Markups and Inequality

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February 2019

Abstract

We study the relationship between markups, firm concentration and inequality using a model of entrepreneurial dynamics in an environment with incomplete markets and borrowing constraints. A key ingredient of the model is that markups are endogenous so that the markup a producer charges depends on the amount of competition it faces. We ask two questions. First, what fraction of the rise in income and wealth inequality is due to changes in the U.S. tax code and decline in anti-trust enforcement that led to a rise in the level and dispersion of markups? Second, what are the consequences of policies aimed at curtailing the market power of firms and reducing the level of markups? We answer these questions by studying micro-level data on income and wealth, entrepreneurial activity and product market concentration through the lens of our model.

Keywords: concentration, misallocation, inequality, markups, entrepreneurship.

JEL classifications: D4, E2, L1.

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1 Introduction

The United States has experienced a sharp increase in both firm- and household-level inequality in recent decades. On one hand, the market share of the largest firms has increased considerably in most industries, a trend accompanied by a rise in profit shares and measured markups. On the other hand, household wealth and income inequality has increased dramatically as well. Since firm ownership is highly concentrated, these two trends may be interrelated: an increase in firm profits and the resulting decline in the labor share of income redistributes income away from workers towards firm owners. Indeed, a number of commentators (see for example Stiglitz (2012)) have forcefully made this point.

This paper aims to understand the relationship between these two trends. We study two sets of questions. On the positive side, we examine the extent to which the decline in the progressivity of the U.S. tax code and anti-trust enforcement are responsible for the trends in firm- and household-level inequality and the increase in measured markups. On the normative side, we evaluate the welfare consequences of policies aimed at curbing inequality, the market power of firms, and their markups. We do so by studying micro-level data on income and wealth, entrepreneurial activity and product market concentration using a dynamic general equilibrium model with incomplete markets, imperfect competition in the product market, entrepreneurial dynamics, and in which markups are endogenously determined.

The model we study features heterogeneous producers engaged in monopolistic competition with non-CES demand, as in Kimball (1995). Two types of producers co-exist: privately owned businesses operated by entrepreneurs and publicly owned corporate firms. Unlike corporate firms, private businesses face collateral constraints that limit the amount they can borrow. An entrepreneur's wealth is therefore a key determinant of how much a private business can produce. Within a given industry, more productive or less financially constrained producers are larger and face less elastic demand, so they charge higher markups than less productive or more financially constrained firms.

Our analysis builds on the work of Atkeson and Burstein (2008), Bilbiie et al. (2012) and Edmond et al. (2018), who study models in which markups are endogenously determined by the amount of competition individual firms face. These papers assume perfect consumption sharing across households and thus abstract from concerns about the distribution of income. In such a setting, the optimal policy response to markups, which act like a tax on economic activity, is to subsidize firms, more so the larger their markups. Such policies allow one to achieve the efficient level of production in the economy. In contrast, in our economy subsidizing large producers may further increase wealth and income inequality and thus may be undesirable. In short, markups have both production and distributional consequences. We therefore use our model to evaluate the aggregate and distributional consequences of several policy reforms aimed at removing markup distortions and curtailing inequality.

The economy we study consists of a large number of households who work and have the option to run a private business. Households are subject to idiosyncratic shocks to both their labor market efficiency and their entrepreneurial productivity. They can insure against these shocks by saving in a risk-free asset managed by a financial intermediary, who uses household savings to purchase capital, shares in corporate firms or government bonds. Households who run a private business are the monopoly supplier of a differentiated variety of a good and charge a markup over marginal cost.

We explicitly model entrepreneurial activity because it is an important determinant of wealth and income inequality, as pointed out by Cagetti and De Nardi (2006). According to the 2013 Survey of Consumer Finances, though entrepreneurs represent only about 7% of all households, they account for about 37% of all wealth and 28% of all income. Privately-owned businesses are much more reliant on external finance than publicly-owned firms are (Shourideh and Zeitlin-Jones, 2017) and therefore more likely to be borrowing constrained. We follow Buera et al. (2011) in assuming that privately owned businesses face a collateral constraint that limits the amount of capital they can rent to a multiple of their wealth. More productive entrepreneurs have a larger optimal scale of operations and are more constrained, on average. Dispersion in entrepreneurial productivity therefore gives rise to dispersion in the rates of returns on savings and is an important determinant of wealth inequality. Collateral constraints imply that entrepreneurs are inefficiently small, which in turn reduces aggregate productivity and output. Progressive tax policies or policies that reduce entrepreneurial profits may therefore reduce the returns on entrepreneurs' savings, wealth and ability to self-finance and have adverse consequences for output.

Entrepreneurs compete among themselves as well as against firms in the corporate sector. Corporate firms operate an identical technology, but do not face borrowing constraints. The assumptions we make on the demand system imply that the demand elasticity a producer faces decreases in their relative size, and so larger producers charge higher markups. In this environment, more competition reduces markups.

One of the goals of this paper is to study the distributional consequences of policies aimed at reducing markup distortions, for example, production subsidies for larger firms. The welfare consequences of such policies depend greatly on the incidence of the tax burden of such policies. It is therefore imperative that our model does well in reproducing the very low wealth and income shares of the median household. We calibrate the parameters of the model to match moments of the wealth and income distribution, several salient facts about entrepreneurs, the relative size and concentration of the corporate sector, as well as an estimate of the aggregate markup of 15% from Barkai (2017).

We find that financial constraints are important in our model, even though only a few entrepreneurs are constrained. Absent financial constraints the entrepreneurial firms would double in size and account for 2/3 of the economy's sales compared to approximately 1/3 in our baseline model. These constraints imply that policies that remove the dispersion of markups by subsidizing larger producers reduce TFP by further reallocating resources towards corporate firms who do not face borrowing constraints. This result highlights the importance of factoring in financial frictions when evaluating policies aimed at removing markup distortions.

We also find that a more progressive tax system, similar to that the United States had in the 1970s, greatly reduces output, wages and labor productivity, but have a negligible effect on the aggregate markup. Though more progressive taxes do increase the consumption of the poor, they come at the cost of large declines in consumption for the rest of the agents. Intuitively, progressive taxes shrink the entrepreneurial sector by reducing the entrepreneurs' incentives to save and overcome their borrowing constraints.

On the normative side, we find that the effect of policies aimed at reducing markup distortions greatly depends on how these policies are financed. We consider sales subsidies which restore production efficiency in a representative consumer economy with variable markups (Edmond et al., 2018). Since markups are an implicit tax on output, subsidies that increase with firm size exactly offset the markup distortion, increasing the capital and labor shares. With perfect consumption sharing across households, such subsidies can be financed with lump-sum taxes and greatly increase output and consumption. In contrast, in our economy with incomplete markets lump-sum taxes would be very costly. We therefore assume that the government finances these by either increasing the average income tax rate or the progressivity of the tax system. Regardless of how sales subsidies are financed, the resulting output gains are much smaller than those obtained in Edmond et al. (2018).

Increasing the average tax rate raises output in the new steady state by only 1.4%, shrinks the entrepreneurial sector, and increases misallocation by 0.6%.[1] This increase in misallocation may appear counterintuitive since the policy we consider reduces all markup dispersion, a source of allocative inefficiency. However, the side effect of removing markup distortions is that sales subsidies disproportionately benefit corporate firms which are not financially constrained and can easily expand production. This results in a reallocation of production from entrepreneurs to the corporate sector, which is inefficiently large to begin with. This decline in aggregate productivity, as well as the increase in the marginal tax rates reduces labor supply and implies that removing markup distortions has a modest effect on consumption.

Financing sales subsidies by increasing tax progressivity instead has much larger negative effects on output, employment and aggregate productivity. Though more progressivity

[1] We relegate the analysis of the transition dynamics to the next draft of the paper.

reduces wealth inequality, it generates only a modest increase in the consumption of the very poor, at the expense of a large drop in the consumption of the rich. This echoes the results of our analysis of the tax system in the United States in 1970.

Related Work Despite the growing concern in policy circles about markups and inequality and the potential relationship between the two, most academic work has treated the two topics in isolation. Most of the literature studying the determinants of markups, such as Atkeson and Burstein (2008), Bilbiie et al. (2012, 2018) and Edmond et al. (2018), assumes perfect consumption sharing across households and thus abstracts from concerns about the distribution of income. The literature on inequality, originating with Castaneda et al. (2003), Cagetti and De Nardi (2006) and more recently Benhabib et al. (2017) and Hubmer et al. (2018), typically assumes perfect competition in the product market or that markups are constant. A notable exception is the work of Colciago and Mechelli (2019) who study the effect of increasing markups in an Aiygari model in which homogeneous firms engage in oligopolistic competition. In contrast to their work, we focus on monopolistic competition, explicitly model firm heterogeneity, entrepreneurial activity, and study the normative implications of the rise in markups.

Our work is also related to several other important strands of research: the decline in labor share (Karabarbounis and Neiman, 2013, Eggertsson et al., 2018), development policies (Itskhoki and Moll, 2019), rise in inequality (Piketty and Goldhammer, 2014, Kuhn and Rios-Rull, 2016), increase in measured markups (Gutierrez and Philippon, 2017, De Loecker et al., 2018), increase in firm concentration (Autor et al., 2017), taxation of private businesses (Piketty et al., 2014, Dyrda and Pugsley, 2018, Bhandari and McGrattan, 2018).

The remainder of the paper proceeds as follows. Section 2 presents several facts on inequality and market concentration that motivate our work. Section 3 presents the model. Section 4 explains how we parameterize the model to match inequality and market concentration. Section 5 discusses the role of markups and borrowing constraints in shaping the equilibrium outcomes of the model. Section 6 conducts a number of policy experiments aimed at understanding the aggregate and distributional consequences of changing tax progressivity and restoring production efficiency. Section 7 concludes.

2 Motivating evidence

We motivate our modeling choices below by summarizing several salient facts in the data on the rise in firm concentration, firm markups, wealth and income inequality. We also highlight the importance of entrepreneurial activity by reporting statistics on the wealth and income shares of entrepreneurs. Though these facts are well-known from existing work by Autor et al. (2017), De Loecker et al. (2018), Cagetti and De Nardi (2006), Saez and Zucman (2016) and Kuhn and Rios-Rull (2016), we report them here in order to provide some context for our quantitative model.

Firm Concentration. Figure 1 plots the evolution of the share of sales accounted for by the top 10% and top 5% largest firms in Compustat, since 1950. We calculate these shares within four-digit industries and report in the figure a sales-weighted average across industries. Figure 1 shows a clear upward trend over time – both measures suggest that industries have become more concentrated. Among Compustat firms, the share of sales accounted for by the largest 5% of firms in an industry rose from 0.30 in 1950 to 0.64 in 2014, while the share of sales of the largest 10% of firms increased from 0.40 in 1950 to 0.72 in 2014.

