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Entrepreneurs, Managers and Inequality

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Abstract

Since the 1980s, the U.S. income distribution has become considerably more concentrated toward the top while the wealth distribution has not. I argue that this can be accounted for by occupational shifts caused by the decline in tax progressivity. To show this, I construct a dynamic general equilibrium model of occupational choice which distinguishes between entrepreneurs, who run their own firms, and managers, who run publicly owned firms. Collateral constraints induce entrepreneurs to hold more wealth, while managers earn higher wages as a result of competitive assignments to firms. Feeding observed tax policy changes from 1970 to 2000 into the model, I find that (i) less progressive taxation increases the relative mass of managers in equilibrium, and explains approximately 30% of the observed increase in the concentrations of earnings and income without increasing that of wealth, and (ii) reverting to historical tax policies has only a negligible impact on consumption equivalent welfare.

JEL Classifications: *C68, E21, E62, J3*

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1. Introduction

Wealth is much more concentrated than income in the United States. According to the Survey of Consumer Finances (SCF), for most of the latter half of the 20th century the top 1% of the wealthiest households held approximately 33% of aggregate wealth. In contrast, the top 1% of the highest income households earned approximately 10% of aggregate income (Tables 1-3).[1] At the same time, income has become much more concentrated toward rich households since the 1980s compared to the previous post-war era, with the highest income percentile earning 7.8% of aggregate income in 1970 and 16.5% in 2000 (Piketty and Saez (2003)). In contrast, wealth concentration has increased only modestly, if at all. In short, rich households are richer than before the 1980s, but do not seem to be saving as much.

Two questions beg explanation: first, what has been the driving force of the dramatic increase in income concentration? And second, why was this not accompanied by a corresponding increase in wealth concentration?[2] To answer these questions, I present a heterogeneous household model where the income sources and savings behavior of households differ depending on their occupations. Feeding observed tax policy changes from 1970 to 2000 into the model, I find that less progressive taxation can explain approximately 30% of the observed increase in the concentrations of earnings and income without increasing that of wealth.

The novel component of the model is the distinction between entrepreneurs and managers. It is often difficult to differentiate the two, and most models often treat them identically.[3] Theoretically, these models are missing a market for managers or talent. As a first step toward differentiating the two and incorporating the missing market, I take a simple approach where entrepreneurs are constrained to use their own assets to run a firm, while managers are hired by firms in which they need not invest (e.g., a publicly held firm of which the executive does not hold the majority of shares). This also leads to a natural distinction between corporate and non-corporate firms - in this paper, I will call those firms run by entrepreneurs "private firms" and those run by managers, "corporate firms." While both occupations comprise the bulk of the richest income groups, there

[1] In a standard life-cycle model of precautionary savings, it is natural that wealth should be more concentrated than income due to idiosyncratic uncertainty and intergenerational transfers. However, numerous studies have found that these by themselves cannot quantitatively explain the degree of wealth concentration that is observed in the data. See Cagetti and De Nardi (2008) for an excellent review.

[2] Income is a flow variable while wealth is a stock. Hence it may be the case that the wealth of high-income earners will eventually rise to levels corresponding to their income, as argued in Kopczuk and Saez (2004). But if this is true, we should observe an upward trend in wealth inequality, which we do not.

[3] As an example, macroeconomic models with entrepreneurs typically exploit Lucas (1978), which was originally proposed as a model to explain the general equilibrium effects of an economy with *managers*.

is a trade-off between becoming an entrepreneur or a manager - the former faces collateral constraints but retains the entire surplus, while the latter is unconstrained but must be hired by public investors and split the surplus with them. Moreover, managers earn most of their income in the form of wages, while entrepreneurs earn most of their income in the form of business or capital income.

As in most entrepreneurial models, the collateral constraints create a strong concentration of wealth. In addition, competitive assignment between corporate firms and managers implies that managerial compensation is proportional to the size of the firms they run (up to a constant). Therefore, managerial compensation will increase with the mass of corporate firms in the economy, leading to superstar wages for the managers who run the largest firms.[4] When managers replace entrepreneurs at the high end of the income distribution, income becomes more concentrated because managers have higher earnings.[5] At the same time, wealth does not become as concentrated because managers have a weaker savings motive than entrepreneurs. Many rich entrepreneurs still remain at the top of the wealth distribution even if they are relegated to lower fractiles of the the income distribution, while the rich managers at the top of the wealth distribution may have a lower savings propensity than entrepreneurs, but save out of a higher income. This is in line with the explosive increase in managerial compensation since the 1980s and the rise in earnings concentration being the main culprit for the rise in income concentration, which led to "the working rich replacing the traditionally rich" (Piketty and Saez (2003)).

My quantitative results show that such an occupational shift can be induced by a decline in tax progressivity. Taxes are modeled as an exogenous policy variable and I numerically compute the response of the economy to historical policy changes. Federal income taxation has become much less progressive, with the highest income groups paying as much as 70% of their income in taxes before the 1980s as opposed to 35% today.[6] Lower taxes on high levels of managerial compensation induces more individuals to opt to become managers, which in turn reduces the relative measure of entrepreneurs versus managers at the high end of the income distribution.

Given these results, I then analyze the welfare consequences of switching *back* to 1970 tax policies from 2000 policies within the model environment. Despite the higher savings propensity at

[4] Gabaix and Landier (2008) build a theoretical model that shows that the size of the corporate sector can explain the the huge increase in managerial compensation. The analytical form used in my model is motivated by theirs, which was first derived by Tervio (2008).

[5] In the paper, I use "earnings" to refer to wage income, and "income" to refer to total income.

[6] Corporate income tax has also become less progressive and capital gains tax has become lower. This is also in favor of higher managerial compensation, of which a large share is paid out in the form of stock options and grants.

the top, the steady state level of capital is approximately 7.3% lower under 1970 levels of progressivity. However, it turns out that the collateral constraint is less inefficient than the inefficiency that arises in the process of hiring managers, so that steady state output is almost unchanged. The combined effect is such that average consumption drops by 6.1%, less than the drop in aggregate capital. However, the associated drop in income concentration that comes without an increase in wealth concentration leads to a drop in consumption inequality. This implies a smoother expected equilibrium consumption plan, which is preferable for the risk averse agent. This compensates for the drop in average consumption, resulting in a consumption equivalent welfare loss of only 2.7% across steady states. The losses are even smaller along the transition path, given that capital must be decumulated and is used for additional production and consumption. This results in a negligible loss of less than 1% when considering the transition.

Related Literature This paper is closely related to the macroeconomic literature on income and wealth inequality. Quantitative explorations of inequality typically employ Bewley-type incomplete market models with heterogeneous households. Most of these models attempt to explain the high degree of wealth concentration observed in the data.

Aiyagari (1994) shows that incomplete markets alone come far from accomplishing this. In a similar model but with aggregate uncertainty, Krusell and Smith (1998) find that aggregate uncertainty is also insufficient. However, by adding small differences in the subjective discount factor that vary stochastically with the aggregate state, they find that the wealth distribution in their model comes close to that of the U.S. Krueger and Perri (2006) replace the incomplete market friction with limited commitment, but find that this generates more risk-sharing than observed in the U.S. data. While not a focus of their study, their model cannot explain the degree of wealth concentration in the data, as more risk-sharing would imply less accumulation of wealth. Castañeda et al. (2003) add an additional source of earnings heterogeneity, the labor-leisure choice, and find that a model with endogenous labor supply and taxes can almost exactly match the earnings and wealth inequality moments in the data.

