of the parameters are calibrated similarly to what done for the static model: ω captures the fraction of entrepreneurs in the SCF data, ν is calibrated to replicate a labor share of 0.6, the functional form for $\Upsilon_i(\cdot)$ is assumed to be the Klenow and Willis (2016) one for all entrepreneurs i, the parameter σ is set so to match the aggregate markup $\mathcal{M} = 1.2$ and the parameter ψ so to capture the empirically estimated relationship between firm level markups and market shares (for details see Section 4.1). Differently from the static model the steady-state wealth and capital distribution are now endogenous objects. Notice that we have shown that the steady-state level of wealth that each entrepreneur uses as capital for his own firm is function of his skill level (and the aggregates w, P, Y^E). Hence the entrepreneurial skill distribution is calibrated so to target some moments of distribution of wealth that entrepreneurs hold as capital in their own firms (i.e. target some moments of the *entrepreneurial wealth* distribution). In particular, the skills of each entrepreneur are assumed to be drawn from a Pareto distributed random variable $Pa(x_z, \eta_z)$, where the two parameters are chosen so to match the top 1%, top 5%, top 10% and Gini coefficient of the entrepreneurial wealth distribution. As Table 3 shows, with two parameters available the model is able to replicate very closely all the four targeted moments.

Now consider the function $\phi(\cdot)$, which associates to an entrepreneur with skills z^i the fraction of his overall wealth he holds in his own business $\phi^i = \phi(z^i)$. This is assumed to

TABLE 3. *Steady state calibration: summary*

Par.	Description	Value	Target	Model
β	discount factor	0.962	r = 4%	4%
δ	depreciation rate	0.02	entr. wealth fract. = 0.46	0.48
a_0	workers' wealth	26.5	$Y^E/Y = 0.4$	0.42
ω	fraction of workers	0.88	fraction of non-entr.	0.88
ν	capital exponent prod.	0.28	Labor share = 0.6	0.6
σ	elasticity $q = 1$	14.3	$\mathcal{M} = 1.2$	1.2
ψ	super-elasticity demand	2.32	$\psi/\sigma = 0.162$	0.162
σ_e^2	variance labor supply dist.	1.1	Gini coeff. income inequality = 0.59	0.59
			top 1% wealth = 0.43	0.43
x_z	scale par. entr. ability dist.	0.5	top 5% wealth = 0.71	0.72
η_z	tail par. entr. ability dist.	4.8	top 10% wealth = 0.83	0.82
			Gini wealth = 0.88	0.86

Notes: *the Table summarizes the parameter choices to calibrate the steady state of the dynamic model presented in Section 6. The first column indicates the symbol used to identify the parameter in the model, the second column the parameter description, the third column the chosen value for the parameter, the fourth column the moment targeted to calibrate each parameter, the fifth column the value of the targeted moment in the simulated model* be a polynomial function. However, since the skills of entrepreneurs are not observable in the data, the function $\phi(z^i)$ is chosen so that the steady-state relationship between wealth and fraction of wealth held as equity in the entrepreneur's business replicates the one observed in the data (Figure 2). Figure 19 in Appendix C shows that the chosen functional form for $\phi(\cdot)$ allows to capture the observed portfolio choices of entrepreneurs across the wealth distribution.

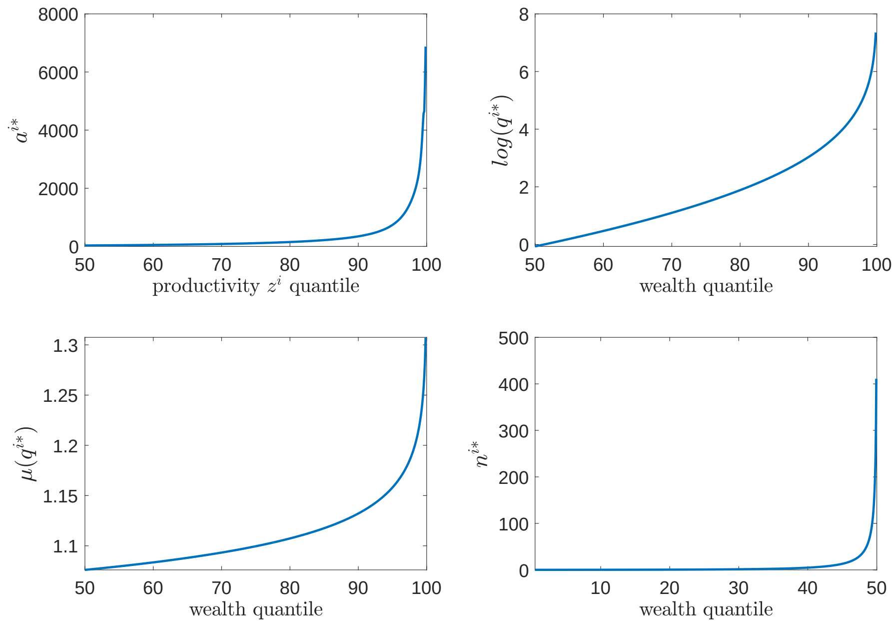
The discount factor β is calibrated so to have a "market asset" which provides a return of 4%. This is an approximation of the average return that US households could receive from investing in financial markets (stocks, bonds...), according to 2019 SCF data (Xavier (2021)). Then, the depreciation rate δ is chosen together with the parameter a_0. These two allow to target two moments: the ratio between production of American entrepreneurs (which does not include production from listed firms) and aggregate production in the US ($\approx$ 40%, Boar and Midrigan (2023)) and also the wealth share accruing to entrepreneurs ($\approx$ 50%).

In Appendix C, Figure 18, it is possible to observe that although in this calibration the return distribution is untargeted (differently from the static model) the simulated steady-state returns closely replicate the observed ones. Furthermore, although not targeted also the shape of the overall wealth distribution of entrepreneurs (not only the wealth held as equity in the entrepreneurial business) is closely matched[12].

Steady-state choices: Figure 12 reports the simulated entrepreneurs' choices at the calibrated steady-state. In the first panel notice a monotonic relationship between accumulated wealth and skills, i.e. the most productive entrepreneurs are also the ones accumulating more wealth at the steady-state. Since the fraction of net wealth $\phi(z^i)$ invested by the entrepreneur in his own business is increasing in z^i (and hence in wealth too), at the steady-state there is a monotonic increasing relationship between skills of the entrepreneur and the amount of wealth invested in his own business. Entrepreneurs' production choices across the wealth distribution are similar to the ones analyzed in the static model: the more productive the entrepreneur is, the more wealth he invests in his business, the more produces, the larger the markup he imposes.

[12]In particular, top 1% wealth 37% in the data and 38% in the model, top 5% wealth 65% in the data and 66% in the model, top 10% of wealth 76.5% in the data and 77% in the model

Figure 12. *Simulated entrepreneurs' choices at the steady-state*



Notes: *the first panel reports the steady-state wealth accumulated by entrepreneurs at different quintiles of the productivity distribution. The other three panels report simulated relative quantities q_i^*, markups $\mu(q_i^*)$ and labor demand n_i^* for entrepreneurs at different quantiles of the steady-state wealth distribution when the dynamic model is calibrated as in Table 3*

6.3 Wealth tax experiment: steady-state comparison

Suppose that the economy is at the steady-state previously described and let's implement a *permanent* wealth tax policy identical to the one analyzed in the previous Sections of the paper. Since the wealth tax is imposed only on the wealthiest 1% of households, workers do not pay any wealth tax, although they receive the lump-sum transfer resulting from it. Hence, let's focus on the entrepreneurs' problem when the wealth tax is in place:

$$
\begin{aligned}
\max_{\{c_t^i, a_{t+1}^i, p_t^i, y_t^i, n_t^i\}_{t=0}^{\infty}} \quad & \sum_{t=0}^{\infty} \beta^t \frac{(c_t^i)^{1-\theta}}{1-\theta} \\
\text{s.t.} \quad & c_t^i + a_{t+1}^i = (1+r)(1-\phi^i)a_t^i + (1-\delta)\phi^i a_t^i + \pi_t^i - \mathbb{I}_{a_t^i \geq \underline{a}} \tau(a_t^i - \underline{a}) + T_t \\
& \pi_t^i = p_t^i y_t^i - w_t n_t^i \\
& p_t^i = P_t \Upsilon_i \left(\frac{y_t^i}{Y_t^E} \right) \qquad\qquad (E) \\
& y_t^i = z^i (\phi^i a_t^i)^{\nu} (n_t^i)^{1-\nu} \\
& c_t^i \geq 0, \ a_{t+1}^i \geq 0, \ \phi^i = \phi(z^i) \\
& a_0^i, \ z^i \text{ given}
\end{aligned}
$$

where the lump-sum transfer T_t is such that: $T_t = \int_{a_t^i > \underline{a}} \tau(a_t^i - \underline{a}) di$. Furthermore, let's assume that the wealth threshold $\underline{a}$, above which the tax is paid is equal to the 99^{th} wealth percentile of the initial steady-state wealth distribution (i.e only the wealthiest 10% of entrepreneurs get taxed). Furthermore, the tax rate is set to $\tau = 2\%$ so that the tax revenues at the steady-state amount to approximately 1% of GDP (a reasonable figure for wealth tax revenues absent tax evasion effects Saez and Zucman (2022)). How does the new steady-state, where the tax is implemented, differ from the initial one with no tax?