Firm Markups. Figure 2 reproduces the evidence in Edmond et al. (2018) on the evolution of the cost-weighted average markup in Compustat. They compute firm-level markups using a methodology similar to that in De Loecker et al. (2018). The average markup rose from 1.16 in 1950 to 1.24 in 2014. The increase is especially prominent between 1980 and 2014, when the average markup rose from 1.11 to 1.24.

Inequality. We use the Survey of Consumer Finances (SCF) to compute moments of the wealth and income distribution, and to study the prevalence of entrepreneurs in the different parts of these distributions. As Figure 3 shows, both wealth and income inequality increased considerably over the past four decades, especially at the very top. Between 1989 and 2016 the share of wealth held by the 10% wealthiest households increased from 0.67 to 0.77, while the share of wealth held by the wealthiest 1% increased from 0.29 to 0.39. The top 1% income share increased from 0.18 to 0.30, while the top 10% income share increased from 0.46 to 0.58.

Table 1 reports several statistics that describe the prevalence of entrepreneurs in the wealth and income distribution in the 2013 SCF survey, which we use to calibrate our model. We follow Cagetti and De Nardi (2006) in defining an entrepreneur as a self-employed business owner who is actively engaged in managing a business. Entrepreneurs are wealthier and earn more on average: though they represent only 7% of all households, they account for 37% of the wealth and 29% of the income of all households. Focusing on specific wealth and income groups, notice that entrepreneurs account for a large fraction of households at the top of the wealth and income distribution. For example, entrepreneurs account for 58% of the wealthiest 1% of households and hold 62% of the wealth of this group. Similarly, entrepreneurs account for 55% of the richest 1% and hold 64% of the income of this group. These observations motivate the inclusion of entrepreneurial activity in our theoretical framework.

3 Model

The economy is inhabited by a continuum of households who work and have the option to run a privately-owned business. There is also a continuum of perfectly diversified corporate firms. Given our focus on understanding longer term trends, we abstract from aggregate uncertainty, and study the steady state of the model and transition dynamics after various changes in policies.

3.1 Households

Households seek to maximize life-time utility given by

$$\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{c_t^{1-\theta}}{1-\theta} - \frac{h_t^{1+\gamma}}{1+\gamma} \right)$$

subject to the budget constraint

$$c_t + a_{t+1} = i_t - T\left(i_t\right) + a_t,$$

where a_{t+1} are savings, c_t is consumption, h_t are hours worked, i_t is pre-tax income, derived from work, return on asset holdings and profits from entrepreneurship, and $T(i_t)$ is the amount the household pays in taxes. Households save with financial intermediaries at a risk-free rate r_t. Financial intermediaries use the resources obtained from agents to finance purchases of capital, shares in corporate firms and a risk-free government bond. We describe the problem of the financial intermediary below.

All households supply labor and earn wage income $W_t e_t h_t$, where e_t is the agent's idiosyncratic efficiency on the job and W_t is the wage rate. In addition, households may choose to operate a private business and supply a differentiated product variety.[2] Operating a business gives profits $\pi_t\left(a, z\right)$, which depend on the household's wealth (due to a leverage constraint that we describe below) and entrepreneurial productivity z. As we explain below, even though there are no fixed costs of operating a business, only the most productive and wealthiest households become entrepreneurs in equilibrium.

We assume that the logarithm of entrepreneurial and labor market efficiency, z_t and e_t, evolve according to independent AR(1) processes, with persistence ρ_z and ρ_e and volatility

[2] A household who operates a private business supplies $e_t h_t$ of own labor and can hire an additional $l_t - e_t h_t$ units, in order to operate with l_t units of labor. Since the two types of labor are perfect substitutes, we keep the notation simple and say that all households supply $e_t h_t$ units of labor, but the entrepreneurs earn an additional income from the profits of the firm.

σ_z and σ_e. Specifically,

$$\log z_{t+1} = \rho_z \log z_t + \sigma_z \varepsilon_t^z,$$

and

$$\log e_{t+1} = \rho_e \log e_t + \sigma_e \varepsilon_t^e,$$

where ε_t^z and ε_t^e are independent standard normal random variables.

The income of the household is

$$i_t = r_{t-1} a_t + W_t e_t h_t + \pi_t \left(a_t, z_t\right),$$

where the profits $\pi_t \left(a_t, z_t\right)$ are zero for households who choose not to run a business. We refer to households for whom $\pi_t(a_t, z_t) > 0$ as *entrepreneurs.*

We assume taxes are determined according to the function

$$T\left(i_t\right) = i_t - \left(1 - \tau\right) \frac{i_t^{1-\xi}}{1 - \xi},$$

where τ governs the level of the tax rate and $\xi \in (-\infty,\ 1)$ governs the progressivity of the tax schedule. If $\xi > 0$ (< 0) the tax is progressive (regressive). This specification, introduced in dynamic heterogeneous agents models by Benabou (2000), has been shown to approximate well the US tax and transfer system (Heathcote et al., 2017). The after-tax income is therefore

$$i_t - T\left(i_t\right) = \frac{1 - \tau}{1 - \xi} \left[r_{t-1} a_t + W_t e_t h_t + \max\left\{0,\ \pi_t \left(a_t, z_t\right)\right\}\right]^{1-\xi}.$$

Before we derive the profit function $\pi_t \left(a, z\right)$, we must describe the goods markets.

3.2 Final goods firms

We normalize the price of the final good to 1. The output of the final goods sector is used for consumption, investment and to finance government spending, so the aggregate resource constraint is

$$Y_t = C_t + X_t + G,$$

where G is spending by the government and X_t is investment in physical capital

$$X_t = K_{t+1} - \left(1 - \delta\right) K_t.$$

The final goods sector is competitive, with final goods firms purchasing a quantity $y_t\left(\omega\right)$ of differentiated intermediate varieties from both entrepreneurs and corporate firms. Each intermediate goods producer is the only supplier of such a variety and thus has market power. The technology with which the final goods sector operates is implicitly defined by the Kimball aggregator

$$\int_0^{\bar{N}} \Upsilon\Big(\frac{y_t(\omega)}{Y_t}\Big)\, \mathrm{d}\omega = 1,$$

where $\bar{N}$ is the mass of all potentially available varieties, sold by both corporate and privately-owned firms. The function $\Upsilon(q)$ is strictly increasing and strictly concave. We follow Klenow and Willis (2016) in assuming an aggregator of the form

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

where $\Gamma(s,x)$ is the upper incomplete gamma function. This specification nests the CES aggregator as a special case ($\varepsilon = 0$). The Klenow-Willis functional form implies a variable demand elasticity

$$\theta\left(q\right) = -\frac{\Upsilon'(q)}{\Upsilon''(q)q} = \sigma q^{-\frac{\varepsilon}{\sigma}},$$

which falls with the producer's relative quantity $q = y/Y$. This in turn implies that the producer's markup

$$m\left(q\right) = \frac{\theta\left(q\right)}{\theta\left(q\right)-1} = \frac{\sigma}{\sigma - q^{\frac{\varepsilon}{\sigma}}}$$

is endogenous and increases with the firm's relative size q when $\varepsilon > 0$.

This specification of the demand system is widely used both in macroeconomics (Smets and Wouters, 2007) and international economics (Gopinath and Itskhoki, 2010). Importantly, explicitly modeling search frictions (Benabou, 1988, Levin and Yun, 2011) or oligopolistic competition in the product markets (Atkeson and Burstein, 2008) gives rise to similarly-shaped smoothly kinked demand curves and thus a positive relationship between firm size and markups. In contrast to the CES benchmark, such demand systems allow one to model the effect more competition (a reduction in a producer's relative size or market share) has on markups.

Taking the prices $p_t(\omega)$ of the inputs as given, final good producers choose how much of each intermediate variety $y_t(\omega)$ to buy in order to maximize profits

$$Y_t - \int_{\Omega_t} p_t\left(\omega\right) y_t\left(\omega\right) \mathrm{d}\omega,$$

subject to the Kimball production function. Here Ω_t is the set of varieties that are produced in equilibrium in period t. Let $N_t \leq \bar{N}$ denote the mass of producers who find it optimal to operate. The optimality condition for this problem gives rise to the demand for each intermediate producer's product

$$p_t(\omega) = \Upsilon'\Big(\frac{y_t(\omega)}{Y_t}\Big)\, D_t,$$

where

$$D_t = \left(\int_{\Omega_t} \Upsilon'\Big(\frac{y_t(\omega)}{Y_t}\Big)\frac{y_t(\omega)}{Y_t}\,\mathrm{d}\omega\right)^{-1}$$

is a demand index, determined in equilibrium by the production choices of all firms. As is well known, in the CES case with $\varepsilon = 0$ and $\Upsilon(q) = q^{1-\frac{1}{\sigma}}$, this demand index is constant and equal to $\sigma/(\sigma-1)$ and the demand function reduces to $p = (y/Y)^{-\frac{1}{\sigma}}$.

3.3 Intermediate goods producers

Each variety $\omega \in [0,\ \bar{N}]$ can be produced by a single producer, either a corporate or privately-owned firm. The technology with which a producer with efficiency z_t operates is

$$y_t = z_t k_t^{\alpha} l_t^{1-\alpha},$$

where l_t is the amount of efficiency units of labor it hires and k_t is the amount of capital it rents. Producers pay W_t per unit of labor and R_t per unit of capital. The producer's profits are therefore

$$p_t y_t - W_t l_t - R_t k_t.$$

In addition, privately-owned businesses are subject to a leverage constraint which limits the capital used in production to be below a multiple $\lambda \geq 1$ of one's wealth

$$k_t \leq \lambda a_t. \tag{1}$$

As is well-known (see for example Midrigan and Xu, 2014), absent adjustment costs on capital this setup is isomorphic to one in which entrepreneurs own their capital and can borrow up to a fraction $1 - 1/\lambda$ of the value of their capital stock. As a result, not all potentially profitable businesses receive appropriate funding. Households with little wealth can borrow little, and thus have a sub-optimally low level of capital.

An entrepreneur's optimal choice of capital and labor satisfy

$$R_t + \mu_t = \phi_t \alpha \frac{y_t}{k_t}, \tag{2}$$

and

$$W_t = \phi_t (1-\alpha) \frac{y_t}{l_t}, \tag{3}$$

where μ_t is the multiplier on the borrowing constraint (1), given by

$$\mu_t = \max\left[\frac{\alpha}{1-\alpha} W_t \left(\frac{y_t}{z_t \lambda a_t}\right)^{\frac{1}{1-\alpha}} - R_t, 0\right]$$

and ϕ_t is the marginal cost of production

$$\phi_t = \frac{1}{z_t}\left(\frac{R_t + \mu_t}{\alpha}\right)^{\alpha}\left(\frac{W_t}{1-\alpha}\right)^{1-\alpha}.$$

Constrained entrepreneurs, those with $\mu_t > 0$, effectively face upward sloping marginal cost curves. Such producers cannot increase their capital above the borrowing limit λa_t and thus increase production solely by increasing the amount of labor hired, which is subject to decreasing returns.