In all of these models, the main source of uncertainty is the idiosyncratic labor shock. In this sense, all individuals are identical in that they are wage workers but with stochastic abilities. As such, the sole source of inequality in this class of models is labor efficiency. Though they deliver valuable insights and may be a good approximation of the U.S. economy as a whole, most of these models do poorly at the high end. Indeed, Castañeda et al. (2003) are able to achieve their results only after assuming an extremely high shock that occurs with very small probability.

Instead of assuming that some workers happen to be extremely efficient by chance, entrepreneurial models use a Lucas (1978)-type "span of control" mechanism with collateral constraints to endogenously explain why some individuals generate higher income and also exhibit higher savings behavior. This class of models has been more successful in matching inequality moments, particularly at the high end. Quadrini (2000) shows that a model with stochastic projects, collateral constraints and entrepreneurial risk can explain the income class mobility as well as the wealth distribution in the U.S. Cagetti and De Nardi (2006) use a parsimonious overlapping generations model of occupational choice between becoming a worker or an entrepreneur, and show that endogenous collateral constraints together with bequest motives can generate a realistic wealth distribution. Conceptually, both models are adding a small fraction of entrepreneurs into a model otherwise identical to Aiyagari (1994). These models are suitable for analyzing the behavior of entrepreneurs and how they interact with the macroeconomy, but are subject to the criticism that the large role played by private firms (which are run by entrepreneurs) is not very representative of the U.S.

However, all the models above will not be able to answer why income concentration has increased while wealth concentration has not. The reason they are able to create a strong concentration of wealth is because the high income earners have an unusually large savings motive compared to the average, whether it be because they face a different income process or they have different occupations. Hence, an increase in income concentration will necessarily lead to an even higher concentration of wealth, contrary to what we observe in the data.[7]

I draw from various lines of literature to build a stylized model that can explain U.S. inequality facts. The first is entrepreneurial models of development. A growing literature explores the role of entrepreneurial collateral constraints in the course of economic development, e.g. Moll (2010); Buera and Shin (2009); Buera et al. (2011). In contrast, I build a model of an already developed economy by adding a new high income earning occupation, a manager, that competes with entrepreneurs. Using this model, I explore how fiscal policy shifts can change the distributions of income and wealth in the U.S. The creation of the managerial occupation is accomplished by

[7] Poschke (2010) develops a model of skill-biased change in entrepreneurial technology to explain historical U.S. and cross-country data on entrepreneurship and firm size. But his model lacks any endogenous dynamics, and does not differentiate between income, earnings and wealth. Moreover, his model is again subject to the criticism that the U.S. economy cannot be represented solely by entrepreneurial activity. In addition to being able to explain all the facts he focuses on, I can explain a much richer set of facts while also not relying only on entrepreneurship or an abstract notion of technological change.

technology transfers. In my model, entrepreneurs choose between running their own business or selling it. This component of the model can be viewed as a simplified version of Holmes and Schmitz (1990, 1995). In recent work, Silveira and Wright (2010) generalize their setting and add various frictions to focus on the transfer process. Instead, I interpret this "transfer of ideas" as a mechanism that brings a business to the disposal of public investors and simplify the process so that it can be embedded in a general equilibrium framework. This simplification is done by borrowing from managerial assignment models in the business literature, e.g. Tervio (2008), Gabaix and Landier (2008).

In my framework, the occupational choices and incomes of households are determined in a dynamic general equilibrium. High income groups display different characteristics depending on the relative ratio of entrepreneurs versus managers that comprise those groups. When there are more entrepreneurs, the model behaves more similarly to an entrepreneurial model with collateral constraints, and when there are more managers, it behaves more similarly to a competitive assignment model with superstar earnings. Thus, a shift in occupational choices alters the savings behavior of different income groups and the dynamics of their sources of income. I numerically compute the resulting equilibrium distributions of income and wealth in response to shifts in an empirically calibrated tax code along with the welfare costs and benefits of such shifts.

The rest of paper is organized as follows. In the next section I summarize the empirical facts that form the basis of this study. Section 3 presents the benchmark model and its properties. Section 4 describes the calibration strategy and the numerical policy experiment. Section 4.2 discusses the results and the quantitative mechanisms of the model, and Section 5 concludes.

2. Empirical Facts

This section presents in detail the empirical facts outlined in the introduction and which this paper seeks to explain, namely:

1. Large increase in income concentration since the 1980s that was not accompanied by a corresponding increase in wealth concentration
2. Concurrent explosion of the number and compensation of managers.

In addition, I also document trends in the tax code, which is modeled as an external policy variable in the quantitative section.

2.1 U.S. Income and Wealth Distribution

Figure 1 plots the time series for the top 1% share of wealth from Scholz (2003) and my own computations, both using the SCF.[8] It also plots wealth data based on estate tax returns from Kopczuk and Saez (2004).[9] I account for wealth as "NET WORTH" as defined in the SCF. It is reassuring that my results are similar to Scholz (2003) and Kennickell (2009), the designer of the SCF, with the exception of 1986, which Scholz (2003) exclude due to concern of spurious reporting, and 2004 and 2007, which I include.[10] The graph shows that the top percentile wealth share has no specific trend over the years the SCF data were collected. While it does seem to display a slight increase in the early 1990s, this trend was reversed afterward. Furthermore, the increase is nowhere near the level of the increase in top income shares, which has continually increased.

Piketty and Saez (2003) document that top income shares have grown dramatically since the 1980s, and that they show a strong correlation with top earnings shares.[11] Figure 2 plots their time series of the top percentile and decile shares of total income and wage income. The figures show that top income shares are closely tracked by top earnings shares, suggesting that the increase in total income concentration is caused by wages and salaries. This visual trend is confirmed in Tables 1-3, where I have tabulated the Gini coefficients and size distribution for wealth, wage and total income for all available years when the SCF survey was conducted,[12] along with older data from the 1962 Survey of Financial Characteristics of Consumers and 1963 Survey of Changes in Family Finances (SFCC/SCFF).

Along with these facts we observe that the wage income share of high income groups has become higher over time. After dividing total income into three sources - capital, wage and business - Figure 3 plots these shares for the top income percentile and decile. The peculiar trends of the early 1980s are typically attributed to anomalous tax reporting episodes around the time of the 1986 tax reform. During this period, business owners began to report corporate income as personal income to take advantage of the fact that personal income tax rates fell below corporate income

[8] Wolff (2007) also uses SCF data to argue that both the income and wealth distributions have become more concentrated. While the methods he uses to estimate wealth shares are controversial (Scholz (2003); Kopczuk and Saez (2004)), it does not alter the main picture: there has been a surge in top income shares that was not accompanied by an equivalent increase in top wealth shares.

[9] They find that top wealth shares has only increased moderately over the entire post-war period, and is still much lower than in the early 20th century. Notwithstanding that more data are available for a historical analysis, it is difficult to draw conclusions about wealth from estate tax returns as it is subject to major tax avoidance issues.