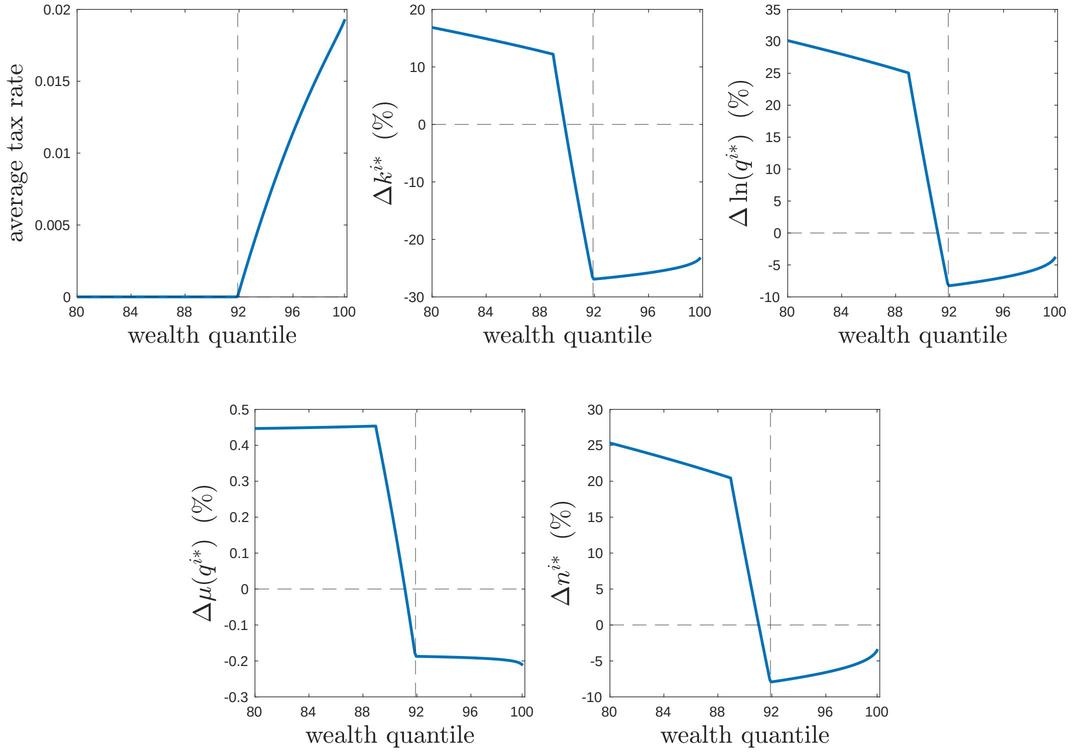
First of all, notice that due to the kinked shape of the wealth tax schedule, the Euler equation at the steady-state (17), when the tax is implemented becomes:

$$
\begin{cases}
\frac{\partial \Pi_i^*(z^i, k^{i*}, w^*, P^*, Y^{*E})}{\partial k^{i*}} = r^* + \delta & \text{if } k^{i*} < \phi^i \underline{a} \\
r^* + \delta < \frac{\partial \Pi_i^*(z^i, k^{i*}, w^*, P^*, Y^{*E})}{\partial k^{i*}} < r^* + \delta + \frac{\tau}{\phi^i} & \text{if } k^{i*} = \phi^i \underline{a} \\
\frac{\partial \Pi_i^*(z^i, k^{i*}, w^*, P^*, Y^{*E})}{\partial k^{i*}} = r^* + \delta + \frac{\tau}{\phi^i} & \text{if } k^{i*} > \phi^i \underline{a}
\end{cases}
$$

where, as usual, $k^{i*} = \phi^i a^{i*}$. The steady-state Euler equation indicates bunching of entrepreneurs at the same wealth tax threshold $\underline{a}$. However, due to their heterogeneous investment choices, entrepreneurs bunching at $\underline{a}$ with different $\phi^i = \phi(z^i)$ have different amounts of wealth held as capital in their business: $k^{i*} = \phi^i \underline{a}$.

Figure 13 reports how the choices of entrepreneurs at different quantiles of the wealth distribution differ in the two steady-states (without the tax and with the tax). First of

Figure 13. *Wealth tax effects on entrepreneurs' choices: steady-states comparison*



Notes: *Figure represents the difference between entrepreneurs' choices at the steady-state with no wealth tax and at the steady-state in which the permanent wealth tax is in place. The first panel indicates the average tax rate. The other panels represent the differences between entrepreneurs' steady-state capital, relative quantities, markups, labor demand and overall wealth.*

all, notice that in the steady-state where the wealth tax is implemented, households below the 92^{th} percentile do not pay any tax. The reason is that in the steady-state with wealth taxation implemented, the 92^{nd} wealth percentile is equal to the 90^{th} percentile in the steady-state with no tax. Now focus on the second panel and notice that taxed entrepreneurs significantly reduce investment in their own businesses (as a result of reduced wealth accumulation). However, also some untaxed entrepreneurs reduce their steady-state capital level. These, in particular, are the entrepreneurs bunched at the wealth threshold level $\underline{a}$ that prefer reducing their wealth accumulation (and capital invested in their firms) so not to pay the wealth tax. Households below the 90^{th} wealth percentile, instead, increase their steady-state level of wealth and capital investment due to the higher profits (with respect to the steady-state with no tax) they receive in every period. Untaxed entrepreneurs benefit from lower wages to produce more and make more profits, while wealthy entrepreneurs due to direct effect of the wealth tax on available capital for production produce less and make less profits, notwithstanding the lower equilibrium wage in the economy. As you can see in Figure 13 the observed changes in production

choices across the wealth distribution closely track the changes in the steady-state level of capital available for production.
The observed changes in markups imposed by entrepreneurs determine a reduction in the aggregate steady-state markup of 0.74%. This induces an increase in the labor share of income of equal size, thus redistributing resources from wealthy entrepreneurs to poor workers. The production in the entrepreneurial sector (40% of overall GDP), is simulated to be 5% lower than in the steady-state with no wealth tax ($\Delta Y^E = -5\%$), and the associated wage loss is 4.3% ($\Delta w = -4.3\%$). However, the reduction in total production in the economy is smaller ($\Delta Y = -4.2\%$). The reason is the following. Poorer and untaxed entrepreneurs as a result of the wealth tax, accumulate more wealth. Furthermore they invest most of their wealth in the market asset, rather than in their business. Because of that, their increased wealth level mitigates the reduction in aggregate capital in the "market" sector. Hence, the lower production drop in the market sector than in the entrepreneurial sector ($\Delta Y^M = -3.7\%$ vs $\Delta Y^E = -5\%$) mitigates the drop in the overall production of the economy.

6.4 Wealth tax dynamic effects: constant markups

How do the effects of wealth taxation on the aggregates of the economy change under the assumption that all entrepreneurs impose the same (constant) markup? What if, instead, markups imposed by entrepreneurs are heterogeneous but arise through type dependence?
To answer these questions I recalibrate the dynamic model of this Section assuming that entrepreneurs now face a demand function for their own variety featuring constant elasticity of demand (similarly to what I have done in Section 5). In particular, if entrepreneurs are assumed to impose heterogeneous markups, independent on the firm's production scale, let's assume that $\Upsilon_i(q) = q^{\frac{\sigma_i - 1}{\sigma_i}}$, so that the demand function faced by each entrepreneur is $p_i(q) = q^{-\frac{1}{\sigma_i}}$. If instead it is assumed that all entrepreneurs impose the same constant markups: $\Upsilon_i(q) = q^{\frac{\sigma-1}{\sigma}}$, so that $p_i(q) = q^{-\frac{1}{\sigma}}$ for all i. The optimality conditions (14) and (16) for each entrepreneur i remain the same.

Calibration - constant and heterogeneous markups (type dep.): all parameters are chosen so to match the same moments I have targeted in the model with markups arising through scale dependence. The calibration choices are summarized in

Table 7 (Appendix C). The elasticity of demand σ_i of each entrepreneur i is assumed to be a monotone increasing polynomial function of the entrepreneur's skills: $\sigma_i = \sigma(z_i)$. In particular, $\sigma(\cdot)$ is chosen so that the entrepreneur belonging to the steady-state wealth distribution quantile x imposes the same markup imposed by the entrepreneur at the x quantile of the steady-state wealth distribution in the model with scale dependent markups. Besides, to obtain the same steady-state wealth and capital distribution I retrieved in the model with scale dependent markups, the parameters of the Pareto distribution $Pa(x_z, \eta_z)$ from which entrepreneurial skills are drawn have to be suitably changed. In particular, similarly to the static model the skill distribution needed must be more skewed than the one employed in the model with markups arising through scale dependence. All the other parameters remain unaffected.[13] The steady-state choices of entrepreneurs replicate those described in Figure 12.