The firm's optimal price is equal to a markup over the marginal cost,

$$p_t = \frac{\sigma}{\sigma - (y_t/Y_t)^{\frac{\varepsilon}{\sigma}}} \phi_t. \tag{4}$$

Clearly, an unconstrained firm's profits do not depend on the owner's wealth. For constrained producers, an additional unit of wealth allows the producer to expand its capital stock by λ and increases the firm's profits by $\lambda\mu_t$ on the margin. This implies that the implicit pre-tax marginal return to wealth for entrepreneurs is equal to

$$r_{t-1} + \frac{\partial\pi\left(a_t, z_t\right)}{\partial a} = r_{t-1} + \lambda\mu_t\left(a_t, z_t\right).$$

This model therefore predicts dispersion in the implicit rates of return on savings, which Benhabib et al. (2017) argue is an important determinant of wealth inequality.

We finally explain why not all households choose to operate a business, despite the absence of fixed operating costs. Given our specification of the demand system, the price of a particular variety $p_t(q) = \Upsilon'(q)D_t$, evaluated at $q = 0$, is finite, and equal to $p_t(0) = \frac{\sigma-1}{\sigma}\exp\left(\frac{1}{\varepsilon}\right)D_t$. This implies that there is a *choke price* above which the demand for a firm's product is zero. Producers with marginal cost exceeding this cutoff choose not to operate. The productivity cutoff above which a household operates a private firm is therefore

$$\bar{z}_t = \frac{\sigma}{\sigma-1}\exp\left(-\frac{1}{\varepsilon}\right)\frac{1}{D_t}\left(\frac{R_t}{\alpha}\right)^{\alpha}\left(\frac{W_t}{1-\alpha}\right)^{1-\alpha}, \tag{5}$$

provided $a > 0$.

Corporate firms solve the same problem as privately owned firms, but are not subject to a borrowing constraint. We assume an exogenously given measure N^c of producers with log-normally distributed productivity, $\log z \sim \mathbb{N}\left(\bar{z}_c, \sigma_{z_c}\right)$. We let $n^c(z)$ denote the mass of corporate firms over their productivity. As we explained above, producers with productivity below the cutoff in (5) choose not to operate.

We assume that corporations face a linear tax τ_c on their profits. The dividends paid by a corporate firm are

$$d_t^c\left(z\right) = \left(1-\tau_c\right)\Big(p_t^c(z)y_t^c(z) - W_t l_t^c(z) - R_t k_t^c(z)\Big),$$

and are rebated each period to their owners.

3.4 Household choices

We now write the problem of the household recursively. An agent's state variables are current assets a, entrepreneurial ability z and labor market efficiency e. The value function of an agent is

$$V_t\left(a,z,e\right)=\max_{c,h,a'}u\left(c,h\right)+\beta\mathbb{E}V_{t+1}\left(a',z',e'\right)$$

subject to

$$c+a'=a+\frac{1-\tau}{1-\xi}\left[r_{t-1}a+W_teh+\pi_t\left(a,z\right)\right]^{1-\xi}$$

and

$$a'\geq 0.$$

The optimal labor supply satisfies

$$h_t(a,z,e)^{\gamma}=c_t\left(a,z,e\right)^{-\theta}\left(1-\tilde{\tau}_t(a,z,e)\right)W_te,$$

where $\tilde{\tau}_t(a,z,e)$ denotes the marginal income tax rate and is equal to

$$\tilde{\tau}_t(a,z,e)=1-(1-\tau)\left[r_{t-1}a+W_teh_t(a,z,e)+\pi_t\left(a,z\right)\right]^{-\xi}.$$

Households choose hours to equate the marginal cost and the marginal benefit of working. Supplying an additional hour of market work entails marginal disutility $h_t(a,z,e)^{\gamma}$, but generates after-tax income $\left(1-\tilde{\tau}_t(a,z,e)\right)W_te$, which is valued at the marginal utility of consumption.

The optimal choice of savings is dictated by the Euler equation

$$c_t\left(a,z,e\right)^{-\sigma}=\beta\mathbb{E}_t\left(1+\tilde{r}_{t+1}\left(a',z',e'\right)\right)c_{t+1}\left(a',z',e'\right)^{-\sigma},$$

where $\tilde{r}_{t+1}$ is the agent's marginal after-tax return on savings:

$$\tilde{r}_{t+1}\left(a,z,e\right)=\left(1-\tilde{\tau}_{t+1}(a,z,e)\right)\left(r_t+\lambda\mu_{t+1}\left(a,z\right)\right).$$

As usual, households choose savings to equate the marginal cost of forgoing a unit of current consumption with the marginal benefit of having an additional unit of resources available in the following period. The marginal benefit of saving depends on the marginal utility of consumption next period and the agent's marginal after-tax return on savings. Efficient but poor households are more constrained and thus face a higher effective return on savings.

Figure 4 illustrates the entrepreneurs' production choices as a function of productivity z for two levels of wealth, high and low. The figures shows that output, employment and capital increase with both wealth and productivity, while the price decreases. The kinks in the graphs reflect the region in which the borrowing constraint starts binding. For a given level of wealth, more productive entrepreneurs are more constrained because they require a larger stock of capital. Because markups increase with firm size, more productive and wealthier producers charge higher markups.

Figure 5 illustrates the entrepreneurs' consumption, savings and hours choices. More productive entrepreneurs have a higher marginal after-tax return on savings, $\tilde{r}$, and find it optimal to consume less and supply more hours than the less productive entrepreneurs. More productive entrepreneurs therefore accumulate wealth at a faster rate in an effort to grow out of their borrowing constraints.

3.5 Financial intermediaries

We assume that households deposit their savings with perfectly competitive financial intermediaries who use these resources to either purchase capital, shares in corporate firms or government bonds.

The budget constraint of the financial intermediary is

$$K_{t+1} + Q_t S_{t+1} + B_{t+1} + (1 + r_{t-1})\, A_t = (R_t + 1 - \delta)\, K_t + (Q_t + D_t)\, S_t + (1 + r_{t-1})\, B_t + A_{t+1}.$$

where A_t denotes total assets of the households, K_t is the capital stock in the economy, B_t is the amount the debt issued by the government in period $t-1$, Q_t is the price of a share in corporate firms and D_t is the total amount of after-tax dividends issued by corporate firms.

The right-hand-side of the budget constraint lists the intermediary's source of funds: the value of undepreciated capital $(R_t + 1 - \delta)\, K_t$, the cum-dividend market value of the corporate stocks $(Q_t + D_t) S_t$, the return on the government bond $(1 + r_{t-1})\, B_t$, and deposits from households A_{t+1}. The intermediary uses these resources to pay interest on households' initial deposits $(1 + r_{t-1})\, A_t$ and to purchase new capital, corporate shares and government bonds.

Since this is a closed economy, all of the investments made by the financial intermediary must add up to the savings of the households

$$A_{t+1} = K_{t+1} + Q_t S_{t+1} + B_{t+1}.$$

Absent aggregate uncertainty, no-arbitrage requires

$$R_{t+1} = r_t + \delta$$

and

$$Q_t = \frac{1}{1 + r_t} (Q_{t+1} + D_{t+1}).$$

3.6 Government

The government has an outstanding stock of debt B_t on which it pays the equilibrium interest rate r_{t-1}. It finances an exogenous amount of government spending G and collects taxes T_t from both households and corporate firms. The government budget constraint is

$$(1 + r_{t-1})\, B_t + G = B_{t+1} + T_t.$$

3.7 Equilibrium

A competitive equilibrium consists of: *(i)* aggregate prices W_t, R_t, r_t, Q_t, *(ii)* consumption, saving and labor supply decision rules for households $c_t(a,z,e)$, $a_{t+1}(a,z,e)$, $h_t(a,z,e)$, *(iii)* employment, capital, output and price choices of entrepreneurs $l_t(a,z)$, $k_t(a,z)$, $y_t(a,z)$, $p_t(a,z)$ and of corporations $l_t^c(z)$, $k_t^c(z)$, $y_t^c(z)$, $p_t^c(z)$, and *(iv)* measures of households over their idiosyncratic states $n_t(a,z,e)$, such that

1. Given prices, households, entrepreneurs and corporations solve the optimization problems in Sections 3.3 and 3.4.

2. Total output satisfies the Kimball aggregator

$$\int \Upsilon\left(\frac{y_t(a,z)}{Y_t}\right) \mathrm{d}n_t(a,z,e) + \int \Upsilon\left(\frac{y_t^c(z)}{Y_t}\right) \mathrm{d}n^c(z) = 1.$$

3. Markets clear period by period. The labor market clearing condition is

$$\int l_t(a,z)\,\mathrm{d}n_t(a,z,e) + \int l_t^c(z)\,\mathrm{d}n^c(z) = \int e h_t(a,z,e)\,\mathrm{d}n_t(a,z,e)$$

   The asset market clearing condition is

$$\int a_{t+1}(a,z,e)\,\mathrm{d}n_t(a,z,e) = A_{t+1}$$

   The capital market clearing condition is

$$\int k_t(a,z)\,\mathrm{d}n_t(a,z,e) + \int k_t^c(z)\,\mathrm{d}n^c(z) = K_t.$$

   The goods market clears by Walras' Law.

4. The budget constraints of the financial intermediary and of the government are satisfied period by period.

5. The law of motion for the measure $n_t(a,z,e)$ evolves according to an equilibrium mapping dictated by the households' optimal choice of assets and the stochastic process for entrepreneurial productivity and labor efficiency.

4 Quantifying the model

In this section we outline our calibration strategy, and then evaluate the model's ability to account for a number of additional features of the data not targeted in our calibration. We assume the economy is in a steady-state in 2013, so we target statistics for the year 2013, the last year for which the data we use to calibrate the model is available.

4.1 Calibration strategy

We next describe how we choose parameters for our quantitative analysis.

4.1.1 Assigned parameters

We assume that a period is one year and set the depreciation rate $\delta = 0.06$. We assume that the stock of government debt $\bar{B}$ is constant and we choose it to ensure that the equilibrium risk-free rate r is equal to 2% in the steady state. We set the elasticity of capital in production $\alpha = \frac{1}{3}$, the relative risk aversion $\theta = 2$, and the inverse of the Frisch elasticity of labor supply to $\gamma = 1$. We assume a flat corporate profits tax schedule, as is the case in the United States, and set $\tau_c = 0.40$, roughly consistent with the combined profit and dividend tax on C-corporations (Bhandari and McGrattan, 2018). The last parameter we assign is the ratio ε/σ. As equation (4) shows, this ratio determines how quickly markups increase with firm size. We set $\varepsilon/\sigma = 0.15$, consistent with the estimate of Edmond et al. (2018), as well as other estimates surveyed by Klenow and Willis (2016). We summarize these parameter choices in Panel B of Table 2.