[10] Kennickell (2009) only analyzes 1989 onward.

[11] They use tax returns data published annually by the Internal Revenue Service (IRS), based on income as reported by a tax unit (single or married couple).

[12] 1963, 1983, 1986, 1989, 1992, 1995, 1998, 2001, 2004, 2007.

tax rates for the first time in history, while the actual sources of income remained unchanged. For the same reasons, more options were exercised, and shareholders realized large amounts of their capital gains. Regardless, overall we observe that the wage share of income has increased and that the capital and business shares have decreased in both the top income percentile and decile in the long run, as also confirmed in Table 4. This indicates the "crowding out" story of this paper - that the "savings rich" (entrepreneurs) have been replaced by the "earnings rich" (managers).[13]

2.2 Entrepreneurs vs Managers

A As noted in Cagetti and De Nardi (2006), a large fraction of the rich people are entrepreneurs. The main definition of an entrepreneur that they use are active, self-employed business owners according to the SCF. According to this definition, 7.6% of the population are entrepreneurs, they own 33% of total wealth, and comprise 54% of the top wealth percentile (Tables 1, 2, and 3, respectively, in Cagetti and De Nardi (2006)) in the 1989 SCF. It is quite clear that entrepreneurs own a significant amount of total wealth, but as they also ask, who are the other rich people?

Recent trends indicate that a significant portion of these other rich people may be managers. In my model, a manager is an individual who runs a publicly owned company on the owners' behalf. Accordingly, the top managers in my model correspond to CEOs of large corporations. Gabaix and Landier (2008) find that CEO compensation has increased nearly 6-fold since the 1980s, which coincided with a 6-fold increase in market capitalization. Piketty and Saez (2003) also conjecture that the relative rise in executive compensation compared to the average wage may have caused the rise in income and earnings concentration. Figure 4(a) plots the relative increase in the top 10 and top 100 ranked CEO as published in Forbes Magazine, against the average annual wage from the National Income and Product Accounts (NIPA), from 1970 to 2000.[14] The relative increase is visually clear for both measures.

While it may seem natural to conclude that these executives are sitting at the top of the distribution, in particular since the 1980s, empirical evidence is scant. The problem is that the only survey that properly represents the high end of the distribution, the SCF, does not include a clear

[13]However, the increase in the wage income share for top income groups happens earlier than the surge of top earnings and income shares. Piketty and Saez (2003) conjecture that the rise in income concentration may be due to shifts in social norms, which may also explain the different timings and also the quantitative moments not explained by this paper.

[14]Frydman and Saks (2010) track the three highest paid executive officers of the largest 50 firms in 1940, 1960 and 1990. In addition to going farther back into the past, it has the additional favorable feature that option grants are evaluated at grant-date. Their analysis confirm the explosive increase in compensation after the 1980s.

classification for managerial occupations. This makes it difficult to conduct a direct comparison between the income and wealth levels of entrepreneurs and managers. However, there is ample evidence that the aggregate share of managers in the entire population has grown relative to entrepreneurs. I present one such piece of evidence from the Integrated Public Use Microdata Series of the Current Population Survey March supplement[15] in Figure 4(b). As in Feyrer (2009), I compute the fraction of households where a household member is categorized as "Managers, Officials, and Proprietors" under the 1950 census occupational coding. The ratio of households involved in management increases from approximately 13% to 18% from 1970 to 2000. From this group of households, I drop those households who are self-employed and with positive business income—the entrepreneurs according to Cagetti and De Nardi (2006)'s definition. It is clear that the increase in the share of households involved in management is due to those who are *not* entrepreneurs. Indeed, the fraction of entrepreneurs in the March CPS is relatively stable throughout this time span at approximately 2.5%.[16] The figure also plots the share of entrepreneurs among the households classified as management, which declines from approximately 25% percent in 1970 to 15% in 2000.

2.3 Tax Progressivity

The 1980s Reagan era was characterized by a series of tax reforms. While it is arguable how much of the distributional trends are attributable to taxes, federal income tax rates decreased quite dramatically during this period. Refer to Figure 5(a) for historical series of personal and corporate top marginal statutory tax rates.[17] Of course, statutory tax rates do not immediately translate into effective tax rates. While statutory personal tax rates have become less progressive, it is not clear whether effective tax rates have become less progressive as lower tax rates induce high income individuals to receive more of their income in taxable form. Corporate income taxes are also hard to interpret, especially because different types of corporate entities have different ways to avoid the "double taxation" issues, i.e., both the corporation and shareholders being taxed. In order to cope with these issues one would need to look at not only the effective tax rates for all income groups, but how much of each income source is being taxed - a herculean task when one takes into account the full complexity of the tax code.

[15] King et al. (2010), `http://cps.ipums.org/cps/`.

[16] This figure is most likely small compared to those computed from the SCF as the CPS may miss business incomes.

[17] While ignored in the quantitative analysis of this paper, corporate taxation will mainly affect individuals with a large number of shares and top level management. Therefore it may potentially play a large role in explaining the evolution of top income and wealth shares.

Nonetheless, Piketty and Saez (2007) report that the U.S. tax system has become less progressive in recent decades. Figure 5(a) plots the effective average tax rate faced by the top 0.01 percentile richest households from Piketty and Saez (2007) against the statutory tax rates, from which one clearly sees that top effective rates closely track top statutory rates. While the effective average tax rate for all households rose from 23.3% in 1970 to 27.4% in 2000, the tax rate for the top income percentile fell from 47.2% to 38.6%. Furthermore, they find that while there have been large changes at the top income percentile, there are relatively small changes below that. Interestingly, while the effective tax rate has fallen for this group, the share of taxes they have been paying has increased, from 18.4% to 27.7%, consistent with the huge increase in their share of aggregate income. This is visually contrasted against the effective average tax rate of the top 0.01 percentile richest households in Figure 5(b).

In addition to the direct effects coming from tax reporting, there are other indirect ways through which high incomes, in particular top executive compensation, can be affected by the tax code. When income taxes are progressive, not only does the manager occupation become less desirable for the individual, but also for the firm. This is because high marginal income tax rates require huge pretax compensation that firms may simply not be able to meet with salary and stock grants (Frydman and Saks (2005)). Lower personal income taxes for high income brackets enable firms to pay out higher after-tax salaries. Lower corporate income taxes and favored tax treatment for capital gains can also indirectly affect executive compensation. These allow the firm to compensate the manager in the form of stock options or other forms of compensation that are more lightly taxed. Accordingly, Frydman and Saks (2010) find that option grants have been on a steady rise since the 1950s.

Following Piketty and Saez (2003)'s division of individual income into three sources, my model also specifies three sources of income - capital, wage and business. As the model addresses neither tax avoidance or evasion nor double taxation issues, I ignore these problems and assume that individuals truthfully report these three sources of income, and compress all tax progressivity on the wage income tax schedule. The reason I do so is because earnings are the dominant source of income for households in all income groups, and therefore any changes in a generic income tax schedule would affect earnings the most. Also, there are many loopholes in the tax code for capital and business income that taxpayers can easily exploit to their advantage. Figure 6 shows calibrated average wage income tax functions for 1970 and 2000, and their construction is discussed in Section 4. The functions show a clear decrease in progressivity between the two periods in time. In my quantitative exploration, I argue that this can explain changes in the distributions of income and wealth.