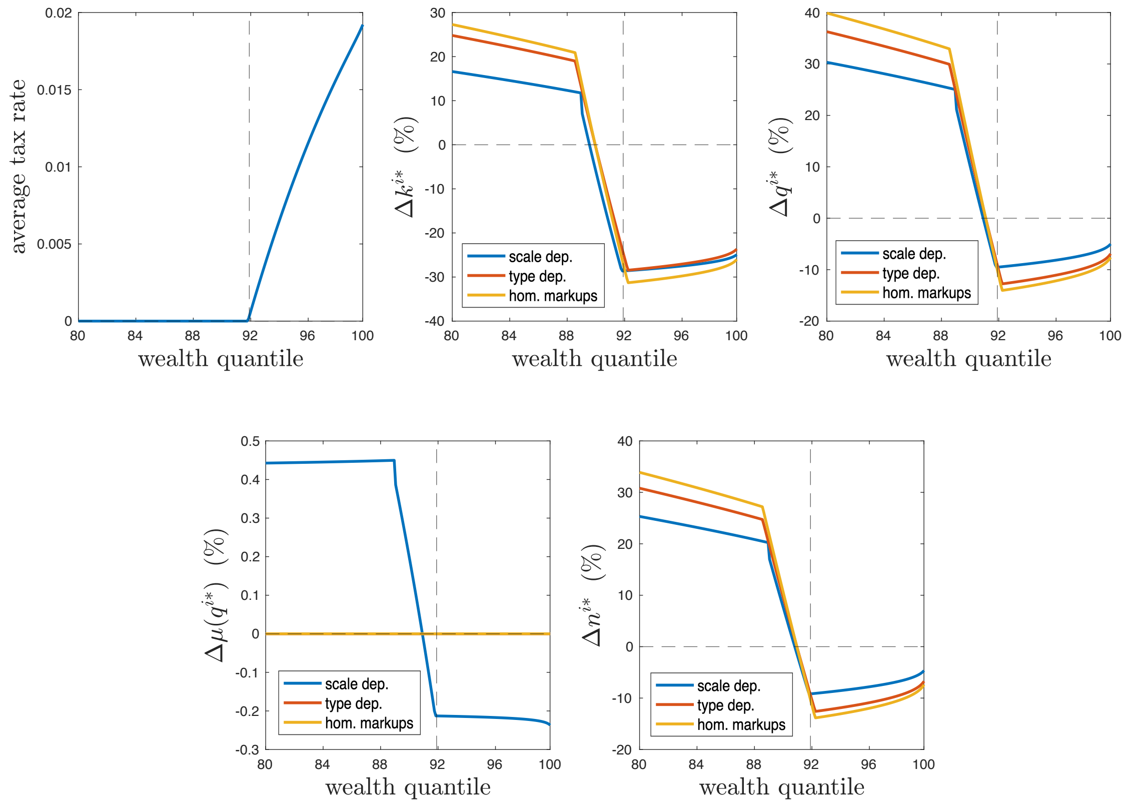
Calibration - constant and homogeneous markups: all model parameters are now chosen so to match the same moments I have targeted in the model with markups arising through scale and type dependence, apart from markups heterogeneity. The calibration choices are summarized in Table 8 (Appendix C). The elasticity of demand parameter σ is chosen so to match the same aggregate markup $\mathcal{M} = 1.2$. Again, to obtain the same steady-state wealth and capital distribution I retrieved in the model with heterogeneous markups, the parameters of the Pareto distribution $Pa(x_z, \eta_z)$ from which entrepreneurial skills are drawn are recalibrated. In particular, the chosen skill distribution is less skewed than the one employed in the models with heterogeneous markups.[14] All the remaining parameters remain unaffected.[15] Again, the steady-state choices of entrepreneurs replicate those described in Figure 12 with the only difference that now all entrepreneurs impose the same constant markup.

[13]For completeness notice that the polynomial function $\phi(z^i)$ is appropriately re-calibrated so to obtain the same steady state portfolio choices of the variable markups model.

[14]The reason is that in the model with homogeneous markups all entrepreneurs have marginal profits (which determine the steady-state wealth and capital level) decreasing at the same constant rate. Instead, in the model with variable markups marginal profits decrease at an increasing rate. In particular, entrepreneurs producing at a very large scale (imposing above the average markups) face a marginal profits curve decreasing at a higher rate than the one in the homogeneous markups model. This effect dampens wealth accumulation at the top of the wealth distribution. Hence, in the constant and homogeneous markups model a less skewed skill distribution is needed so to match the observed wealth distribution moments.

[15]For completeness notice that the polynomial function $\phi(z^i)$ is appropriately re-calibrated so to obtain the same steady state portfolio choices of the variable markups model.

FIGURE 14. *Wealth tax effects: type dep. vs scale dep. vs homogeneous markups*



Notes: *Figure represents the difference between entrepreneurs' choices at the steady-state with no wealth tax and at the steady-state in which the permanent wealth tax is in place. The blue lines represent these differences in the model simulated with scale dependent markups (see Figure 13), the red lines when the model is simulated with type dependent markups and the yellow lines in the case of entrepreneurs imposing homogeneous and constant markups. The first panel indicates the average tax rate. The other panels represent the differences between entrepreneurs' steady-state capital, relative quantities, markups, labor demand, overall wealth with and without the tax.*

Wealth tax experiment - scale vs type vs homogeneous markups: let's consider the same wealth tax analyzed in the previous Section of the paper. Notice that in the three calibrated versions of the dynamic model the equilibrium wealth distributions is the same. Hence, the considered wealth tax raises the same revenues in the three economies. Figure 14 shows how the wealth tax affects entrepreneurs' steady-state choices when entrepreneurs impose variable and heterogeneous markups arising through scale dependence (blue), constant and heterogeneous markups (i.e. arising through type dependence, orange), constant and homogeneous markups (yellow). The second panel of the Figure shows that taxed entrepreneurs reduce their steady-state capital (and wealth) in a larger extent in the economy with homogeneous and constant markups. The intuition is the following. Taxed entrepreneurs in models with heterogeneous markups (arising through scale or type dependence) impose above the average markups and have a marginal profits curve which is steeper than the one faced by taxed entrepreneurs in the constant markups model. From the Euler equation notice that the steady-state level of marginal profits of entrepreneurs once the tax is implemented is larger than in the steady-state with no tax ($r + \delta + \tau/\phi^i > r + \delta$) and is the same in the three economies. Hence, in the economies with heterogeneous markups a lower capital decrease is needed so to match the larger steady-state level of marginal profits.

Furthermore, the difference in capital drop between the three economies would have been larger, absent general equilibrium effects. Indeed, the larger equilibrium wage reduction in the model with constant markups allows entrepreneurs to increase their profits in a larger extent (for any given capital level) than in the economies with heterogeneous markups. This fosters capital accumulation and allows untaxed entrepreneurs in the constant markups model to increase their steady-state capital and wealth level more than in the economies with heterogeneous markups across entrepreneurs.

Also notice that, although the reduction in steady-state capital and wealth is similar in the economies with markups arising through scale and type dependence, the stronger general equilibrium effects in the economy in which markups arise through type dependence induces a larger capital accumulation among untaxed entrepreneurs. The next paragraph examines the reasons behind the different general equilibrium effects in the three economies.

This result is due to two effects: first of all the larger reduction in capital used for entrepreneurial production in the economy with homogeneous markups. Furthermore, as highlighted in the static framework, even if the changes in steady-state capital used for production across entrepreneurs had been been the same in the three economies, the reduction in aggregate production would have been larger in the economy with homogeneous markups (see Section 5.2 for the detailed discussion). This is due to a larger reallocation of production from high productive to low productive entrepreneurs (hence a reduction in aggregate productivity) in the model with homogeneous markups. This effect is further amplified in the dynamic case by the changes in the steady-state capital distribution across entrepreneurs previously described. Furthermore, notice that although the reduction in aggregate capital used for production is larger when markups arise through scale dependence rather than type dependence, the effect on entrepreneurial production is the opposite: i.e. in the economy with type dependent markups entrepreneurial production decreases more. Again, this is due to the larger reallocation of production from high to low productive entrepreneurs in the economy with markups arising through type dependence.

The logic behind the larger drop in equilibrium wage in the economy with homogeneous markups with respect to the other economies is similar to that of production. Again, the larger drop in capital used for entrepreneurial production in the model with homogeneous markups induces a larger drop in labor demand in this economy. Furthermore, as the static model has shown, even if the changes in capital across entrepreneurs had been the same in the three economies, the drop in labor demand would have been larger in the economy with homogeneous markups across entrepreneurs (as shown in the static framework, see Section 5.2).