4.1.2 Calibrated parameters

We divide the remaining parameters into two groups. The first group includes parameters that are chosen to exactly match a specific target in the data. The second group includes parameters that are jointly chosen in order to minimize the weighted distance between a number of moments in the model and in the data.

Parameters in group 1. The parameters included in the first group are those governing the average demand elasticity, σ, the maximum leverage ratio, λ, the income tax schedule, τ and ξ, the mean and variance of productivity distribution of corporate firms, $\bar{z}_c$ and σ_{z_c}, and the mass of corporate firms, N^c.[3] We report the parameter values in Panel C of Table 2 and the moments we target with these parameters in Panel A of Table 2.

We set $\sigma = 31.3$ to match an aggregate markup of 1.15, corresponding to the midpoint of recent estimates in the literature.[4] We set $\lambda = 1.77$ to match a size-weighted average debt to capital ratio for entrepreneurs of 0.35, as reported by Zetlin-Jones and Shourideh (2017) for UK firms and Crouzet and Mehrotra (2017) for US firms.

The parameters $\bar{z}_c$, σ_{z_c} and s_c pin down the size of the corporate sector. We set $\bar{N}^c = 0.005$ to match the fact that 4.9% of all firms are corporations. We set $\bar{z}_c = 1.09$ to match that corporations account for 63% of all sales. We associate corporate firms in the model with

[3] We normalize the mass of households to 1, so that the mass of potential varieties is $\bar{N} = 1 + N^c$.

[4] See, for example, Barkai (2017), De Loecker et al. (2018), Hall (2018).

C-corporations in the data and use the statistics reported by Dyrda and Pugsley (2018) for 2012. Finally, we set $\sigma_{z_c} = 0.38$ to match concentration in the corporate sector. As we show in Figure 1, the largest 5% corporate firms account for 66% of corporate sales in 2013.

We set the tax parameters τ and ξ to match the overall average federal income tax rate (23%) as well as the average income tax rate of individuals between the 99.5^{th} and 99.9^{th} percentile of the income distribution (33%). These statistics were computed by Piketty and Saez (2007) for 2004. As Panel A of Table 2 shows, we also match well the average income tax rates of other income groups at the top. The resulting parameter values are $\tau = 0.276$ and $\xi = 0.078$ which imply a degree of progressivity in line with the estimates of Guner et al. (2014).

Parameters in group 2. We have a total of 5 remaining parameters that we choose by minimizing the weighted distance between a number of moments in the model and in the data. The moments describe the prevalence of entrepreneurs in the economy, as well as the wealth and income distributions. We report the parameter values in Panel C of Table 2. These parameters are the discount factor β, the persistence and the standard deviation of the process for entrepreneurial ability ρ_z and σ_z, and the persistence and the standard deviation of the process for labor market efficiency ρ_e and σ_e.

We choose these parameters to minimize the weighted distance between 10 moments in the model and in the data. Panel A of Table 2 reports the values of the moments we target. Specifically, we target the share of entrepreneurs among all households, the average wealth to average income ratio, the shares of aggregate wealth and aggregate income held by entrepreneurs, the Gini coefficients of the wealth and income distributions across all households, as well as across entrepreneurs and workers in isolation. All target moments are calculated based on the 2013 SCF.

In minimizing the distance between the moments in the model and in the data, we assign a higher weight to matching the share of households that are entrepreneurs and the average wealth to average income ratio. Specifically, we assign these two moments a five times larger weight than to the other moments. We match the moments we overweight almost exactly. In particular, 7.1% of households are entrepreneurs in both the model and the data. The wealth to income ratio is 6.3 in both the model and the data. The model also reproduces well the other moments we have targeted. It matches well the Gini coefficient of the wealth distribution not only across all households (0.81 in the data vs. 0.80 in the model), but also across workers (0.78 vs. 0.76) and entrepreneurs (0.76 vs. 0.86). It also accounts well for the Gini coefficient of the income distribution of entrepreneurs (0.75 vs 0.72), but understates the income Gini across all households (0.63 vs 0.50) and across workers (0.55 vs 0.45). Lastly, the model somewhat understates the share of wealth held by entrepreneurs (0.37 vs. 0.28) and the share of income held by this group (0.28 vs. 0.18). This discrepancy is not surprising given that we effectively use only five parameters to target ten moments.

Panel C of Table 2 reports the values of the calibrated parameters. The discount factor, which is primarily pinned down by the average wealth to average income ratio, is $\beta = 0.955$. The process for entrepreneurial ability has persistence $\rho_z = 0.994$ and standard deviation $\sigma_z = 0.049$. The process for labor market efficiency has persistence $\rho_e = 0.975$ and standard deviation $\sigma_e = 0.233$.

Intuition for identification. We next provide some intuition for how the various moments we have targeted pin down parameters in the second group. Clearly, for a given interest rate, the discount factor determines how much individual agents save, and therefore the wealth to income ratio. For a given level of unconditional dispersion in entrepreneurial productivity, $\sigma_z^2/(1-\rho_z^2)$, the persistence parameter ρ_z determines how much wealth entrepreneurs hold: the more persistent z is, the more time the entrepreneur has available to accumulate wealth and grow out of their borrowing constraint. Matching the relatively high wealth shares of entrepreneurs in the data thus requires a lot of persistence in the process for entrepreneurial ability. In turn, the unconditional dispersion of z pins down the fraction of entrepreneurs in the economy: when z is more dispersed, the very efficient producers dominate, bidding up factor prices and reducing the demand for other producers' goods, thereby making it more costly for less efficient producers to operate. Hence, when z is more dispersed, fewer households choose to run a private business. Finally, the parameters governing the efficiency with which households provide labor, ρ_e and σ_e, are pinned down by the Gini coefficients for wealth and income. Though we do not use panel information to identify these parameters, we note that our estimates are in the neighborhood of those obtained in earlier work using panel data, for example, Krueger et al. (2017).

4.2 Additional moments not targeted in calibration

We next evaluate ability of the model to account for a number of additional features of the data not targeted in our calibration. Since our focus is on studying the relationship between markups and inequality in a model of entrepreneurial activity, it is important that the model reproduces well the distribution of wealth and income, as well as the prevalence of entrepreneurs in various parts of these distributions. We next discuss how the model does along these dimensions. Table 3 reports these additional statistics.

Wealth and income distribution. In our calibration we have only targeted the Gini coefficients of the wealth and income distributions. Panels A and B of Table 3 show how the model reproduces the wealth and income distributions more broadly. Though the model somewhat understates the top wealth and income shares, it does a reasonably good job of reproducing the observation that the wealthiest (richest) households account for a large share share of wealth (income). For example, households in the top 1% of the wealth distribution hold 36% of wealth in the data and 28% of wealth in the model. Similarly, households in the top 1% of the income distribution hold 26% of income in the data and 16% of income in the model.

The model also reproduces well the very low wealth and income shares at the bottom of the distribution. For example, households in the bottom half of the wealth distribution hold only 1% of the wealth both in the data and in the model, while households in the bottom half of the income distribution hold 8% of income in the data and 18% in the model.

Entrepreneurs in the wealth and income distribution. Panels C and D of Table 3 report the fraction of households that are entrepreneurs in different percentiles of the wealth and income distribution. In the model, as in the data, entrepreneurs are much more prevalent at the top. For example, 58% of the households in the top 1% of the wealth distribution are entrepreneurs in the data and 40% in the model. Only 2% of the households in the bottom half of the wealth distribution are entrepreneurs in the data and 4% in the model. The statistics are similar for the income distribution.

Panels E and F of Table 3 report the fraction of wealth and income held by entrepreneurs in different percentiles of the wealth and income distribution. In the model, as in the data, entrepreneurs account for a larger fraction of wealth and income at the top. For example, entrepreneurs hold 62% of the wealth of the top 1% wealthiest households in the data and 73% in the model. They account for 63% of the income of the top 1% richest households in the data and 68% in the model. In contrast, entrepreneurs hold a much smaller share of wealth and income at the bottom. They account for 3% of the wealth held by the bottom half of the wealth distribution in the data and 9% in the model. They account for 5% of the income held by the bottom half of the income distribution both in the data and in the model.

In summary, our model does a good job at reproducing the high degree of inequality in wealth and income in the United States. Given our focus on the incidence of the tax burden of policies aimed at reducing markup distortions, it is encouraging that we reproduce well the very low wealth and income shares of the median household, as well as the high concentration of entrepreneurs at the top of the distribution.

5 Role of markups and financial constraints

We next discuss the impact markups and borrowing constraints have in shaping the equilibrium outcomes in our model economy. We do so by first reporting the size of the wedges in the first-order optimality conditions for capital and labor of individual firms and then aggregating these firm-level wedges into their aggregate counterparts which in turn determine the equilibrium aggregate prices and quantities in this economy. We then study the impact of removing the markup distortions and the financial constraint on the steady state of our model.

5.1 Labor and capital wedges

Consider first the distortion in the firm's choice of labor. Combining the first-order condition for employment (3) and the optimal price (4) implies that the labor share of firm i is inversely proportional to its markup:

$$\frac{W_t l_{it}}{p_{it} y_{it}} = \frac{1-\alpha}{m_{it}}, \tag{6}$$

where $m_{it} = \frac{\sigma}{\sigma - q_{it}^{\varepsilon/\sigma}}$ is the firm's markup. Straightforward algebra[5] then implies that the aggregate labor share is equal to

$$\frac{W_t L_t}{Y_t} = \frac{1-\alpha}{M_t}, \tag{7}$$

where

$$M_t = \int m_{it} \frac{l_{it}}{L_t} \mathrm{d}i \tag{8}$$

is the *aggregate markup*, an employment-weighted average of individual firm markups. In deriving this expression we have imposed the labor market clearing condition, $L_t = \int l_{it} \mathrm{d}i$, and the zero profit condition for final goods firms, $Y_t = \int p_{it} y_{it} \mathrm{d}i$.

Consider next the distortion in the firm's choice of capital. Let

$$\nu_{it} = \frac{R_t + \mu_{it}}{R_t} \tag{9}$$

denote the wedge in the capital first-order condition implied by the borrowing constraint.

Combining the first-order condition for capital (2) and the optimal price (4) implies that the capital share of firm i is inversely proportional to the product of the firm's markup and the wedge induced by the collateral constraint:

$$\frac{R_t k_{it}}{p_{it} y_{it}} = \frac{\alpha}{\lambda_{it}}, \tag{10}$$

[5] See, for example, Edmond et al. (2018), for a derivation.

where

$$\lambda_{it} = m_{it}\nu_{it}$$

The aggregate capital share is then

$$\frac{R_t K_t}{Y_t} = \frac{1-\alpha}{\Lambda_t}, \tag{11}$$

where

$$\Lambda_t = \int \lambda_{it} \frac{k_{it}}{K_t} \mathrm{d}i$$

is a capital-weighted average of the individual firm wedges.