Figure 7 shows how my model can explain the facts presented in this section. The collateral constraints generate strong wealth concentration due to the entrepreneurial savings motive. Managers earn the highest wages due to competitive assignments. Less progressive taxation induces managers to crowd out entrepreneurs in high income groups, leading to higher earnings and income concentration. Wealth concentration does not change because even though the high income groups have a lower savings propensity than before, they are saving out of a larger pie. In addition, even though tax rates are lower for high income groups, they pay a higher share of taxes because their earnings become disproportionately larger than low income groups.

3. Model

I use a dynamic version of Lucas (1978)'s "managerial span of control" technology, which is standard for quantitative models with entrepreneurs, e.g. Cagetti and De Nardi (2006), Buera et al. (2011). The novel component of my model is differentiating entrepreneurs from managers. Entrepreneurs are subject to collateral constraints while managers are not. This is meant to capture the fact that investors that outsource their managers have more operational funds than the single entrepreneur. Potential entrepreneurs decide whether or not to sell their "projects"[18], where a sale leads to a change of ownership as in Holmes and Schmitz (1990, 1995). But unlike their model, these decisions can be made in every period, as the project fully depreciates within a period.

In addition to the collateral constraint faced by entrepreneurs, another critical element of the model is the competitive assignment between projects and managers. In any given period, the within period equilibrium displays competitive assignment between projects and managers as in Tervio (2008), so that the returns to managerial talent is increasing in talent.

[18]In terms of constructing a model, different authors call this an "opportunity," "idea," or "business."

3.1 Setup

Time is discrete, $t = 0, 1, \ldots$, with a unit measure of individuals.[19] Individuals live forever and are heterogeneous with respect to projects q, managerial abilities m, and wealth a. Projects are assumed to be drawn from a binary set $q \in \{0, 1\}$ according to the Markov transition matrix Ω with associated stationary distribution G. If $q = 1$, individuals own a project - specifically, they have access to an economy-wide technology that depends on managerial ability, and capital and labor inputs as specified below. The project can be implemented, sold or simply forgone. If $q = 0$, it implies that the individual does not have a project, that is, does not have access to the technology. Managerial ability shocks also follow a Markov process. If today's managerial ability shock is m, the probability that tomorrow's ability m' is m is χ. Otherwise, m' is newly drawn from an ergodic distribution F with support $[0, \overline{m}]$.[20] The wealth state a denotes the individual's asset holdings, which is endogenously chosen by the forward-looking rational individuals.

All states are assumed to be perfectly observable, and I do not model any information or bargaining problems that may arise when an individual sells a project, or when a project is matched to a manager that is not its original owner. Projects are rival and last for only one period. In other words, once an individual sells her project she cannot implement it on her own, and regardless of who owns the project, it is gone at the end of the period. Whenever the project is implemented, I call this a "firm."

I assume that the economy is in a steady state, so we can ignore aggregate variables. Individuals enter each period with the state vector $x = (q, m, a)$. Individuals with $q = 1$ have the choice of selling the project to intermediaries at a competitive price. Those who sell their project lose the chance to implement the technology. If an individual keeps her project and implements it, I call her an *entrepreneur*, and the firm *private*. If she sells it, she chooses to become a *worker* or *manager*. Individuals who discard their project or with $q = 0$ choose between becoming a worker or manager as well. I call a firm run by a manager a *public* or a *corporate* firm. In this sense, if an individual sells her project but chooses to become a manager, she can be viewed as an entrepreneur who has gone public.

Managers are hired in a manager market where the employers are the new owners of the

[19] I begin by presenting the model absent of idiosyncratic labor shocks and tax policy variables, which are added in the quantitative model for calibration. Taxes are only critical to the extent that they affect individuals' occupational choices, which is what I focus on in this section.

[20] The analysis focuses on continuous ability types and binary project types, as this is what is done in the calibration. Assuming different cases would increase notation without adding any intuition, therefore I keep the set of possible project qualities as simple as possible. This is discussed in detail below.

projects (i.e., the intermediaries) sold by individuals. I assume that entrepreneurs have an advantage over managers, which is captured by the parameter $\kappa \in [0, 1)$. Specifically, managers can only utilize $(1-\kappa)m$ of their ability on a project, while entrepreneurs can use their whole m. This is tantamount to assuming that all else equal, the original owner of a project is better at implementing a project. The parameter κ may also include the cost of bargaining that arises when assigning projects to managers, as analyzed in Silveira and Wright (2010).[21] After all occupation choices are made, entrepreneurs and managers make their production decisions, and all individuals make consumption and savings decisions. The sequence of events is depicted in Figure 8.

Preferences Preferences are standard and identical across individuals. Given a history of states $\{x^t\}_{t=0}^{\infty}$ and a state contingent consumption plan $c^t = \{c_t, c_{t+1}, \ldots\}$, expected utility at time t is given by

$$U(c^t) = \mathbb{E}_t \left[\sum_{s=t}^{\infty} \beta^{t-s} u(c_s(x^s)) \right]$$

where β is the subjective discount factor and the expectation is taken over the future realizations of $\{x^s\}_{s=t}^{\infty}$ at time t.

Technology There is a single economy-wide technology only accessible by owners of projects, i.e., individuals with $q = 1$ who have not sold their project or those who purchased a project. Production requires a project, a manager, capital, and labor. The manager makes all production decisions subject to the production function

$$f(\tilde{m}, k, l) \quad = \quad \tilde{m}^{1-\alpha-\nu} k^{\alpha} l^{\nu},$$

where $\tilde{m}$ is the ability of the individual implementing the project. If she is the owner of the project I call her an entrepreneur, and otherwise a manager. For entrepreneurs, $\tilde{m} = m$, while for managers, $\tilde{m} = (1-\kappa)m$. The variables k and l are the amounts of capital and labor used in production, respectively, and α and ν represent factor intensities.

Since I later incorporate collateral constraints, it is useful to define the indirect profit function

[21] This assumption is made mainly for quantitative purposes and does not affect the qualitative results of the model, as discussed in Section 3.3.

and factor decisions without collateral constraints. These are given by

$$
\begin{aligned}
\pi^*(\tilde{m}) &= \max_{k,l}\left\{\tilde{m}^{1-\alpha-\nu}k^{\alpha}l^{\nu} - Rk - wl\right\} \\
&= (1-\alpha-\nu)\tilde{m}\left[\left(\frac{\alpha}{R}\right)^{\alpha}\left(\frac{\nu}{w}\right)^{\nu}\right]^{\frac{1}{1-\alpha-\nu}} \\
Rk^*(\tilde{m}) &= \alpha\tilde{m}\left[\left(\frac{\alpha}{R}\right)^{\alpha}\left(\frac{\nu}{w}\right)^{\nu}\right]^{\frac{1}{1-\alpha-\nu}} \\
wl^*(\tilde{m}) &= \nu\tilde{m}\left[\left(\frac{\alpha}{R}\right)^{\alpha}\left(\frac{\nu}{w}\right)^{\nu}\right]^{\frac{1}{1-\alpha-\nu}},
\end{aligned}
$$

where R is the rental rate for capital, and w the wage rate.