Effects on aggregate variables: Table 4 summarizes the effects of the wealth tax on several aggregate variables in the three considered economies. As expected, the top wealth tax reduces aggregate steady-state wealth and capital. In particular, the aggregate of capital employed for entrepreneurial production decreases between 1-1.5 pp more in the economy with homogeneous markups with respect to the economies in which markups are heterogeneous across entrepreneurs. Furthermore, in the framework with homogeneous markups the wealth tax delivers a 0.3-0.8 pp larger reduction in entrepreneurial production with respect to the economies with heterogeneous markups.
Finally, let's compare the effects of the considered wealth tax on total production and equilibrium wage in the three analyzed economies. First of all, notice that the drop in market sector production (Y^M) in the model with homogeneous markups is 0.4-0.5 pp larger than in the economies in which entrepreneurs impose heterogeneous markups. These differences are actually smaller than the ones observed for entrepreneurial production (1-1.5 pp difference). The reason is that although aggregate wealth decreases the most in the model with homogeneous markups, in this setting poorer entrepreneurs, mainly investing in the market sector, increase their wealth accumulation, and hence investment in the market sector, more than in the economies with markups heterogeneity.

TABLE 4. *Steady-state wealth tax aggregate effects: comparison*

	scale dep. mark.	**type dep. mark.**	**homogeneous mark.**
ΔK^E	-15.1%	-14.6%	-16.1%
ΔY^E	-5%	-5.3%	-5.8%
ΔY^M	-4.2%	-4.1%	-4.6%
ΔY	-4.5%	-4.6%	-5.1%
Δw	-4.3%	-4.8%	-5.8%
$\Delta \mathcal{M}$	-0.74%	-0.53%	0%

Notes: *the Table reports the effects of the studied wealth tax on several aggregates of the three calibrated economies: capital used for entrepreneurial production K^E, entrepreneurial production Y^E, market production Y^M, aggregate production Y, wage w, aggregate markup $\mathcal{M}$*

As a consequence, the reduction in aggregate production in the economy with homogeneous markups turns out to be 0.5-0.6 pp larger than in the economies with markups heterogeneity across entrepreneurs. Furthermore, notice that the effects of the wealth tax on aggregate production and market production in the economies with markups heterogeneity are extremely similar.

The differences in equilibrium wage drop across the three economies, instead, are quantitatively more sizable. In the economy with no markups heterogeneity across entrepreneurs the reduction in equilibrium wage is 1-1.5 pp larger than in the economies with markups heterogeneity.

To sum up, these results suggest that neglecting the role of market power heterogeneity across entrepreneurs in studying the effects of wealth taxation would have led to overestimate the distortionary effects of taxing top wealth and underestimate its redistributive effects. In particular, for the considered wealth tax this would imply to overestimate GDP loss by 0.5-0.6 percentage points and overestimate the wage loss by 1-1.5 percentage points. Whether market power heterogeneity across entrepreneurs is generated through scale or type dependence is almost irrelevant to determine the effects of the wealth tax on aggregate production. Instead, in the model with scale dependent markups the wealth tax induces a reduction in equilibrium wage 0.5 pp lower than in the model in which markups arise through type dependence.

7 Conclusion

In this paper I build a model with poor workers and wealthy entrepreneurs to study the equity-efficiency trade-off of top wealth taxation. The contribution of this work is to study this trade-off in a framework in which returns that entrepreneurs receive not only reflect their productivity but also their market power (arising through scale or type dependence mechanisms). In this setting wealthier (and more productive) entrepreneurs manage firms that produce at a larger scale, have more market power and impose larger markups. This is consistent not only with the evidence in the Survey of Consumer Finances data of wealthier entrepreneurs managing larger firms in terms of capital endowment and employees, but also with the literature estimating a positive relationship between firm market shares and markups in the US.

Taking into account that wealthier entrepreneurs own firms with larger market power, relaxes the equity-efficiency trade-off of top wealth taxation with respect to the case in which this market power heterogeneity is neglected. To obtain this result I have studied and calibrated three different economies: the first two featuring heterogeneous markups across entrepreneurs (arising through scale or type dependence) and a third one in which all entrepreneurs impose the same markups. I these settings the same revenue-equivalent, top wealth tax has been simulated. Top wealth taxation induces smaller losses in equilibrium production and wage in the economies where entrepreneurs impose heterogeneous markups. In this setting, indeed, the distortionary effect of wealth taxation is mitigated by the reduction in the distortions induced by markups thanks to the wealth tax policy. In particular, the losses in equilibrium wage and production are smaller when markups are heterogeneous and depend on the entrepreneur's production scale (scale dependence mechanism) rather then when they are heterogeneous across entrepreneurs but constant (type dependence). These results hold true, although dampened in magnitude, even if households are allowed to endogenously choose their occupation between worker and entrepreneur (Appendix D).

The previously described wealth tax effects are then quantified in a framework in which entrepreneurs, beyond making production choices, decide how much to consume and how much to invest in their own business. In this setting top wealth taxation reduces taxed households' incentives to save, downward distorting their wealth, capital accumulation and production choices. These effects dominate the enhanced capital accumulation by poorer entrepreneurs who do not pay any tax. When market power arises through scale dependence the wealth tax reduces aggregate production at the steady-state by 4.5%, reduces the steady-state wage by 4.3% and reduces the aggregate markup in the economy by 0.74%. If market power arises through type dependence the losses in aggregate production due to the tax are almost the same, while equilibrium wage decreases by extra 0.5 percentage points.

Instead, under the assumption that entrepreneurs impose constant and homogeneous markups equilibrium production is 0.6 percentage points lower and the reduction in equilibrium wage is 1.5 percentage points larger with respect to the model with markups arising through scale dependence.

Hence, neglecting the role of market power heterogeneity in shaping entrepreneurs' profits and returns may lead to overestimate production and wage losses induced by top wealth taxation. Further work (in progress) will allow me to quantify these effects in a framework where returns to entrepreneurial investment are assumed to be stochastic.

Appendix

A - Proofs

Proof of Lemma 1

Consider equation (6). Using the expression for the elasticity of demand of intermediate good produced by entrepreneur i reported in (5):

$$\mathcal{E}_i^d(q_i) = -\frac{\Upsilon_i'(q_i)}{q_i \Upsilon_i''(q_i)}$$

it is possible to re-write equation (6) as:

$$P\left(\Upsilon_i'(q_i^*) + q_i^* \Upsilon_i''(q_i^*)\right) q_i^{*-\frac{\nu}{1-\nu}} - \frac{wY^{\frac{\nu}{1-\nu}}}{1-\nu}\left(\frac{1}{z_i k_i^\nu}\right)^{\frac{1}{1-\nu}} = 0$$

Define the left hand side of the previous equation as the function $F_i(q_i^*, z_i, k_i, P, Y)$ which allows to re-write it as:

$$F_i(q_i^*, z_i, k_i, P, Y) = 0$$

Now, let's use the Implicit Function Theorem to show that $\frac{\partial q_i^*}{\partial z_i} > 0$ and $\frac{\partial q_i^*}{\partial k_i} > 0$. The proof to obtain the sign of the other partial derivatives reported in Lemma 1 is analogous. It is possible to show that:

$$\frac{\partial F_i(\cdot)}{\partial q_i^*} = P\left(2\Upsilon_i''(q_i^*) + q_i^* \Upsilon_i'''(q_i^*)\right) q_i^{*-\frac{\nu}{1-\nu}} - P\frac{\nu}{1-\nu}\left(\Upsilon_i'(q_i^*) + q_i^* \Upsilon_i''(q_i^*)\right) q_i^{*-\frac{\nu}{1-\nu}-1} < 0 \tag{19}$$

The reason why the previous derivative is negative is that both terms are negative. Indeed, using Assumption 1 it is possible to show that $2\Upsilon_i''(q_i^*) + q_i^* \Upsilon_i'''(q_i^*) \leq 0$ for all $q_i^* \geq 0$. Furthermore, $\Upsilon_i'(q_i^*) + q_i^* \Upsilon_i''(q_i^*) > 0$. The way to show it is the following. Equation (6) guarantees that a profit maximizing entrepreneur will always choose q_i^* which satisfies $\mathcal{E}_i^d(q_i^*) > 1$. Using the formula for the elasticity of demand (5), $\mathcal{E}_i^d(q_i^*) > 1$ rewrites as: $\Upsilon_i'(q_i^*) + q_i^* \Upsilon_i''(q_i^*) > 0$. Now let's compute the following partial derivatives:

$$\frac{\partial F_i(\cdot)}{\partial z_i} = \frac{wY^{\frac{\nu}{1-\nu}}}{(1-\nu)^2}\left(\frac{1}{z_i k_i^\nu}\right)^{\frac{1}{1-\nu}} \frac{1}{z_i} > 0 \qquad \frac{\partial F_i(\cdot)}{\partial k_i} = \frac{\nu w Y^{\frac{\nu}{1-\nu}}}{(1-\nu)^2}\left(\frac{1}{z_i k_i^\nu}\right)^{\frac{1}{1-\nu}} \frac{1}{k_i} > 0 \tag{20}$$