Table 4 summarizes the distribution of the labor wedges, m_{it}, and capital wedges, λ_{it} for all producers, as well as separately for entrepreneurs and corporations. We report percentiles of the distribution of each wedge, weighting each producer by their employment when computing moments of the labor wedge and by their capital when computing moments of the capital wedge.

As the table shows, the average labor wedge across all firms is equal to 1.15, the aggregate markup we have targeted in our calibration. This implies a labor share of 0.58, compared to $1-\alpha = 2/3$ in the absence of markups. The labor wedge ranges from 1.08 at the lower end of the distribution to 1.22 at the top. The capital wedge is, in contrast, larger on average (1.28) and more dispersed, ranging from 1.10 to 1.59, reflecting severe borrowing constraints for productive but poor entrepreneurs. The last columns of the table report these statistics separately for entrepreneurs and corporations. The markup of entrepreneurs is smaller on average than that of corporations (1.12 vs. 1.17) because entrepreneurs are smaller on average. In contrast, the average capital wedge of entrepreneurs is approximately 1.5, implying that the capital-output ratio is equal to two-thirds (1/1.5) of its unconstrained level.

Figure 6 illustrates the joint distribution of entrepreneurial productivity z, markups m, and multiplier on the borrowing constraint ν, for entrepreneurs. The top panels show the distribution of productivity across active entrepreneurs, and the sales share of entrepreneurs with a given level of productivity. The graphs show that a small fraction of entrepreneurs in the right tail of the z distribution account for a large fraction of the sales of private businesses. As the bottom panels of the figure indicate, the most productive entrepreneurs are the most borrowing constrained, with an average multiplier ν in excess of two, implying a capital-output ratio that is half that of the unconstrained corporate firms. The most productive entrepreneurs also charge much higher markups on average.

Figure 7 compares corporate firms with entrepreneurs of a given level of productivity. Since borrowing constraints do not bind for less productive entrepreneurs, they sell almost as much and charge similar markups as corporate firms. In contrast, very productive entrepreneurs are severely borrowing constrained, sell approximately 1/3 as much as corporate firms and thus charge lower markups.

5.2 Aggregate productivity and misallocation

We next explain how the distribution of capital and labor wedges affects aggregate productivity in this economy. Let

$$Y_t = Z_t K_t^{\alpha} L_t^{1-\alpha} \tag{12}$$

denote the aggregate production function, where Z_t is total factor productivity. As we show in the Appendix, Z_t is related to the efficiency of individual firms according to

$$Z_t = \left[\left(\int \nu_{it}^{\alpha} \frac{q_{it}}{z_{it}} \mathrm{d}i \right)^{1-\alpha} \left(\int \nu_{it}^{\alpha-1} \frac{q_{it}}{z_{it}} \mathrm{d}i \right)^{\alpha} \right]^{-1}, \tag{13}$$

where

$$q_{it} = \left[1 - \varepsilon \log \left(m_{it} \frac{\nu_{it}^{\alpha}}{z_{it}} \Omega_t \frac{\sigma}{\sigma - 1} \right) \right]^{\frac{\sigma}{\varepsilon}}, \tag{14}$$

and $\Omega_t = Z_t \Lambda_t^{-\alpha} M_t^{-(1-\alpha)} / D_t$. The capital and labor wedges thus distort the allocations of output q_{it} and therefore labor and capital across firms and reduce aggregate productivity.

We quantify the extent of these distortions by solving the problem of a planner that uses the same amount of capital and labor, K_t and L_t as in the decentralized allocation, but is free to allocate these factors in order to maximize aggregate output, or equivalently, aggregate productivity. Formally, the planner's problem is to:

$$\max_{k_{it}^*, l_{it}^*} Y_t^*,$$

subject to the final goods production function, implicitly defined by the Kimball aggregator:

$$\bar{N} \int \Upsilon \left(\frac{z_{it} k_{it}^{*\alpha} l_{it}^{*1-\alpha}}{Y_t^*} \right) \mathrm{d}i = 1,$$

and the resources constraints for capital and labor,

$$\bar{N} \int k_{it}^* \mathrm{d}i = K_t$$

$$\bar{N} \int l_{it}^* \mathrm{d}i = L_t,$$

where recall that $\bar{N}$ is the mass of potential varieties. The solution to this problem gives

$$Z_t^* = \left(\bar{N} \int \frac{q_{it}^*}{z_{it}} \mathrm{d}i\right)^{-1},$$

where

$$q_{it}^* = \left[1 - \varepsilon \log\left(\frac{\Omega_t^*}{z_{it}} \frac{\sigma}{\sigma - 1}\right)\right]^{\frac{\sigma}{\varepsilon}}$$

and Ω_t^* is a function of the multipliers on the constraints faced by the planner. Clearly, the decentralized allocations coincide with those of the planner only in the absence of markup and credit distortions, that is, if $m_{it} = 1$ and $\nu_{it} = 1$.

Panel B of Table 4 shows that the aggregate productivity losses from misallocation, $\log Z^*/Z$ are equal to 4.8% in our baseline economy. That is, aggregate output would be 4.8% higher if capital and labor were reallocated optimally in the steady state. We next decompose these losses into those due to each of the two wedges. We do so by eliminating the two distortions simultaneously and in isolation, by setting $m_{it} = 1$ and/or $\nu_{it} = 1$. We then use equations (13) and (14) to calculate the counterfactual aggregate productivity resulting from this change. Panel B of Table 4 reports the results of these experiments.

Consider first the effect of removing both distortions. Clearly, this entirely eliminates the losses from misallocation, leading to a 4.8% increase in TFP. Also notice that the sales share of corporate firms falls from 0.63 to 0.43, reflecting the removal of the borrowing constraints faced by entrepreneurs in our baseline economy.

Consider next the effect of removing the markup distortion only. The table shows that the losses from misallocation decline little, from 4.8% to 4.6%. Removing the dispersion of markups thus only leads to a 0.2% increase in TFP. The reason is that removing the markup distortion reallocates market share towards corporate firms who are not subject to collateral constraints. These firms are inefficiently large in our baseline economy to begin with: their sales share is 0.63 compared to 0.43 in the absence of distortions. Removing the markup distortion alone makes corporate firms even larger and thus amplifies the distortions due to credit frictions, offsetting the gains from removing the dispersion in markups.

Finally, we consider the effect of removing the credit distortion. This reduces the TFP losses from misallocation by a substantial amount, to 0.9% and reduces the sales share of corporate firms to 0.33. Clearly, credit frictions account for the bulk of the TFP losses from misallocation in our baseline model.

5.3 Aggregate Implications

Consider finally the effect of markups and credit frictions on the model's aggregate implications. To that end, we can rewrite the aggregate production function (12) as

$$Y_t = Z_t^{\frac{1}{1-\alpha}} \left(\frac{K_t}{Y_t}\right)^{\frac{\alpha}{1-\alpha}} L_t$$

and using equation (11) we can express aggregate labor productivity as a function of TFP, Z_t, and the aggregate capital wedge, Λ_t:

$$\frac{Y_t}{L_t} = Z_t^{\frac{1}{1-\alpha}} \left(\frac{\alpha}{\Lambda_t}\frac{1}{R_t}\right)^{\frac{\alpha}{1-\alpha}}.$$

Using equation (6) we can express the equilibrium wage as a function of the aggregate labor and capital wedge,

$$W_t = \frac{1-\alpha}{M_t}\frac{Y_t}{L_t} = \frac{1-\alpha}{M_t} Z_t^{\frac{1}{1-\alpha}} \left(\frac{\alpha}{\Lambda_t}\frac{1}{R_t}\right)^{\frac{\alpha}{1-\alpha}}.$$

These wedges therefore reduce wages through three channels: i) directly by raising the aggregate markup, M_t, ii) by reducing aggregate productivity, Z_t, iii) by reducing the capital-output ratio.

These expressions allow us to conduct a simple accounting exercise aimed at quantifying the aggregate impact of markups and borrowing constraints. Consider first the effect of removing both distortions, that is, setting $\Lambda_t = M_t = 1$. As Table 4 shows, this has a sizable impact, increasing the capital to output ratio by 24%, the aggregate labor productivity by 19% and the wage by 33%.

The last two columns of the table allow us to decompose these effects into those due to the markup and credit frictions. Removing the markup distortions increases the capital-output ratio by 16%, labor productivity by 8% and the wage rate by 22%. Removing the credit distortions raises the capital-output ratio and labor productivity by 12% and wages by 13%.

5.4 Role of Borrowing Constraints.

Though we find the accounting decomposition above useful in disentangling the role of markup and credit distortions, we cannot use it to fully understand the aggregate consequences of the collateral constraints faced by entrepreneurs. Removing credit constraints would change the firm size distribution and hence the distribution of markups, as well as change the labor supply and savings choices of households. We therefore illustrate the effect borrowing constraints have on the equilibrium outcomes of our model by removing the credit friction on entrepreneurs, setting $\lambda = \infty$. Table 5 reports the results of this experiment.

Absent credit constraints, output is 9.7% higher, primarily due to a 4.1% higher TFP and a 23% increase in the capital stock. TFP increases absent collateral constraints because of a decline in misallocation from 4.8 to 0.7%. Though wages increase significantly, by 13.5%, employment falls by 3.1% owing to wealth effects on the labor supply. We also note that the aggregate markup falls somewhat, from 1.15 to 1.14, as does the interest rate, from 2% to 1.8%. To understand these last two results, notice that the entrepreneurial sector becomes much larger in the absence of credit frictions: it now accounts for 61% of sales, compared to 37% in our baseline model. Increased competition from entrepreneurs reduces the markups of corporate producers and reallocates employment towards smaller entrepreneurial firms, reducing the average level of markups. The interest rate in turn declines because of a large decline in the stock market value of corporate firms. Since this effectively reduces the supply of savings in the economy, the equilibrium interest rate falls. Removing borrowing constraints also increases wealth and income inequality for two reasons. First, the risk-free rate falls, reducing the savings of the poor. Second, the very productive entrepreneurs earn much higher profits and find it optimal to save more.

To conclude, both markup and credit distortions have a sizable impact on aggregate outcomes in our model.

6 Policy Experiments

We next conduct several policy experiments which explore the aggregate and distributional consequences of policies aimed at reducing wealth and income inequality, as well as markup distortions. At this point, we only contrast steady state allocations and relegate the analysis of the transition dynamics to the next draft of the paper.

6.1 Progressive Taxation

As pointed out by Piketty and Saez (2007), the U.S. tax system has become a lot less progressive over the past 40 years. While the average federal income tax rate was almost the same in 1970 as in 2004 (23.3 vs 23.4%), the average tax rate paid by individuals at the top of the income distribution fell considerably. For example, the average tax rate paid by those with income between the 99.5^{th} and 99.9^{th} percentile fell from 44.6% in 1970 to 33% in 2004. Even more striking is the decline of the tax rate paid by the top 0.01% income earners. Their average tax rate fell from 74.6% in 1970 to 34.7% in 2004.