Financial Markets Since projects are sellable, there are essentially three assets in this economy: capital, a one-period risk-free bond, and projects. Individuals can make deposits in and borrow from a perfectly competitive financial market at the risk-free interest rate r. However, borrowing is subject to a borrowing constraint, which I assume is zero. I also assume that all capital used in production must be rented from the financial market. Since this market is competitive intermediaries earn zero profit, so the equilibrium rental rate $R = r + \delta$, where δ is the depreciation rate of capital.

Financial intermediaries in my model play three roles: they rent out capital to entrepreneurs and managers, they buy projects from individuals wishing to sell them, and they hire managers to run the purchased projects. As with the rental rate, perfect competition pins down the price of projects p, so that the returns from buying any project d is identically equal to r.

Managers are hired at a competitive compensation schedule $W(m)$ to implement purchased projects. These managers are not subject to any constraints since they are producing on behalf of an intermediary, who owns the capital. However, entrepreneurs are subject to a collateral constraint $k \leq \lambda a$ which can be motivated by limited enforceability of lending contracts. Specifically, if $\lambda = 1$ the entrepreneur can only use her own funds to implement her technology, while if $\lambda = \infty$ she is in fact not constrained at all.[22] This type of constraint has been used widely in the literature, e.g. Kiyotaki and Moore (1997); Buera and Shin (2009). Since a constrained entrepreneur will always

[22] I could instead be more explicit about the contractual structure of debt, which would imply an endogenous debt limit as in Cagetti and De Nardi (2006); Buera et al. (2011). However, I am more interested in the general equilibrium effects of the multiple occupation choices and modeling the endogenous debt limits would complicate the analysis and numerical algorithm without adding much insight.

rent up to her limit, her indirect profits and factor decisions are

$$\begin{aligned}\pi_c(m,a) &= (1-\nu)m^{\frac{1-\alpha-\nu}{1-\nu}}(\lambda a)^{\frac{\alpha}{1-\nu}}\left(\frac{\nu}{w}\right)^{\frac{\nu}{1-\nu}} - R\lambda a \\ l_c(m,a) &= m^{\frac{1-\alpha-\nu}{1-\nu}}(\lambda a)^{\frac{\alpha}{1-\nu}}\left(\frac{\nu}{w}\right)^{\frac{1}{1-\nu}}.\end{aligned}$$

Hence the profits and factor decisions of an arbitrary entrepreneur can be written as

$$\{\pi(m,a), k(m,a), l(m,a)\} = \begin{cases}\{\pi^*(m), k^*(m), l^*(m)\} & \text{if} \quad \lambda a \geq k^*(m) \\ \{\pi_c(m,a), \lambda a, l_c(m,a)\} & \text{if} \quad \lambda a < k^*(m).\end{cases}$$

The role of the financial intermediaries will be discussed in more detail along with the manager market below.

Individual's Problem Individuals make occupation-consumption-savings decisions. Those with $q = 1$ must also decide whether to sell, keep or discard their projects. If an individual sells her project, she earns p. Denote the individual's occupation decision as $o \in \mathcal{O} = \{o_w, o_m, o_e\}$, where o_w, o_m, o_e is the choice of becoming a worker, manager or entrepreneur, respectively. Obviously, only individuals with $q = 1$ can choose $o = o_e$.

The individuals' occupational choices determine their current period income $\phi(\cdot)$. This is determined endogenously not only by the individual's occupation decision but also by μ, the distribution over individual states. More precisely,

$$\phi(x) = \begin{cases} w + ra & \text{if} \quad o = o_w \\ W(m) + ra & \text{if} \quad o = o_m \end{cases}$$

if $q = 0$, and

$$\phi(x) = \begin{cases} w + p + ra & \text{if} \quad o = o_w \\ W(m) + p + ra & \text{if} \quad o = o_m \\ \pi(m,a) + ra & \text{if} \quad o = o_e \end{cases}$$

if $q = 1$. I discuss this in detail in the following subsection along with the individuals' project and occupation decisions.

Individuals learn their individual states $x = (q, m, a)$ at the beginning of each period. In the stationary distribution, aggregate states are irrelevant to the individual so the only source of uncertainty faced by the individual comes from next period's idiosyncratic states (q', m'). The individual's problem can be expressed recursively as follows. Given the price vector $P = \{R, r, w, p, W(m)\}$, an individual with the state vector $x = (q, m, a)$ solves

$$\begin{aligned} V(x) &= \max_{a'} \{u(c) + \beta \mathbb{E}\left[V(x')|q, m\right]\} \\ \text{s.t.} \quad c + a' &= \phi(x) + a \end{aligned}$$

where $\phi(x)$ is the state-dependent income to be explained in detail below and

$$\mathbb{E}\left[V(x')|q, m\right] = \sum_{q'} \Omega(q, q') \left[\chi V(q', m, a') + (1 - \chi) \int_{m'} V(q', m', a') F(dm')\right].$$

3.2 Equilibrium

Given the setup, we can define a *stationary recursive competitive equilibrium (RCE)* as follows:

Definition 1 *A stationary RCE is defined as a collection of prices $P = \{R, r, w, p, d, W(m)\}$, policies $c(x)$, $a'(x)$, factor decisions $k(x)$, $l(x)$, occupational choices $o(x)$, incomes $\phi(x)$, and a distribution $\mu(\cdot)$ such that*

1. *given P, the policies, occupational choices and production decisions solve the individual's problem,*
2. *intermediaries earn zero profit,*
3. *the manager market clears: $\int_{q=1, o \neq o_e} \mu(dx) = \int_{o=o_m} \mu(dx)$,*
4. *capital and labor markets clear:*

$$\begin{aligned} \int a(x)\mu(dx) &= \int_{o \in \{o_m, o_e\}} k(x)\mu(dx) + \int_{q=1, o \neq o_e} p\mu(dx) \\ \int_{o=o_w} \mu(dx) &= \int_{o \in \{o_m, o_e\}} l(x)\mu(dx) \end{aligned}$$

   and the goods market clears by Walras' Law, and

5. *μ is a fixed point:*

$$\mu = \mathcal{H}(\mu).$$

where $\mathcal{H}$ is aggregate law of motion induced by G, F and the individuals' decisions.

Condition 2 implies $R = r + \delta$ and $d = (1 + r)p$. Given (r, w) and μ, the price of projects, managerial compensation and occupation decisions are jointly determined in the manager and labor markets. In turn, given the individuals' occupation decisions, (r, w) and μ are determined by the production-consumption-savings decisions in the capital, labor and goods markets.

The manager market is in fact an agglomeration of two markets - a project exchange market and a manager hiring market. However, since the intermediaries only purchase projects for which a manager will be hired, the demand for projects equals the demand for managers so that the two markets are linked by the single market clearing condition 3. Specifically, two things happen in the manager market. First, individuals with $q = 1$ decide whether to keep or sell their project given the price p, and intermediaries make their purchases. Second, intermediaries hire managers and individuals make their occupation choices given the competitive wage w and managerial compensation schedule $W(m)$.