Hence, the implicit function theorem guarantees that:

$$\frac{\partial q_i^*}{\partial z_i} = -\frac{\frac{\partial F_i(\cdot)}{\partial z_i}}{\frac{\partial F_i(\cdot)}{\partial q_i^*}} > 0 \qquad\qquad \frac{\partial q_i^*}{\partial k_i} = -\frac{\frac{\partial F_i(\cdot)}{\partial k_i}}{\frac{\partial F_i(\cdot)}{\partial q_i^*}} > 0$$

$\square$

Proof of Lemma 2

First of all, I show that $\frac{\partial \mathcal{N}_i^*(\cdot)}{\partial z_i} > 0$ if Assumption 1 and Assumption 2 hold. The way of showing that $\frac{\partial \mathcal{N}_i^*(\cdot)}{\partial k_i} > 0$ is analogous. Notice that:

$$\frac{\partial \mathcal{N}_i^*(\cdot)}{\partial z_i} > 0 \quad\Longleftrightarrow\quad \frac{\partial}{\partial z_i}\left(\left(\frac{\mathcal{Q}_i^*(\cdot)}{z_i k_i^\nu}\right)^{\frac{1}{1-\nu}}\right) Y^{\frac{1}{1-\nu}} > 0 \quad\Longleftrightarrow\quad \frac{\partial \mathcal{Q}_i^*(\cdot)}{\partial z_i}\frac{z_i}{q^*(\cdot)} > 1$$

where $\mathcal{Q}_i^*(\cdot)$ is the optimal relative quantity function whose arguments are (z_i, k_i, w, Y, P). To shorten notation let $q_i^* = \mathcal{Q}_i^*(z_i, k_i, w, P, Y)$. Using equations (19) and (20) is it possible to show that:

$$\frac{\partial q_i^*}{\partial z_i}\frac{z_i}{q_i^*} = -\frac{\Upsilon_i'(q_i^*) + q_i^*\Upsilon''(q_i^*)}{(2\Upsilon_i''(q_i^*) + q_i^*\Upsilon_i'''(q_i^*))q_i^*(1-\nu) - \nu(\Upsilon_i'(q_i^*) + q_i^*\Upsilon_i''(q_i^*))}$$

which is positive if:

$$-\frac{\Upsilon_i'(q_i^*)}{q_i^*\Upsilon_i''(q_i^*)} > 3 + \frac{q_i^*\Upsilon_i(q_i^*)}{\Upsilon_i''(q_i^*)}$$

which holds under Assumption 2. Using the expression for the function $\mathcal{N}_i^*(\cdot)$:

$$\mathcal{N}_i^*(z_i, k_i, w, P, Y) = \left(\frac{\mathcal{Q}_i^*(z_i, k_i, w, P, Y)\cdot Y}{z_i k_i^\nu}\right)^{\frac{1}{1-\nu}}$$

it is immediate to show that $\frac{\partial \mathcal{N}_i^*(\cdot)}{\partial w} < 0$ and $\frac{\partial \mathcal{N}_i^*(\cdot)}{\partial P} < 0$ since Lemma 1 shows that $\frac{\partial \mathcal{Q}_i^*(\cdot)}{\partial w} < 0$ and $\frac{\partial \mathcal{Q}_i^*(\cdot)}{\partial P} < 0$.
Now, let's show that $\frac{\partial \mathcal{N}_i^*(\cdot)}{\partial Y} > 0$. To see that, first of all notice that:

$$\frac{\partial \mathcal{N}_i^*(\cdot)}{\partial Y} = \left(\frac{1}{k_i^\nu z_i}\right)^{\frac{1}{1-\nu}}\left(\frac{\partial q_i^*}{\partial Y}Y + q_i^*\right)^{\frac{1}{1-\nu}}(q_i^*Y)^{\frac{1}{1-\nu}}\frac{1}{1-\nu} > 0 \quad\Longleftrightarrow\quad \frac{\partial q_i^*}{\partial Y}\frac{Y}{q_i^*} > -1$$

where, again, to shorten notation, $q_i^* = \mathcal{Q}_i^*(z_i, k_i, w, P, Y)$. Using equation (19) it is possible to compute:

$$\frac{\partial q_i^*}{\partial Y}\frac{Y}{q_i^*} = \left(\frac{2\Upsilon_i''(q_i^*) + q_i^*\Upsilon_i''(q_i^*)}{\Upsilon_i'(q_i^*) + q_i^*\Upsilon_i''(q_i^*)} q_i^* \frac{1-\nu}{\nu} - 1\right)^{-1}$$

Hence, to have $\frac{\partial q_i^*}{\partial Y}\frac{Y}{q_i^*} > -1$, rearranging the previous expression, it must hold:

$$-\frac{2\Upsilon_i''(q_i^*) + q_i^*\Upsilon_i''(q_i^*)}{\Upsilon_i'(q_i^*) + q_i^*\Upsilon_i''(q_i^*)} > 0$$

which under Assumption 1 is true since, as the proof of Lemma 1 shows, we both have that $2\Upsilon_i''(q_i^*) + q_i^*\Upsilon_i''(q_i^*) < 0$ and $\Upsilon_i'(q_i^*) + q_i^*\Upsilon_i''(q_i^*) > 0$ for every $q_i^* = \mathcal{Q}_i^*(z_i, k_i, w, P, Y)$ □

B - Klenow and Willis functional form

The Klenow and Willis (2015) functional form for $\Upsilon(\cdot)$ is:

$$\Upsilon(q) = 1 + (\sigma - 1)e^{1/\psi}\psi^{\frac{\sigma}{\psi}-1}\left[\Gamma\left(\frac{\sigma}{\psi}, \frac{1}{\psi}\right) - \Gamma\left(\frac{\sigma}{\psi}, \frac{(q)^{\frac{\psi}{\sigma}}}{\psi}\right)\right]$$

with $\sigma > 1$ and $\psi \geq 0$, and where $\Gamma(s, x)$ denotes the function:

$$\Gamma(s, x) := \int_x^\infty t^{s-1}e^{-t}dt$$

It is possible to show that the first derivative of $\Upsilon(\cdot)$ takes the form:

$$\Upsilon'(q) = \frac{\sigma - 1}{\sigma}\exp\left\{\frac{1 - q^{\psi/\sigma}}{\psi}\right\}$$

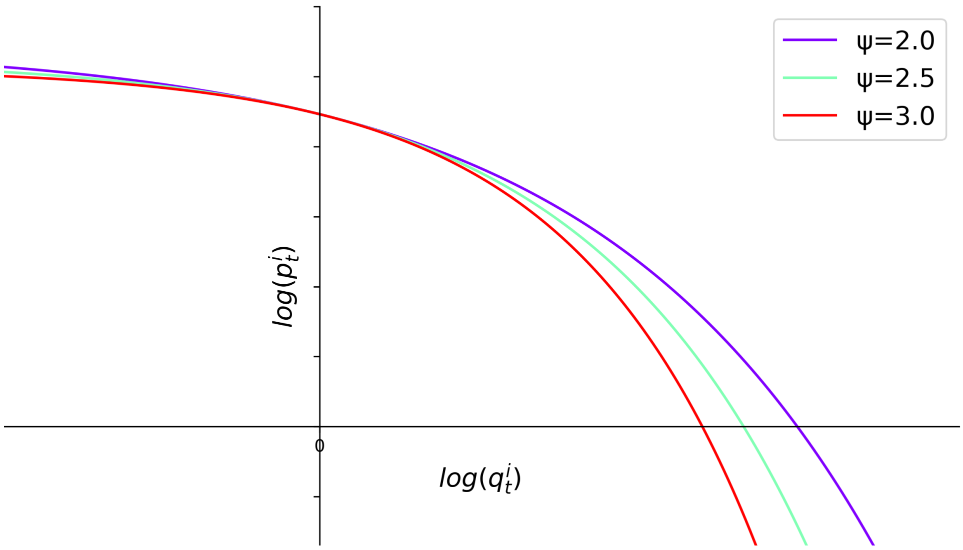
starting from $\Upsilon'(q)$, standard algebra also delivers the expression for $\Upsilon''(q)$. Those expressions can be plugged into the formula for the elasticity of demand derived in (5):

$$\mathcal{E}^d(q_i) = -\frac{\Upsilon'(q_i)}{q_i\Upsilon''(q_i)}$$

delivering:

$$\mathcal{E}^d(q_i) = \sigma(q_i)^{-\frac{\psi}{\sigma}}$$

FIGURE 15. *Demand for the intermediate goods with Klenow and Willis functional form for $\Upsilon(\cdot)$, $\sigma = 6$ and varying values for ψ*



Finally, using the markup definition:

$$\mu(q_i) = \frac{\mathcal{E}^d(q_i)}{\mathcal{E}^d(q_i) - 1} = \frac{\sigma}{\sigma - q_i^{\frac{\psi}{\sigma}}}$$

The following Figure plots an instance of the shape of the demand function for the entrepreneur's $i \in I$ good: $p_i = P\Upsilon'(q_i)$ when $\Upsilon'(\cdot)$ takes the Klenow and Willis (2016) functional form. The demand function is plotted for $\sigma = 6$ (employed in the calibration of Section 4.2) and several values of ψ, showing how this parameter regulates the concavity of the demand function.