Motivated by this observation, we conduct an experiment in which we change the tax parameters τ and ξ to replicate the degree of income tax progressivity in 1970. Specifically, we set $\tau = 0.36$ and $\xi = 0.18$ to match the average tax rate of the entire population and of those between the 99.5^{th} and 99.9^{th} income percentile in 1970. Since the average tax is unchanged, this policy is approximately revenue neutral.

Table 6 reports the results of this experiment. We begin by discussing the aggregate implications of a more progressive tax system, reported in Panel A of the Table. Output falls by 9.3%, owing to a 1.2% drop in productivity, a 17.6% decline in the capital stock, and a

3.4% decline in employment. Productivity falls because of an increase in misallocation from 4.8% to 6%. Intuitively, a more progressive tax system deters productive entrepreneurs from saving, reduces their wealth and tightens their borrowing constraints. Overall, even though the fraction of entrepreneurs increases owing to entry by marginally unproductive businesses, the sales share of entrepreneurs falls from 0.37 to 0.31. The capital stock falls because the interest rate increases from 2 to 2.6%. This is because a more progressive tax system reduces the incentive to save by lowering the after-tax return on saving. Employment falls because the decline in productivity and the capital-output ratio reduces the marginal product of labor and the equilibrium wage by 6%.

Consider next the implications for inequality, reported in Panel B of the Table 6. Notice that pre-tax income inequality does not change, owing to a relative increase in the hours supplied by more productive workers caused by wealth effects on labor supply. In contrast, wealth inequality decreases substantially. Though the median wealth is roughly unchanged, the 99^{th} percentile of the wealth distribution expressed relative to per capita GDP in the baseline steady state falls dramatically, from 36 to 27. The wealth Gini falls as well, from 0.8 to 0.77. Notice finally that consumption changes little at the bottom of the distribution, but declines substantially at the top. For example, as a share of GDP per capita in the initial steady-state, the 25^{th} percentile of the consumption distribution increases from 0.26 to 0.27 and the 99^{th} percentile decreases from 2.1 to 1.7. Clearly, without accounting for transition dynamics, one cannot evaluate the welfare consequences of this policy change.

Lastly, we note that a more progressive tax system has a negligible effect on the aggregate markup, which only increases from 15% to 15.04%. Though entrepreneurs are now more borrowing constrained and reduce their markups, this direct effect is offset by a reallocation of employment towards larger corporate firms who charge higher markups on average.

6.2 Removing Markup Distortions

We next consider the effect of a policy aimed at eliminating the markup distortion. We consider a sales subsidy that removes the markup wedge m_{it} from the first-order conditions of individual producers in equations (6) and (11). Specifically, we assume that the government imposes a subsidy of the form

$$S(p_{it}y_{it}) = \Upsilon\left(\frac{y_{it}}{Y_t}\right) D_t Y_t - \Upsilon\left(0\right) D_t Y_t - p_{it}y_{it}.$$

As Edmond et al. (2018) show, such a subsidy ensures that firms produce up to a point where the marginal product of an individual variety is equal to its marginal cost of production and thus removes the markup wedge. Intuitively, markups in our model act like an output tax that is increasing in firm size, which implies that firms produce too little, more so when they are larger. The subsidy we impose exactly offsets this implicit tax. Given the form of the subsdiy, the producer's first-order condition for hiring labor now reduces to

$$\frac{W_t l_{it}}{p_{it} y_{it}} = (1-\alpha)\frac{(1+S'(p_{it}y_{it}))}{m(q_{it})},$$

where $m(q_{it}) = \sigma/(\sigma - q_{it}^{\varepsilon/\sigma})$ is the markup of price over the marginal cost inclusive of the subsidy. Given the form of the subsidy we assume, $1 + S'(p_{it}y_{it}) = m(q_{it})$, removing the markup wedge.

Edmond et al. (2018) study a representative consumer economy in which such subsidies can be financed with lump-sum taxes. Since in their model firm profits are rebated back to the representative consumer, such subsidies implement the efficient allocations. In contrast, how exactly one finances sales subsidies has important aggregate and distributional implications in our economy with incomplete markets. We therefore consider three alternative financing schemes. To build intuition, we first assume the government reduces its expenditure G, leaving the income tax function unchanged. Second, we assume that the government increases the average tax rate, as determined by τ, leaving the progressivity parameter ξ unchanged. Finally, we consider the effect of financing the subsidy solely by increasing taxes on the rich. Specifically, we adjust both tax parameters to ensure that i) the average tax paid by the bottom 50% of households is unchanged, and that ii) the policy is revenue neutral.

Table 7 reports the results of these three experiments. We begin by discussing the effect of financing the sales subsidies by reducing government spending. Notice that output falls by 1%, which is a consequence of two offsetting effects. On one hand, the capital stock increases by 12% due to the elimination of the markup wedge. One the other hand, both employment and productivity fall. Employment falls by 7% due to wealth effects on labor supply. Productivity falls by 0.2% due to an increase in misallocation. This may appear counterintuitive, since our policy completely eliminates all markup dispersion, which is a source of misallocation. However, removing markup distortions disproportionately benefits corporate firms which are not financially constrained and can easily expand production. This results in a reallocation of production from entrepreneurs to corporations. The percentage of entrepreneurs falls from 7.1 to 4.1 and their sales share falls from 0.37 to 0.28. Since entrepreneurs are inefficiently small to begin with, this reallocation further amplifies the distortions due to financial frictions and increases misallocation.

We also note that the equilibrium interest rate increases from 2 to 2.2%. The expansion of the corporate sector makes it more difficult for entrepreneurs to compete with the corporate firms, thus reducing their incentives to save and overcome the borrowing constraints. This decline in the saving rate together with the increase in the demand for capital owing to the removal of the markup distortion leads to an increase in the equilibrium interest rate. This increase in turn has important implications for wealth inequality, which falls substantially.

The wealth Gini falls from 0.8 to 0.77; the median wealth in the economy, expressed relative to GDP per capita in the initial steady-state, increases by 2/3, while the 99^{th} percentile of the wealth distribution increases by only 12%. Intuitively, the poor benefit from higher interest rates while the rich no longer have access to as profitable business opportunities. In this experiment, income, wealth and consumption increase across the board, due to the fact that the sales subsidies are financed by substantially reducing government spending.

We next turn to two more realistic revenue neutral financing schemes. We first increase τ from 0.28 to 0.38, keeping the progressivity parameter unchanged. This increases the average tax rate from 23 to 35%. Output increases by 1.4%, owing to a much smaller decline in employment relative to the first experiment. As in the first experiment, wages increase considerably, by approximately 17%, owing to an increase in labor demand cause by the elimination of markup distortions. Note that the interest rate increases by more, from 2 to 2.7%. This is because households' incentive to save is further reduced by the increase in taxes, which depresses the return on savings. Wealth inequality falls because households at the bottom of the distribution take advantage of the higher interest rate and save more, while those at the top are crowded out by the expansion of the corporate sector. Consumption changes little, with small gains at the bottom offset by equally small declines at the top.

In our third experiment, we increase the progressivity of the tax system by setting $\tau = 0.5$ and $\xi = 0.24$ to ensure that i) the average tax paid by the bottom 50% of households is equal to 0.14, as in the baseline steady-state, and that ii) the sales subsidy is revenue neutral. As in Section 6.1, more progressive taxes greatly reduce output, increase the losses from misallocation and result in a much more modest wage increase. While wealth inequality substantially falls, the poor benefit very little in terms of consumption, while the rich suffer large losses. To conclude, in contrast to Edmond et al. (2018), the removal of markup distortions does not lead to large consumption gains because the gains from production efficiency are offset by more distortionary income taxes.

7 Conclusions

We study the relationship between markups and inequality using a model of firm dynamics and incomplete markets in which markups are endogenously determined by the amount of competition firms face. We calibrate the model to match salient facts about wealth and income inequality, entrepreneurial activity, firm concentration and markups in the United States. We use the model to study both positive and normative questions. On the positive side, we find that the reduction in the progressivity of the U.S. tax code increased inequality but did not have a large effect on markups. In contrast, an increase in the dispersion of firm productivity greatly increases inequality and leads to a rise in markups, consistent with the trends in the data. On the normative side, we study the welfare consequences of changes in the progressivity of the tax code and product market interventions aimed at reducing markup distortions.

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Table 1: Entrepreneurs in the Wealth and Income Distribution

	Wealth distribution		Income distribution	
	Fraction of entrepreneurs	Share held by entrepreneurs	Fraction of entrepreneurs	Share held by entrepreneurs
All	0.07	0.37	0.07	0.28
Top 1%	0.58	0.62	0.55	0.63
Top 5%	0.40	0.52	0.38	0.53
Top 10%	0.29	0.46	0.25	0.45
Bottom 50%	0.02	0.03	0.04	0.05

Notes: The numbers in the table are based on the 2013 SCF survey. Entrepreneurs are defined as self-employed business owners who are actively engaged in managing the business.

Table 2: Parameterization

A. Moments Used in Calibration

Moments Group 1	Model	Data	Moments Group 2	Model	Data
Aggregate markup	1.15	1.15	Percentage entrepreneurs	7.1	7.1
Average debt to capital ratio	0.35	0.35	Wealth to income ratio	6.3	6.3
Percentage of corporate firms	4.9	4.9	Wealth share of entrepreneurs	0.28	0.37
Sales share of corporate firms	0.63	0.63	Income share of entrepreneurs	0.18	0.28
Top 5% sales concentration, corp.	0.66	0.66	Gini wealth, all hhs	0.80	0.81
Average income tax rate	0.23	0.23	Gini income, all hhs	0.50	0.63
Average income tax rate p95-99	0.27	0.27	Gini wealth, entrepr.	0.86	0.76
Average income tax rate p99-99.5	0.31	0.30	Gini income, entrepr.	0.72	0.75
Average income tax rate p99.5-99.9	0.33	0.33	Gini wealth, workers	0.76	0.78
			Gini income, workers	0.45	0.55

B. Assigned Parameter Values

θ	2	CRRA
γ	1	inverse Frisch elasticity
α	1/3	capital elasticity
δ	0.06	depreciation rate
ε/σ	0.15	super-elasticity
τ_c	0.40	dividends tax schedule

C. Calibrated Parameter Values

Group 1			Group 2		
σ	31.28	demand elasticity	β	0.955	discount factor
λ	1.773	leverage constraint	ρ_z	0.994	AR(1) z
N^c	0.005	mass corporate firms	σ_z	0.049	std. dev. z shocks
$\bar{z}_c$	1.085	average $\log z$ corp. firms	ρ_e	0.975	AR(1) e
σ_{z_c}	0.383	std. dev. $\log z$ corp. firms	σ_e	0.233	std. dev. e shocks
τ	0.276	income tax schedule			
ξ	0.078	income tax schedule			