Since projects are assumed to completely depreciate after one period, we can separately analyze the manager market from the agents' dynamic decisions. In other words, given (r, w), the manager market is static and all the dynamics are determined by the agents' consumption-savings decisions in the capital and goods market as in standard Bewley models. This is a great simplifying step of the model, as it not only allows separate analysis of the manager market but also simplifies the numerical problem. Whenever managers exist in a RCE, I will call this a *managerial equilibrium*. It turns out that any RCE is necessarily a managerial equilibrium as long as $\kappa \in [0, 1)$. I first characterize the managerial equilibrium to establish existence of the stationary RCE. This will also illustrate how the model can describe the empirical facts laid out in Section 2.

Managerial equilibrium Given the price vector (r, w), the price of projects and managerial compensation schedule $(p, W(m))$ are determined in the manager market. In this market, individuals take prices $(p, W(m))$ as given and make their occupation decisions, and those with $q = 1$ also decide whether or not to sell their projects. Intermediaries purchase those projects and hire managers to run them. Effectively, intermediaries are merely playing the role of a central auctioneer between project sellers and managers. Let Q denote the mass of projects purchased by intermediaries. For manager market clearing, the mass of managers hired $M = Q$. Clearly, $Q > 0$ in a managerial equilibrium. I first assume this and then show when it holds, i.e. the conditions for the RCE to be a managerial equilibrium. Since the market is competitive and intermediaries must make zero profit,

$$(1+r)p = d \tag{1}$$

in equilibrium, where d is the intermediary's expected return from purchasing a project. On the other hand, individuals sell their project only if $p \geq 0$. When $p = 0$ they are indifferent between selling and discarding. So there are two possible types of equilibria:[23]

$$\begin{aligned} p &> 0 \quad : \text{no projects are discarded} \\ p &= 0 \quad : \text{a non-negative mass of projects are discarded.} \end{aligned}$$

Since all projects are identical, $p > 0$ in equilibrium implies that the demand for projects meets supply. If $p = 0$, individuals are indifferent between selling and discarding and some projects are discarded due to excess supply.

Either case is possible depending on equilibrium managerial compensation, which is in turn determined by w. Individuals who keep their project choose $o = o_e$, so they do not participate in the manager market. Hence the pool of available managers is $\int_{\{q=0\}\cup\{q=1,o\neq 3\}} \mu(dx) \geq M$. These individuals have either never had or no longer own a project, and their asset levels are irrelevant to their decisions, i.e. their decisions only depend on m. The mechanism I use to assign managers to projects is equivalent to the one analyzed in Sattinger (1979), recently applied to CEO markets in Tervio (2008) and Gabaix and Landier (2008). Perfect competition implies that the agents with the highest ability are hired as managers, as in the original Lucas span-of-control model. Hence there is an ability threshold $\hat{m}$ such that $o = o_w$ if $m \leq \hat{m}$ and $o = o_m$ if $m > \hat{m}$. At the threshold, it must be that $W(\hat{m}) = w$, since the competitive wage serves as the reservation wage for individuals who become managers. For all other managers, the returns to the manager is proportional to their contributions, hence

$$\begin{aligned} W(m) &= w + \int_{\hat{m}}^{m} \pi^{*\prime}((1-\kappa)x)dx \\ &= w + (1-\kappa)\left[\pi^*(m) - \pi^*(\hat{m})\right], \end{aligned}$$

due to the linearity of $\pi*$. Since there is only one type and hence one price for projects, the return

[23] When $p = 0$, it does not matter who is discarding the project (it could also be that the transfer occurs, but the intermediary discards it), so long as it is not being used in production.

the project generates for the intermediary, d, can be determined at the threshold level:

$$d = (1-\kappa)\pi^*(\hat{m}) - w. \tag{2}$$

The remaining task is to determine the threshold $\hat{m}$. First, individuals implement their project, or equivalently $o = o_e$, if

$$\pi(m,a) \quad > \quad \max\{w, W(m)\} + p$$

Similarly, individuals sell their project if

$$\max\{w, W(m)\} + p > \pi(m,a),$$

i.e., it is not worthwhile to implement it. Hence from equations (1) and (2) above, $(p, \hat{m})$ must satisfy

$$\begin{cases} p > 0 & : \quad (1-\kappa)\pi^*(\hat{m}) = (1+r)p + w \quad \text{and} \quad g(1) - \int_{o=o_e} \mu(1, dm, da) = \int_{o=o_m} \mu(dq, dm, da) \\ p = 0 & : \quad (1-\kappa)\pi^*(\hat{m}) = w \quad \text{and} \quad g(1) - \int_{o=o_e} \mu(1, dm, da) \geq \int_{o=o_m} \mu(dq, dm, da) \end{cases}$$

where g is the p.m.f. associated with G and $g(1) = \frac{1-\omega_0}{2-\omega_0-\omega_1}$. When $p = 0$, we are at a corner where individuals are indifferent between selling or discarding the project, and just enough projects are sold to clear the supply of managers.

The prices $(p, W(m))$ and threshold $\hat{m}$ jointly determine the individuals' occupation decisions and hence current period income ϕ. When $p > 0$, we can now express the manager market clearing condition as

$$\int_{o=o_w} \mu(1, dm, da) \quad = \quad \int_{\hat{m}} \mu(0, dm, da), \tag{3}$$

i.e., the mass of individuals with $q = 1$ that become workers must equal the mass of individuals with $q = 0$ that become managers. Otherwise there is excess supply of projects and $p = 0$.

Individuals' occupation choices and μ are depicted in Figure 9. The dark gray, light gray and gray regions are the individuals who choose $o = o_w$, o_m and o_e, respectively. Figure 9(b) is straightforward: individuals with $q = 0$ discard their project and become a worker if $m < \hat{m}$, and become a manager otherwise. Next refer to Figure 9(a). $\tilde{m}$ is the managerial ability threshold such that conditional on being unconstrained, an individual with $q = 1$ sells (discards) her project and becomes a worker, i.e.

$$\pi^*(\tilde{m}) = w + p.$$

For $m \in [0, \tilde{m})$, all individuals sell (or discard) their projects and become workers regardless of their asset levels. For $m \in [\tilde{m}, \hat{m})$, the asset threshold is decreasing in m because holding the level of assets fixed, selling (or discarding) the project and becoming a worker gives a constant return while the returns from becoming an entrepreneur increase in m. However, for $m \geq \hat{m}$, managerial compensation increases more than would profits for a constrained entrepreneur. Hence the threshold is increasing in m.

The manager market clearing condition (3) means that the mass of individuals in the dark gray region of Figure 9(a) must equal the mass of individuals in the light gray region of Figure 9(b).[24] Individuals in the light gray region of Figure 9(a) sell their project (supply) and become managers (demand), so this mass becomes irrelevant for market clearing.