C - Additional Tables and Figures

Table 5. *Model with const. and heterogeneous markups calibration: summary*

Par.	Description	Value	Target
ω	fraction of workers	0.88	non-entrepreneur households in SCF 2019
ν	capital exponent prod.	0.28	labor share = 0.6
x_z	scale par. entr. ability dist.	0.125	observed returns to entrepreneurship
η_z	shape par. entr. ability dist.	4.1	observed returns to entrepreneurship
α_0	$k_i = k(z_i) = \alpha_0 z_i^{\alpha_1}$	868	min. wealth = 1
α_1	$k_i = k(z_i) = \alpha_0 z_i^{\alpha_1}$	3.25	tail parameter entrepreneurial wealth 1.25
σ_e^2	variance labor supply dist.	1.1	Gini coeff. income inequality = 0.59

Notes: *the Table summarizes the calibrated model's parameters values. The first column indicates the symbol used to identify the parameter in the model, the second column the parameter description, the third column the chosen value for the parameter, the fourth column the moment targeted to calibrate each parameter.*

Table 6. *Model with no markups heterogeneity calibration: summary*

Par.	Description	Value	Target
ω	fraction of workers	0.88	non-entrepreneur households in SCF 2019
ν	capital exponent prod.	0.28	labor share = 0.6
x_z	location par. entr. ability dist.	0.15	observed returns to entrepreneurship
η_z	scale par. entr. ability dist.	5	observed returns to entrepreneurship
σ	demand elasticity	6	$\mathcal{M} = 1.2$
α_0	$k_i = k(z_i) = \alpha_0 z_i^{\alpha_1}$	186	min. wealth = 1
α_1	$k_i = k(z_i) = \alpha_0 z_i^{\alpha_1}$	3.96	tail parameter entrepreneurial wealth 1.25
σ_e^2	variance labor supply dist.	1.1	Gini coeff. income inequality = 0.59

Notes: *the Table summarizes the calibrated model's parameters values. The first column indicates the symbol used to identify the parameter in the model, the second column the parameter description, the third column the chosen value for the parameter, the fourth column the moment targeted to calibrate each parameter.*

Table 7. *Steady-state calibration under constant and heterogeneous markups: summary*

Par.	Description	Value	Target	Model
β	discount factor	0.962	r = 4%	4%
δ	depreciation rate	0.02	entr. wealth fraction = 0.46	0.44
a_0	workers' wealth	26.5	$Y^E/Y = 0.4$	0.39
ω	fraction of workers	0.88	fraction of non-entr.	0.88
ν	capital exponent prod.	0.28	Labor share = 0.6	0.6
σ_e^2	variance labor supply dist.	1.1	Gini coeff. income inequality = 0.59	0.59
			top 1% wealth = 0.43	0.43
x_z	scale par. entr. ability dist.	0.5	top 5% wealth = 0.71	0.68
η_z	tail par. entr. ability dist.	4.1	top 10% wealth = 0.83	0.81
			Gini wealth = 0.88	0.87

Notes: *the Table summarizes the parameter choices to calibrate the steady state of the dynamic model in which markups arise through type dependence. The first column indicates the symbol used to identify the parameter in the model, the second column the parameter description, the third column the chosen value for the parameter, the fourth column the moment targeted to calibrate each parameter, the fifth column the value of the targeted moment in the simulated model*

Table 8. *Steady state calibration under homogeneous markups: summary*

Par.	Description	Value	Target	Model
β	discount factor	0.962	r = 4%	4%
δ	depreciation rate	0.02	entr. wealth fraction = 0.46	0.44
a_0	workers' wealth	26.5	$Y^E/Y = 0.4$	0.39
ω	fraction of workers	0.88	fraction of non-entr.	0.88
ν	capital exponent prod.	0.28	Labor share = 0.6	0.6
σ	elasticity of demand	6	$\mathcal{M} = 1.2$	1.2
σ_e^2	variance labor supply dist.	1.1	Gini coeff. income inequality = 0.59	0.59
			top 1% wealth = 0.43	0.44
x_z	scale par. entr. ability dist.	0.7	top 5% wealth = 0.71	0.69
η_z	tail par. entr. ability dist.	5.3	top 10% wealth = 0.83	0.79
			Gini wealth = 0.88	0.86

Notes: *the Table summarizes the parameter choices to calibrate the steady state of the dynamic model presented in Section 6. The first column indicates the symbol used to identify the parameter in the model, the second column the parameter description, the third column the chosen value for the parameter, the fourth column the moment targeted to calibrate each parameter, the fifth column the value of the targeted moment in the simulated model*

TABLE 9. *Model with occupational choice and heterogeneous markups calibration*

Par.	Description	Value	Target
ν	capital exponent prod.	0.28	labor share = 0.6
x_z	scale par. entrepreneurial ability dist.	0.2	observed returns to entrepreneurship
η_z	shape par. entrepreneurial ability dist.	5	observed returns to entrepreneurship
σ	demand elasticity when $q = 1$	10.6	$\mathcal{M} = 1.2$
ψ	shape par. demand elasticity	1.74	$\psi/\sigma = 0.16$
α_0	$k_i = k(z_i) = \alpha_0 z_i^{\alpha_1}$	157	min wealth = 1
α_1	$k_i = k(z_i) = \alpha_0 z_i^{\alpha_1}$	3.97	tail parameter entrepreneurial wealth 1.25
f	fixed cost	0.011	fraction of entrepreneurs

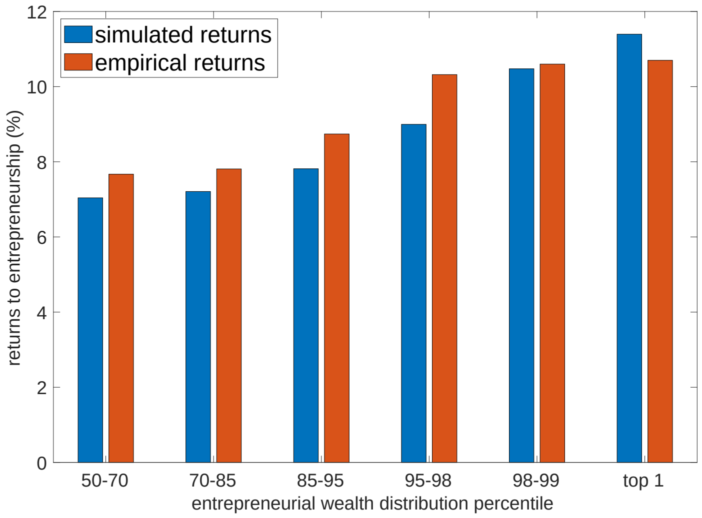
Notes: *the Table summarizes the calibrated parameters values of the model with endogenous occupational choice and entrepreneurs facing demand function for their own variety with variable elasticity of demand. The first column indicates the symbol used to identify the parameter in the model, the second column the parameter description, the third column the chosen value for the parameter, the fourth column the moment targeted to calibrate each parameter.*

TABLE 10. *Model with occupational choice and constant markups calibration*

Par.	Description	Value	Target
ν	capital exponent prod.	0.28	labor share = 0.6
x_z	scale par. entr. ability dist.	0.28	observed returns to entrepreneurship
η_z	shape par. entr. ability dist.	5.4	observed returns to entrepreneurship
σ	demand elasticity	6	$\mathcal{M} = 1.2$
α_0	$k_i = k(z_i) = \alpha_0 z_i^{\alpha_1}$	157	min wealth = 1
α_1	$k_i = k(z_i) = \alpha_0 z_i^{\alpha_1}$	3.97	tail parameter entrepreneurial wealth 1.25
f	fixed cost	0.0515	fraction of entrepreneurs in SCF (2019)

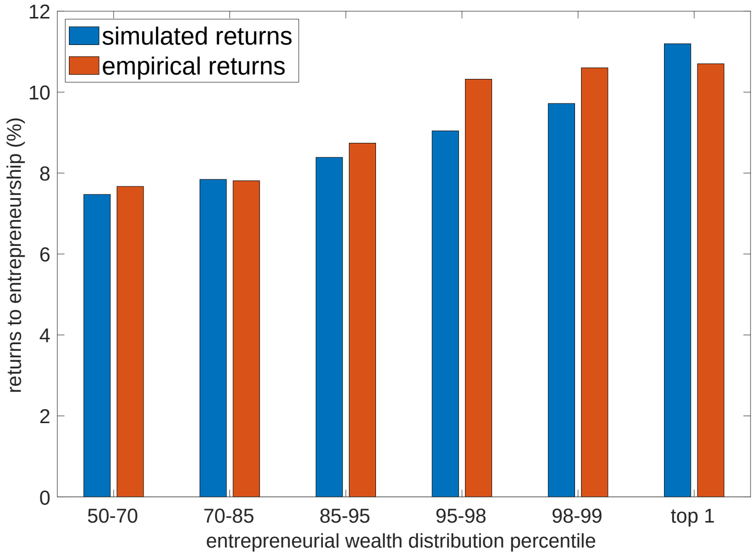
Notes: *the Table summarizes the calibrated parameters values of the model with endogenous occupational choice and entrepreneurs facing demand function for their own variety with constant elasticity of demand. The first column indicates the symbol used to identify the parameter in the model, the second column the parameter description, the third column the chosen value for the parameter, the fourth column the moment targeted to calibrate each parameter.*