Table 3: Non-targeted Moments

	Data	Model		Data	Model
A. Wealth Distribution			**B. Income Distribution**		
Share top 1%	0.36	0.28	Share top 1%	0.26	0.16
Share top 2%	0.47	0.35	Share top 2%	0.33	0.20
Share top 5%	0.63	0.50	Share top 5%	0.44	0.30
Share top 10%	0.75	0.65	Share top 10%	0.55	0.41
Share bottom 75%	0.09	0.13	Share bottom 75%	0.25	0.38
Share bottom 50%	0.01	0.01	Share bottom 50%	0.08	0.18
Share bottom 25%	0.00	0.00	Share bottom 25%	0.00	0.06
C. Fraction Entrep in Wealth Distribution			**D. Fraction Entrep in Income Distribution**		
Top 1%	0.58	0.40	Top 1%	0.55	0.32
Top 2%	0.51	0.26	Top 2%	0.50	0.23
Top 5%	0.40	0.18	Top 5%	0.38	0.16
Top 10%	0.29	0.14	Top 10%	0.25	0.13
Bottom 75%	0.03	0.06	Bottom 75%	0.05	0.06
Bottom 50%	0.02	0.04	Bottom 50%	0.04	0.05
Bottom 25%	0.02	0.00	Bottom 25%	0.01	0.04
E. Wealth by Entrep in Wealth Distribution			**F. Income by Entrep in Income Distribution**		
Share in top 1%	0.62	0.73	Share in top 1%	0.63	0.68
Share in top 2%	0.58	0.61	Share in top 2%	0.60	0.55
Share in top 5%	0.52	0.47	Share in top 5%	0.53	0.41
Share in top 10%	0.46	0.38	Share in top 10%	0.45	0.33
Share in bottom 75%	0.06	0.10	Share in bottom 75%	0.06	0.07
Share in bottom 50%	0.03	0.09	Share in bottom 50%	0.05	0.05
Share in bottom 25%	0.03	0.00	Share in bottom 25%	0.01	0.04

Notes: The data moments are calculated from the 2013 SCF survey. In the data, entrepreneurs are defined as self-employed business owners who are actively engaged in managing the business.

Table 4: Effect of Markups and Borrowing Constraints

A. Distribution of Labor and Capital Wedges

	All firms		Entrepreneurs		Corporations
	Labor wedge	Capital wedge	Labor wedge	Capital wedge	Both wedges
Average	1.15	1.27	1.12	1.49	1.17
p10	1.08	1.10	1.06	1.09	1.11
p25	1.11	1.13	1.09	1.13	1.14
p50	1.15	1.17	1.12	1.32	1.17
p75	1.18	1.24	1.15	1.69	1.20
p90	1.22	1.56	1.17	2.14	1.24

B. Macroeconomic Implications

	Baseline	No distortions	No markup distortions	No credit distortions
Losses from misallocation, $\times 100$	4.8	0	4.6	0.9
Aggregate labor wedge, M	1.15	1	1	1.13
Aggregate capital wedge, Λ	1.27	1	1.08	1.13
Labor share, WL/Y	0.58	0.67	0.67	0.59
Sales share of corporate firms	0.63	0.43	0.71	0.33
$\Delta \log TFP$, $\times 100$		4.8	0.2	3.8
$\Delta \log K/Y$, $\times 100$		23.9	16.0	11.8
$\Delta \log Y/L$, $\times 100$		19.1	8.2	11.6
$\Delta \log W$, $\times 100$		33.1	22.2	13.4

Notes:

Table 5: Role of Borrowing Constraints

	Baseline	No borrowing constraint
A. Aggregate Implications		
$\Delta \log Y$, $\times 100$		9.67
$\Delta \log Z$, $\times 100$		4.08
$\Delta \log K$, $\times 100$		23.0
$\Delta \log L$, $\times 100$		-3.10
$\Delta \log W$, $\times 100$		13.5
Losses from misallocation, $\times 100$	4.76	0.67
Labor share	0.58	0.58
Capital share	0.26	0.29
Aggregate markup	1.15	1.14
Interest rate, r,%	2	1.80
Percentage entrepreneurs	7.14	4.85
Number of producers, rel baseline	1	0.69
Percentage of corporate firms	4.90	6.49
Sales share of corporate firms	0.63	0.39
Top 5% sales concentration, corp.	0.66	0.70
B. Cross-Sectional Implications		
Wealth to income ratio	6.26	5.83
Gini wealth, all hhs.	0.80	0.82
Gini pre-tax income, all hhs.	0.50	0.51
Total pre-tax income, 25pct	0.28	0.31
Total pre-tax income, 50pct	0.46	0.50
Total pre-tax income, 75pct	0.77	0.84
Total pre-tax income, 95pct	1.98	2.15
Total pre-tax income, 99pct	4.03	4.38
Wealth, 25pct	0	0.00
Wealth, 50pct	0.45	0.34
Wealth, 75pct	3.31	3.02
Wealth, 95pct	15.8	16.1
Wealth, 99pct	36.1	39.4
Consumption, 25pct	0.26	0.28
Consumption, 50pct	0.44	0.46
Consumption, 75pct	0.68	0.73
Consumption, 95pct	1.23	1.35
Consumption, 99pct	2.07	2.21

Notes:

Table 6: More Progressive Income Taxes

	Baseline	1970 tax
A. Aggregate Implications		
$\Delta \log Y$, $\times 100$		-9.33
$\Delta \log Z$, $\times 100$		-1.21
$\Delta \log K$, $\times 100$		-17.6
$\Delta \log L$, $\times 100$		-3.40
$\Delta \log W$, $\times 100$		-5.97
Losses from misallocation, $\times 100$	4.76	5.97
Labor share	0.58	0.58
Capital share	0.26	0.26
Aggregate markup	1.15	1.15
Interest rate, r,%	2	2.62
Percentage entrepreneurs	7.14	7.31
Number of producers, rel baseline	1	1.02
Percentage of corporate firms	4.90	4.85
Sales share of corporate firms	0.63	0.69
Top 5% sales concentration, corp.	0.66	0.65
B. Cross-Sectional Implications		
Wealth to income ratio	6.26	5.12
Gini wealth, all hhs.	0.80	0.77
Gini pre-tax income, all hhs.	0.50	0.50
Total pre-tax income, 25pct	0.28	0.26
Total pre-tax income, 50pct	0.46	0.42
Total pre-tax income, 75pct	0.77	0.71
Total pre-tax income, 95pct	1.98	1.84
Total pre-tax income, 99pct	4.03	3.63
Wealth, 25pct	0	0.00
Wealth, 50pct	0.45	0.42
Wealth, 75pct	3.31	2.78
Wealth, 95pct	15.8	12.1
Wealth, 99pct	36.1	26.6
Consumption, 25pct	0.26	0.27
Consumption, 50pct	0.44	0.43
Consumption, 75pct	0.68	0.63
Consumption, 95pct	1.23	1.12
Consumption, 99pct	2.07	1.72

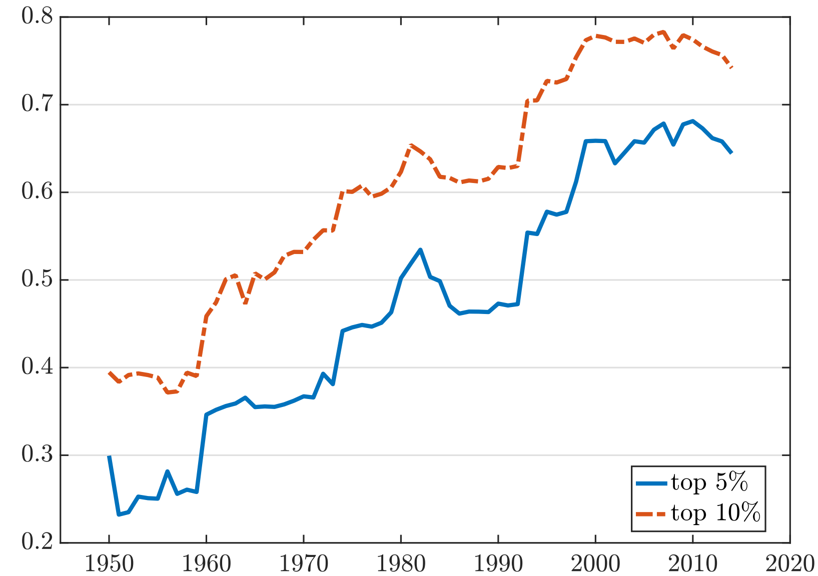
Notes: Income, wealth and consumption moments in Panel B. are all reported relative to per-capita GDP in the baseline model.

Table 7: Effect of Removing Markup Distortion

	Baseline	No tax change	Increase τ	Increase τ and ξ
A. Aggregate Implications				
$\Delta \log Y$, $\times 100$		-1.05	1.40	-12.7
$\Delta \log Z$, $\times 100$		-0.21	-0.60	-2.54
$\Delta \log K$, $\times 100$		11.9	8.94	-18.6
$\Delta \log L$, $\times 100$		-7.21	-1.46	-6.02
$\Delta \log W$, $\times 100$		20.1	16.8	7.25
Losses from misallocation, $\times 100$	4.76	4.96	5.36	7.29
Labor share	0.58	0.67	0.67	0.67
Capital share	0.26	0.31	0.31	0.31
Aggregate markup, incl. subsidy	1.15	1.17	1.17	1.18
Interest rate, r,%	2	2.24	2.71	4.05
Average tax, all	0.23	0.24	0.35	0.48
Average tax, bottom 50%	0.14	0.15	0.27	0.14
Average tax, top 0.5%	0.33	0.33	0.43	0.58
Gov. spending, rel. Y baseline	0.24	0.13	0.24	0.24
Percentage entrepreneurs	7.14	4.08	4.08	4.24
Number of producers, rel baseline	1	0.58	0.59	0.61
Percentage of corporate firms	4.90	7.14	7.17	7.07
Sales share of corporate firms	0.63	0.72	0.74	0.82
Top 5% sales concentration, corp.	0.66	0.70	0.70	0.70
B. Cross-Sectional Implications				
Wealth to income ratio	6.26	6.36	5.58	4.08
Gini wealth, all hhs.	0.80	0.77	0.77	0.71
Gini pre-tax income, all hhs.	0.50	0.49	0.49	0.47
Total pre-tax income, 25pct	0.28	0.34	0.35	0.29
Total pre-tax income, 50pct	0.46	0.54	0.56	0.48
Total pre-tax income, 75pct	0.77	0.90	0.94	0.82
Total pre-tax income, 95pct	1.98	2.28	2.41	2.08
Total pre-tax income, 99pct	4.03	4.54	4.63	3.91
Wealth, 25pct	0	0.00	0.00	0.01
Wealth, 50pct	0.45	0.75	0.72	0.67
Wealth, 75pct	3.31	4.18	3.88	2.97
Wealth, 95pct	15.8	18.5	15.8	10.37
Wealth, 99pct	36.1	40.5	35.7	20.53
Consumption, 25pct	0.26	0.30	0.28	0.28
Consumption, 50pct	0.44	0.50	0.45	0.42
Consumption, 75pct	0.68	0.76	0.68	0.59
Consumption, 95pct	1.23	1.40	1.26	1.01
Consumption, 99pct	2.07	2.25	2.03	1.51