To establish conditions under which we have a managerial equilibrium, I first make the following assumption:

Assumption 1 *a' is bounded above by $\bar{a}$, and $\mu(q, m, da) > 0$ for all $x \in \{0, 1\} \times \mathbb{R}_+ \times [0, \bar{a}]$.*

In the appendix, I show that Assumption 1 indeed holds in the RCE under standard assumptions on preferences. The assumption means that individuals never find it optimal to accumulate assets above a certain level, and that for every (q, m)-state, there exists a non-degenerate mass of individuals for all asset levels $a \in [0, \bar{a}]$. Given this assumption, we have shown:

Proposition 1 *Given any (r, w) and a distribution μ over individual states x,*

1. *As long as $\kappa \in [0, 1)$, managers exist in any RCE, i.e. any RCE is a managerial equilibrium.*
2. *Occupation decisions are such that*

$$o(1, m, a) = \begin{cases} o_w & \text{if} \quad m \leq \hat{m} \quad \text{and} \quad \pi(m, a) \leq w + p \\ o_m & \text{if} \quad m > \hat{m} \quad \text{and} \quad \pi(m, a) > W(m) + p \\ o_e & \text{otherwise}, \end{cases}$$

[24] This does not mean that the areas depicted in the figures must be equal.

$$o(0,m,a) = \begin{cases} o_w & \text{if} \quad m \leq \hat{m} \\ o_m & \text{if} \quad m > \hat{m}. \end{cases}$$

Proof: See Appendix A. □

If $\kappa \geq 1$, we revert to the case of standard entrepreneurial models - individuals become entrepreneurs if entrepreneurial profits are high enough given their collateral constraints, or discard their project and become wage workers otherwise. In either case, a stationary RCE uniquely exists. Stationary distributions are the object of interest in most Bewley-type models, and existence is guaranteed under quite general assumptions. These assumptions also apply to my case with slight modifications:

PROPOSITION 2 *If $u(\cdot)$ is CRRA, a stationary RCE exists.*

Proof: See Appendix A. □

Given that an equilibrium exists, I use numerical techniques to compute it and conduct quantitative policy experiments. Section 4 summarizes the numerical strategy and Section 4.2 discusses the results. Before turning to the numerical analysis, however, I point out several novel aspects of the model.

3.3 Modeling Choices and Aggregate Implications

The main mechanisms of the model are the entrepreneurial collateral constraints and the competitive assignment between projects and managers. Since output increases in managerial ability, when $\kappa = 0$ the unconstrained planner's solution has the best managers running all the projects regardless of ownership, thus the competitive assignment component is efficient. On the other hand, the economy is more efficient than one without a manager market, i.e. standard entrepreneurial models with collateral constraints. Hence, in terms of efficiency, my model with collateral constraints and a friction κ in the manager market falls somewhere in between the unconstrained planner's solution and previous entrepreneurial models. But even when $\kappa = 0$, the project transfers incur two additional inefficiencies that deserve attention.

In my model, projects are additional assets that are inherently different from capital, and investing in a project requires diverting resources that would otherwise have been invested in capital. This can be seen in the capital market clearing condition in Definition 1: financial intermediaries use the households' savings not only for capital investment but also to purchase projects. In other words, while it is more efficient for the projects to be run by unconstrained managers for small values of κ, the project transactions reduce the aggregate amount of capital that can be used for production. Hence there is an inherent efficiency loss regardless of κ.

In essence, the intermediaries are making a portfolio decision between projects and capital investment. This raises the question of why it is not the individuals making the portfolio decision. This is equivalent to asking why it is impossible to contract on the the split of surpluses before production, which leads to the second inefficiency. The "central clearing" (by financial intermediaries) assumption on project transfers and manager assignments creates an economy-wide trade-off between having a non-corporate firm versus a corporate firm. If individuals could directly purchase projects, when $\kappa = 0$ there would be no efficiency loss - collateral constrained individuals with $q = 1$ can effectively sidestep the constraint by signing a contract(s) with rich enough individual(s), from which both parties can benefit as long as $p \geq 0$.

It may be more interesting to let individuals make that decision, more so when we interpret κ as inefficiencies that arise during the project-manager assignment process. I avoid this for two reasons, the first being computational. The second is empirical - it is hard to find a real world interpretation that would differentiate a project investment vis-à-vis capital investment. Both the project and capital assets represent ownership of the firm (claim to profits), and it is not clear how one would empirically differentiate "capital" ownership from "idea (project)" ownership.

In a similar vein, one may question why I do not incorporate multiple project qualities. For example, with a continuum of qualities the manager market becomes identical to those in Tervio (2008); Gabaix and Landier (2008) and others. This would add an additional dimension of inequality and, consequently, higher concentrations of income and wealth. However, not only would this increase the "curse of dimensionality" in computation, but also raise conceptual issues. This dimension of inequality stems from the income earned from selling projects and again, it is unclear which source of income this corresponds to in the data. It also becomes undesirable to assume that projects are purely exogenous shocks. Pursuing this direction is left for further research.

In order to study inequality, ideally I should incorporate the individuals' labor supply decisions. I abstract from this for two reasons. The first is that endogenous labor supply can hardly explain the degree of income and wealth concentration we observe in the data (e.g. Castañeda et al. (2003)), and therefore would add little to the main focus of the paper. The second is that the focus of the paper is to study the occupation choices of a specific group of individuals typically at the high end of the distribution. While labor supply decisions are suitable for studying the behavior of the median agent, it seems reasonable to assume that the entrepreneur-manager choice is relatively unaffected by the hours decision.[25]

3.4 Accounting for Taxes

The framework presented thus far is suitable for my purposes in many ways. First, by separating entrepreneurs and managers, I can separately account for wage income and business income at the high end of the distribution. In addition, if there is only a small mass of corporate firms, managerial compensation is small regardless of firm size. Only when there is a large mass of corporate firms do we see large levels of compensation. Given this, I feed in parametrized tax functions which I calibrate to match the average tax rate and top percentile share of taxes in the data. With taxes, individuals now make their occupational decisions based on after-tax rather than pretax income.

For accounting purposes in the calibration, I divide the sources of income in the simulated model into three categories: capital, labor, and business. Capital income in the model corresponds directly to interest income earned through savings, ra. Wage workers and managers earn zero business income while entrepreneurs are assumed to split their business profits between labor and business income. Specifically, I assume that the wage they would have earned if not an entrepreneur is reported as labor income and the rest as business income. As mentioned earlier, it is hard to find an empirical counterpart for the returns earned by selling a project. This is the return from having been lucky enough to have a project, which could be interpreted as the returns to an "idea." I assume this income is not taxed, and also exclude it when computing income shares.

Capital and business income in the model are taxed at flat rates (τ_k, τ_b) while wage income is taxed according to a parametrized tax function which I denote $ATR(\cdot)$. Then after tax incomes $\tilde{\phi}(x)$ become

$$\tilde{\phi}(x) = \begin{cases} ATR(w) + (1-\tau_k)ra & \text{if} \quad o = o_w \\ ATR\left(W(m)\right) + (1-\tau_k)ra & \text{if} \quad o = o_m \end{cases}$$

[25] A third and obvious reason is, again, for simplicity - adding an additional choice variable would enrich the individual's problem, but the general equilibrium becomes intractable analytically and unnecessarily expensive numerically.

if $q = 0$, and

$$\tilde{\phi}(x) = \begin{cases} ATR(w) + p + (1-\tau_k)ra & \text{if} \quad o = o_w \\ ATR\left(W(m)\right) + p + (1-\tau_k)ra & \text{if} \quad o = o_m \\ ATR(w) + (1-\tau_b)\left[\pi(m,a) - w\right] + (1-\tau_k)ra & \text{if} \quad o = o_e \end{cases}$$

if $q = 1$.

Now suppose that we are at an equilibrium given a certain level of taxes, and consider how a less progressive wage income tax policy would alter the equilibrium. Since managers are the ones who potentially earn superstar wages, the supply of managers increases. This supply must be met by demand in equilibrium, so the size of the corporate sector increases, leading to a higher concentration of earnings.