Figure 16. *Simulated vs empirical returns to entrepreneurship: heterogeneous and constant markups model*



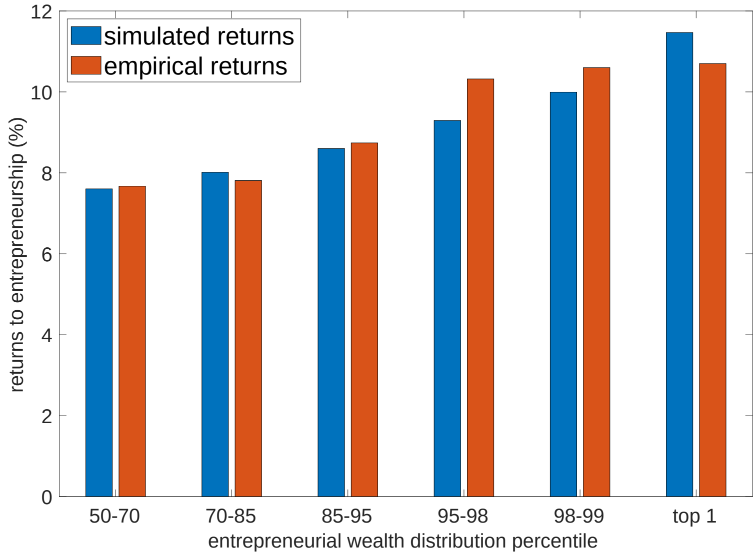
Notes: *the Figure reports the simulated returns to entrepreneurship in the model in which entrepreneurs impose heterogeneous but constant markups (blue) and the estimated returns to entrepreneurship (orange). The simulated returns are computed by averaging across wealth percentiles bins the simulated returns (for calibration details see Table 6). The estimated returns are those reported in Figure 5.*

Figure 17. *Simulated vs empirical returns to entrepreneurship: constant markups model*



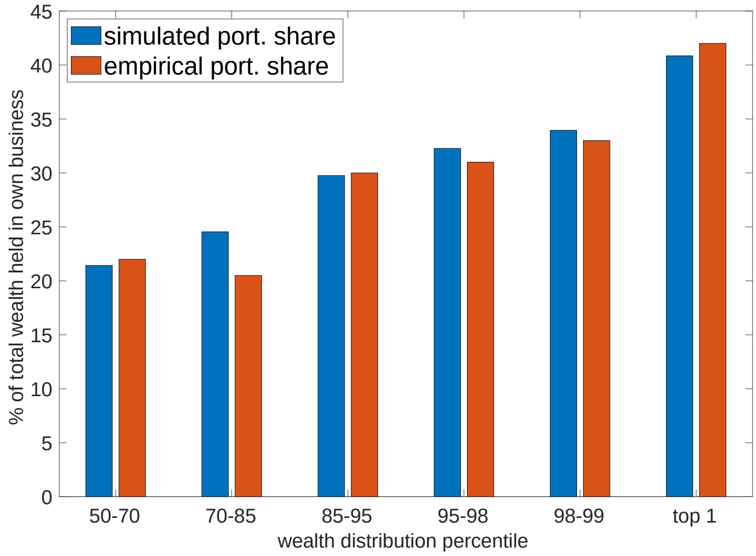
Notes: *the Figure reports the simulated returns to entrepreneurship in the model in which entrepreneurs impose constant markups (blue) and the estimated returns to entrepreneurship (orange). The simulated returns are computed by averaging across wealth percentiles bins the simulated returns (for calibration details see Table 6). The estimated returns are those reported in Figure 5.*

FIGURE 18. *Simulated vs empirical returns to entrepreneurship at the steady state*



Notes: *the Figure reports the simulated returns to entrepreneurship at the steady state (blue) and the estimated returns to entrepreneurship (orange). The simulated returns are computed by averaging across wealth percentiles bins the simulated returns (for calibration details see Table 3). The estimated returns are those reported in Figure 5.*

FIGURE 19. *Simulated vs empirical portfolio shares at the steady-state*



Notes: *the Figure reports the simulated fraction of net wealth ($\phi^i = \phi(z^i)$) that entrepreneurs hold in their business at the steady-state (blue) and the estimated portfolio shares (orange, see Figure 2). The simulated portfolio shares are computed by averaging across wealth percentiles bins the simulated portfolio shares.*

D - Static model with endogenous occupational choice

How does the endogenous occupational choice affect wage and output losses in the two economies studied in Sections 4-5? This Section argues that even when endogenous occupational choice is allowed, the same revenue equivalent wealth tax induces larger output and wage losses in the economy in which entrepreneurs impose constant markups.

D.1 Model and calibration

I now suitably modify the model studied in Section 3 to allow for endogenous occupational choice. Assume that all households $i \in [0,1]$ are endowed with entrepreneurial skills z_i drawn from a Pareto distribution with cdf $F(z)$ and support $[\underline{z}, \infty)$ (with $\underline{z} > 0$) and wealth $k_i = k(z_i)$. Each household can now choose between becoming a worker or an entrepreneur:

- A worker receives the wage w. For simplicity all households, when workers, are assumed to inelastically supply a unit of labor. Furthermore, when a household is a worker he invests his wealth k_i in a risk-free investment opportunity with zero return. Hence, the consumption of each household $i \in [0,1]$ who decides to be a worker is: $c_i = w$.

- An entrepreneur receives profits from his entrepreneurial activity. Each entrepreneur solves the profit maximization problem (E)[16]. Furthermore, to become entrepreneur an household has to pay the fixed cost $f > 0$.[17]

Each household $i \in [0,1]$ makes his occupational choice comparing his consumption when he decides to be a worker with consumption in the entrepreneurial occupation. Formally, each household $i \in [0,1]$ becomes entrepreneur if:

$$\pi^*(z_i, k(z_i), w, P, Y) - f \geq w$$

where $\pi^*(\cdot)$, see equation (7), denotes the optimal profits made by entrepreneur i when solving problem (E). If the function $\Upsilon(\cdot)$ takes either the Klenow and Willis (2016)

[16]When I will study the effects of wealth taxation in the economy in which entrepreneurs impose constant markups the problem to be solved will be (E').

[17]A fixed cost is needed since without it the model would not able to replicate all the calibration targets matched in the previous analysis without occupational choice, *plus* the fraction of workers and entrepreneurs observed in the SCF data (which before was exogenous). More details about calibration will follow.

functional form (see (10)) or $\Upsilon(q) = q^{\frac{\sigma-1}{\sigma}}$ (which will be the two functional forms used when calibrating the model) it is possible to show that $\pi^*(\cdot)$ is monotonically increasing in z_i while labor income w is independent of z_i. Thus, it is possible to define an occupational choice threshold $\hat{z}$ such that:

$$\pi^*(\hat{z}, k(\hat{z}), w, P, Y) - f = w$$

and all households with skills $z_i \geq \hat{z}$ become entrepreneurs, while all households with skills $z_i < \hat{z}$ become workers.

Equilibrium: The equilibrium of this static economy with occupational choice is a set of aggregates $\{w^*, Y^*, P^*\}$, an occupational choice threshold $\hat{z}$, a vector of quantities consumed by each household (workers and entrepreneurs) $\{c_i^*\}_{i\in[0,1]}$, relative quantity function $q^*(z_i, k(z_i), w^*, P^*, Y^*)$, labor demand function $n^*(z_i, k(z_i), w^*, P^*, Y^*)$, profit function $\pi^*(z_i, k(z_i), w^*, P^*, Y^*)$ such that:

- Each worker i consumes his labor income $c_i^* = w^*$
- Given the aggregates $\{w^*, Y^*, P^*\}$ the functions $q^*(z_i, k_i, w^*, P^*, Y^*)$, $n^*(z_i, k_i, w^*, P^*, Y^*)$, $\pi^*(z_i, k_i, w^*, P^*, Y^*)$ solve the entrepreneur's i problem (E)
- The occupational choice threshold $\hat{z}$ is such that:

$$\pi^*(\hat{z}, k(\hat{z}), w^*, P^*, Y^*) - f = w^*$$

- Labor market clears:

$$\int_{\underline{z}}^{\hat{z}} F(z)dz = \int_{\hat{z}}^{\infty} n^*(z, k(z), w^*, P^*, Y^*)F(z)dz$$

- Kimball aggregator is satisfied:

$$\int_{\hat{z}}^{\infty} \Upsilon\left(q^*(z, k(z), w^*, P^*, Y^*)\right) F(z)dz = 1$$

Calibration: the model with occupational choice is calibrated so to match the same targets of the models without occupational choice presented in the previous Sections (observed returns, observed wealth distribution, aggregate markup $\mathcal{M} = 1.2$, labor share). The only difference in the calibration procedure of the model with occupational choice is that the fixed cost f is calibrated so to have the fraction of households who decide to be entrepreneurs equal to the fraction of households defined as entrepreneurs in the SCF 2019 data (0.12). Furthermore, notice that to study the economy in which entrepreneurs impose markups increasing in their market shares, the Klenow and Willis (2016) functional for for $\Upsilon(\cdot)$ will be used (see equation 10). Instead, to study the economy in which entrepreneurs impose constant markups the functional form chosen for $\Upsilon(\cdot)$ will be $\Upsilon(q) = q^{\frac{\sigma-1}{\sigma}}$. Details on the calibrated parameters are reported in Appendix C, Tables 9 and 10.