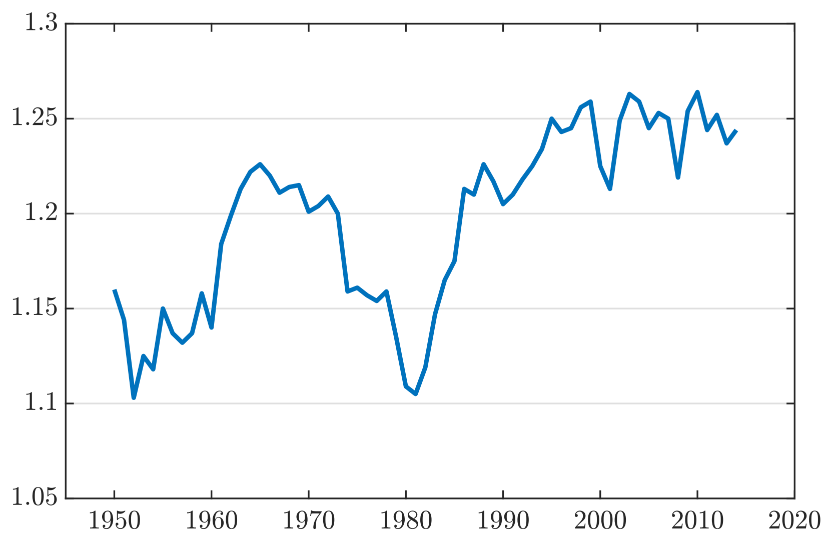
Notes: Income, wealth and consumption moments in Panel B. are all reported relative to per-capita GDP in the baseline model.

Figure 1: Sales Concentration Across Four Digit Industries



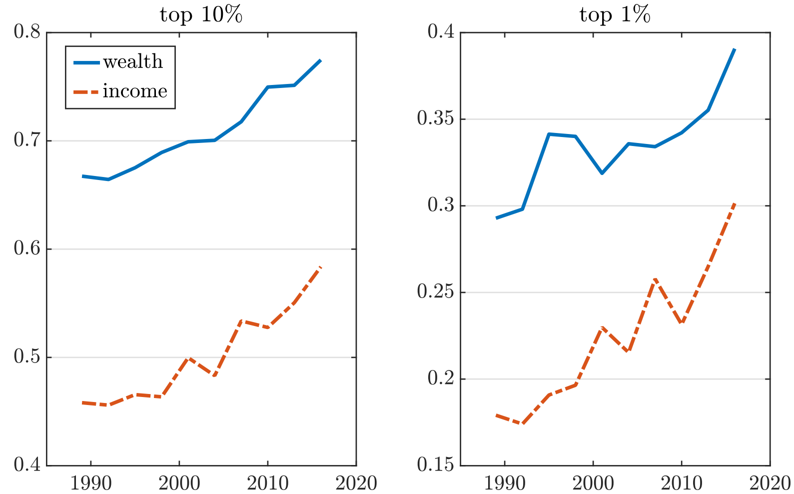
Notes: The figure plots the evolution of the average sales share of the top 10% (dashed red line) and top 5% (solid blue line) largest firms in Compustat. Sales shares are calculated for each four-digit industry and then averaged across all industries (sales-weighted average).

Figure 2: Average Markup (cost-weighted)



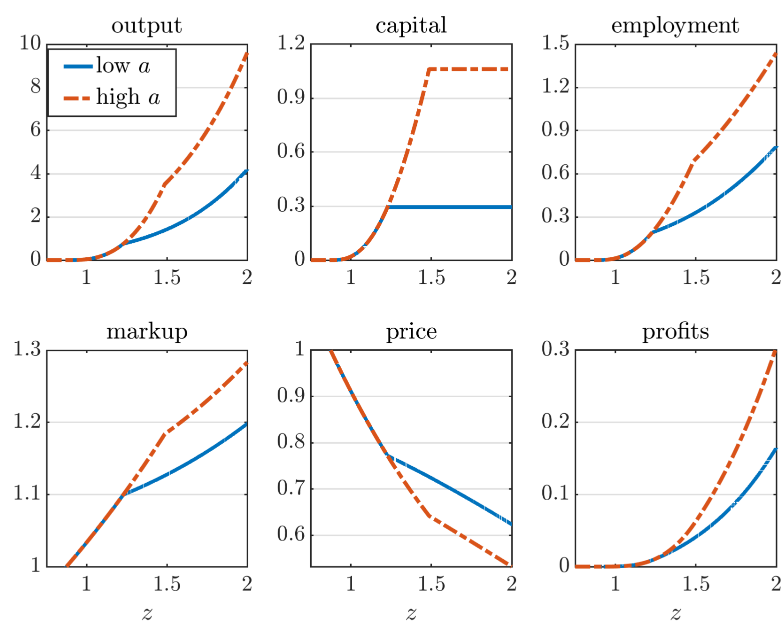
Notes: The figure depicts the cost-weighted average of firm markups in Compustat from Edmond et al. (2018).

Figure 3: Top Wealth and Income Shares in the U.S.



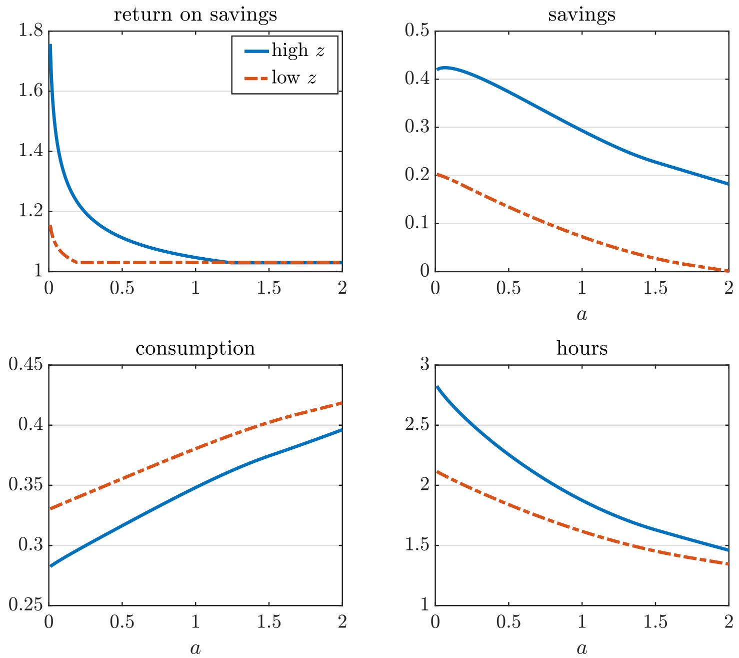
Notes: The solid blue lines show the share of wealth held by households in the top 10% of the wealth distribution on the left and the top 1% of the wealth distribution on the right. The dashed red lines show the share of income held by households in the top 10% of the income distribution on the left and the top 1% of the income distribution on the right.

Figure 4: Decision Rules: Production



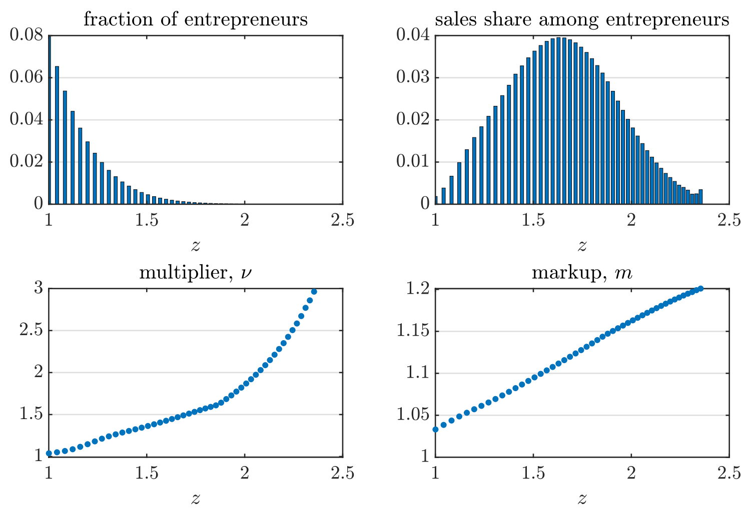
Notes: The solid blue lines show the decision rules of a low a agent against productivity. The dashed red lines show the decision rules of a high a agent.

Figure 5: Decision Rules: Savings and Hours



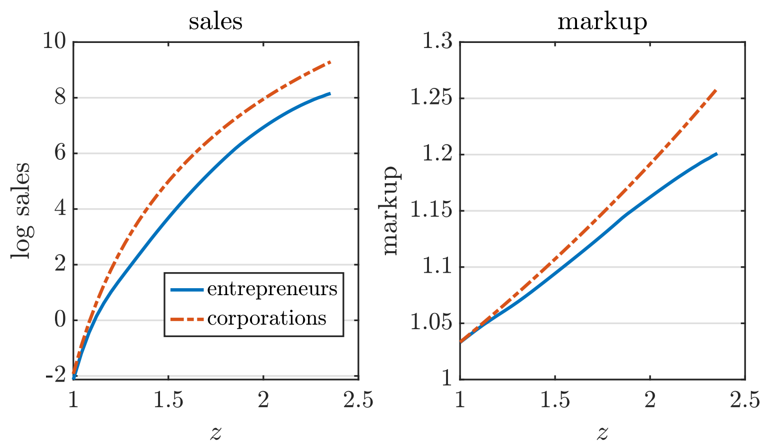
Notes: The solid blue lines show the decision rules of a high z agent against wealth. The dashed red lines show the decision rules of a low z agent.

Figure 6: Distribution of Wedges for Entrepreneurs



Notes: The figures show the distribution of productivity for operating entrepreneurs (upper-left panel), the sales share of operating entrepreneurs (upper-right panel), the average multiplier ν on the collateral constraint of entrepreneurs of a given level of productivity (lower-left panel), and the average markup m of entrepreneurs of a given level of productivity (lower-left panel)

Figure 7: A Comparison of Entrepreneurs and Corporate Firms



Notes: The left panel contrasts the average sales of entrepreneurs (logs) of a given level of productivity with the sales of corporate firms. The right panel contrasts the average markups of the two types of firms