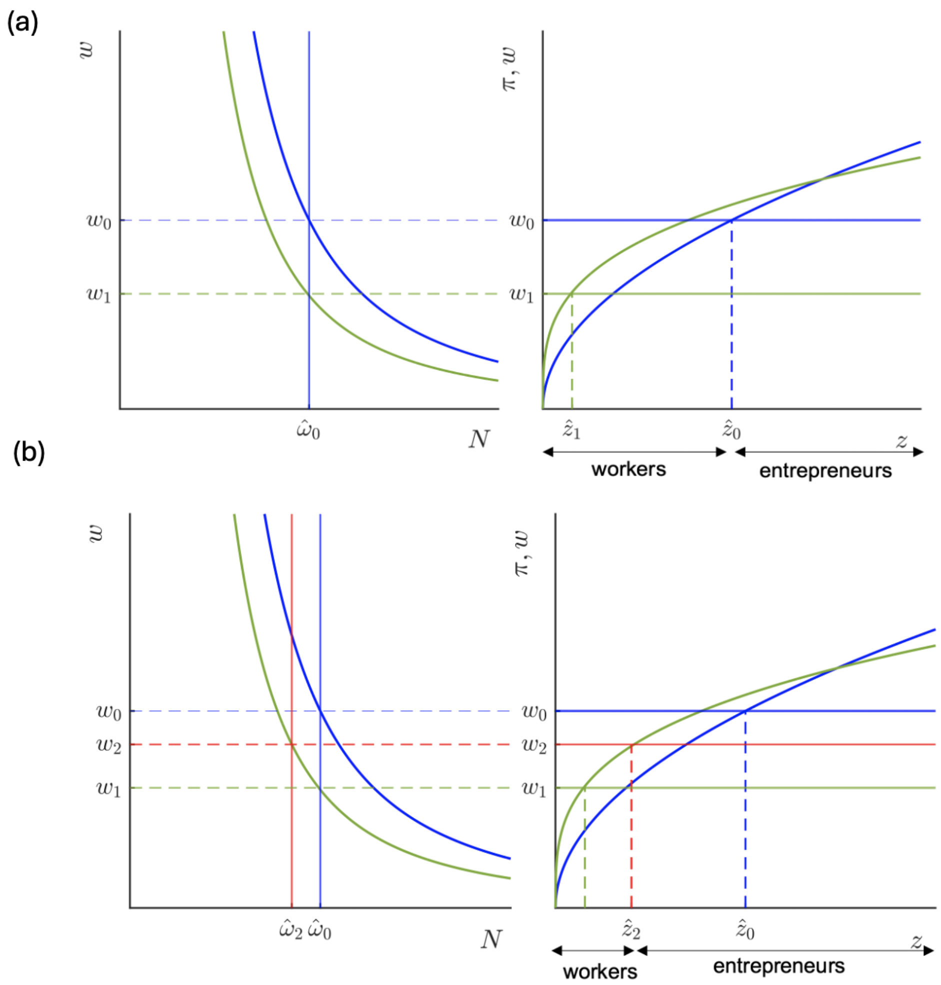
D.2 Wealth tax experiment with occupational choice

Figure 20 shows how allowing for endogenous occupational choice changes the aggregate effects of wealth taxation. First of all consider panel (a). The concave blue line in the right hand plot represents profits as a function of entrepreneurial skills and the horizontal line equilibrium wage. Their intersection at $(w_0, \hat{z}_0)$ identifies the equilibrium wage and occupational choice threshold in the initial equilibrium of the economy, when no tax is implemented. The blue lines in the left plot, instead, represent aggregate labor supply and labor demand functions. Notice that while labor demand is downward sloped, the labor supply curve is vertical. Indeed, when the measure of workers in the economy is $\hat{\omega}_0$, for any wage offered the aggregate labor supply will just be the measure of workers available for production $\hat{\omega}_0$.

As I showed in Figure **??** the introduction the wealth tax reduces profits for wealthiest entrepreneurs and increases profits for poorer entrepreneurs, thus the profits function after the wealth tax is implemented becomes the one in green. Furthermore, the wealth tax reduces aggregate labor demand, which shifts to the left (green curve in the left plot, panel (a)). Suppose just for the moment that the measure of workers is exogenously fixed at $\hat{\omega}_0$ (as if there was no occupational choice). The intersection between labor supply and labor demand at $(\hat{\omega}_0, w_1)$ determines the new equilibrium wage, w_1, once the tax is implemented. Furthermore, notice that all workers between $\hat{z}_1$ and $\hat{z}_0$ now would like to become entrepreneurs but they cannot since the number of workers has been exogenously fixed.

Now let's look at panel (b) of Figure 20 which plots in red the new labor supply and equilibrium wage once I allow households to freely choose their occupation. The workers willing to become entrepreneurs induce a reduction in labor supply (labor supply shifts to the left) and the intersection with labor demand at $(w_2, \hat{\omega}_2)$ determines the new

FIGURE 20. *Wealth tax effects on occupational choice threshold and wage*



Notes: *Panel (a): the left plot reports aggregate labor supply and labor demand curves of the analyzed economy. The right plot reports equilibrium wage and profits as a function of productivity. Blue lines represent these curves before the wealth tax is implemented. Green lines represent these curves after the wealth tax is implemented but keeping labor supply fixed at the initial level. Panel (b): the curves in red represent the same curves in panel (a) but once the wealth tax is implemented and labor supply is allowed to vary.*

equilibrium wage w_2. Hence, notice that, once I allow occupational choice the reduction in equilibrium wage due to the wealth tax is lower and there are more entrepreneurs producing: $\hat{z}_2 < \hat{z}_0$.

The model simulations allow to quantify the previously described effects. They are reported in Table 11. The first two columns report how the wealth tax affects several aggregates when the model in which entrepreneurs impose heterogeneous markups is simulated, first keeping the occupational threshold $\hat{z}$ fixed and then allowing $\hat{z}$ to change once the wealth tax is implemented. The same exercise is repeated for the economy in which all entrepreneurs impose the same markups and the results are reported in columns

TABLE 11. *Wealth tax aggregate effects in the model with occupational choice: simulation results*

	Heterogeneous markups		**Constant markups**	
(%)	fixed $\hat{z}$	end. $\hat{z}$	fixed $\hat{z}$	end. $\hat{z}$
Δw	-0.16	-0.13	-0.22	-0.148
ΔN	0	-0.032	0	-0.046
ΔK	-0.613	-0.50	-0.613	-0.474
ΔZ	-0.023	-0.025	-0.034	-0.038
$\Delta \mathcal{M}$	-0.025	-0.031	0	0
ΔY	-0.18	-0.18	-0.22	-0.194

Notes: *the Table summarizes the effects of the wealth tax policy described in 4.2 on equilibrium wage, aggregate employment, aggregate capital, aggregate productivity, aggregate markup, aggregate production. These effects are obtained simulating the model with occupational choice calibrated in 6.1. The wealth tax effects are computed first keeping the occupational choice threshold $\hat{z}$ fixed, and then letting $\hat{z}$ vary after the tax implementation*

3-4 of Table 11.

Notice that in both economies allowing $\hat{z}$ to change once the tax is implemented reduces the drop in equilibrium wage and aggregate capital used for production, with respect to the case in which the measure of workers is fixed. Furthermore, in both economies, the entry of new entrepreneurs (who have low productivity) reduces aggregate productivity and also aggregate markup in the economy in which entrepreneurs impose heterogeneous markups. The reason is that the newly entered entrepreneurs have low productivity, produce at a small scale and hence apply small markups. Finally, notice that the magnitude of all these affects is larger in the economy where entrepreneurs impose constant markups. The reason for this is the larger increase of profits of poorer entrepreneurs and the larger reduction of wage in the economy with constant markups. However, even when allowing households to make an occupational choice the considered wealth tax reduces aggregate production and equilibrium wage more in the economy where entrepreneurs impose constant markups.

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