4. Quantitative Analysis

I first obtain the benchmark model parameters by calibrating a stationary equilibrium to empirical moments from 2000. Holding fixed the benchmark model parameters, I recalibrate only the tax function parameters to match 1970 tax characteristics in the data. In other words, I allow only tax policies to change over time to conduct a controlled experiment.[26]

Continuing to hold all model parameters at their benchmark values, I conduct several counterfactual experiments. First, I tabulate results from a hypothetical stationary equilibrium with flat taxes to demonstrate the qualitative effects of changes in tax progressivity. This shows that while flatter taxes lead to more income concentration, wealth concentration does not respond much. Second, I focus on the quantitative effects of varying the parameters λ and κ. In particular, I systematically set κ to half its calibrated value, $\kappa = 1$ (economy with only entrepreneurs), and $\lambda = 0$ (economy with only managers). These results further illustrate that previous models would fail in delivering my quantitative results. In both economies, there is a positive correlation between the concentrations of income and wealth. Third, starting from the 2000 steady state benchmark, I compute welfare gains (loss) if we were to revert to progressivity levels from 1970, including transition costs. In Appendix C, I add a brief explanation on comparing the entire model transition path with the data, where the transition now begins from 1970 steady state.

[26] It is more realistic to think that several of the parameters vary over time, in particular those governing financial markets, which would only increase the model fit. I refrain from this to isolate the effect of the tax change.

The numerical problem is nonstandard in the sense that there are three market clearing variables we must keep track of, $\{r, w, \hat{m}\}$. This is a challenging task, in particular when computing the transition. To deal with this, I apply a guessing method to Ríos-Rull (1997) to conserve on computation time. See Appendix B for the details of the numerical procedure. When interpreting distributional moments, keep in mind that all computations are based on pretax income, both in the data and in the model.

4.1 Calibration

My approach is to use a parsimonious version of the model to reduce the number of parameters to be calibrated and focus only on the data moments of interest. Before I discuss how the parameters are calibrated within the model, I first add some discipline to parametric forms and explain which parameters are taken as given.

Preferences and Technology The utility function is standard and parametrized as

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

Relative risk aversion is fixed at $\gamma = 2$, which is in the range of values consistent with previous studies. The discount factor β is calibrated to the data as is typical in models with collateral constraints.

Capital-labor income shares and the depreciation rate are taken from conventional values in the real business cycle literature and fixed at $\alpha = 0.30$ and $\delta = 0.06$, respectively.[27] This leaves ν as a parameter to calibrate. The collateral constraint λ along with the friction parameter κ are critical parameters that affect the relative mass of entrepreneurs and, hence, the relative mass of managers in the high income groups.

Exogenous Processes The Markov transition matrix for projects, Ω, gives us two parameters to calibrate:

$$\Omega = \begin{pmatrix} \omega_0 & 1-\omega_0 \\ 1-\omega_1 & \omega_1 \end{pmatrix}.$$

[27]These values are identical to those in Buera et al. (2011). In their model, factor shares are approximately equal to factor elasticities when capital markets are perfect and the equilibrium mass of entrepreneurs is small (Proposition 2). My model is slightly different, but nonetheless, the capital share is close to $\alpha = 0.30$ in the calibration.

Managerial ability m dictates the size of the firm in the model, which corresponds to an establishment in the data. As the empirical distribution of establishments is well approximated by a Pareto distribution (Axtell (2001)), I assume that m is also drawn from a Pareto distribution as in Buera et al. (2011). I assume a "shifted" Pareto distribution with shape parameter s:

$$F(m) = \frac{1-(1+m)^{-s}}{1-(1+\overline{m})^{-s}}$$

so that the lowest ability manager has zero productivity.[28]

My model focuses on the differentiation between entrepreneurs and managers, so particularly relevant are the equilibrium masses of each occupation. Along with the friction parameters (λ, κ), the persistence parameters $(\omega_0, \omega_1, \chi)$ and ability parameters $(s, \overline{m})$ govern the distribution and the relative mass of different occupations. They also determine the sources of income within and relative income between different income groups. I assume that the q and m processes are independent.[29] Since all firms come from projects, I fix $g(1) = \frac{1-\omega_0}{2-\omega_0-\omega_1}$, which is the mass of management (entrepreneurs plus managers) in the model, at 17.7%, the mass of management in the 2000 CPS. χ is fixed at 0.887 according to Murphy and Zabojnik (2007), who report that the average CEO turnover rate from 1990-2000 is 11.3%, and the Pareto shape parameter at $s = 1$ following Axtell (2001).[30]

To create variation in the lower income groups and also facilitate numerical clearing of the labor market in the calibration, I assume idiosyncratic labor efficiency shocks that are independent of the managerial ability shocks. The labor efficiency shocks ϵ_t are assumed to follow the $AR(1)$ process

$$\log \epsilon_{t+1} = (1-\rho)\mu_\epsilon + \rho \log \epsilon_t + \varepsilon_{t+1},$$

where ρ is the persistence in labor efficiency, $\varepsilon_{t+1} \sim \mathbb{N}(0, \sigma_\varepsilon^2)$ and $\mu_\epsilon = -\frac{\sigma_\varepsilon^2}{1-\rho^2}$ so that mean labor efficiency is normalized to 1. I use a discretized version of this process according to Rouwenhorst

[28]The ability of a manager is not to be confused with the ability of a worker. Models with human capital typically assume that workers have lognormal abilities. This is motivated by the assumptions that human capital has a fixed proportional relationship with abilities and that wages are proportional to human capital. Under these assumptions, abilities should follow the wage distribution, which is well approximated by a lognormal distribution. However, managerial abilities in my model represent the productivity of the firm, or establishment, not the worker. Hence managerial abilities should follow the establishment size distribution.

[29]Assuming a correlation of 0.5 did not have any significant effects.

[30]This is not very different from previous quantitative studies such as Cagetti and De Nardi (2006); Buera and Shin (2009); Buera et al. (2011) once we do the appropriate transformations of variables.

(1995), which Kopecky and Suen (2009) show to be more accurate than the more commonly used quadrature-based method of Tauchen and Hussey (1991) for persistent processes.

Tax Variables Capital and business income tax rates (τ_k, τ_b) are taken from the effective marginal tax rates (EMTR) estimated by Gravelle (2007). Her estimates show that there has been some variation in the 1970s but not much since the 1980s. Since the time variation in occupational choices will be affected by the relative taxes imposed on the different sources of income, I keep these constant to isolate the effect of progressivity. I use the non-corporate EMTRs to tax business income and total EMTR to tax capital income, both at their average values from 1970 to 2000. These are approximately 20% and 35%, respectively.

While there are empirical tax functions calibrated to specific points in time, such as Guvenen et al. (2009); Guner et al. (2011), to the best of my knowledge, the only study which provides a time series of such functions is Gouveia and Strauss (1994, 2000). However, they only provide functions up to 1989. I assume the following average tax rate (ATR) function and calibrate the parameters directly from the model:

$$ATR^t(y) = b_0^t + b_1^t (y - y_{min}^t)^{b_2^t},$$

where y_{min}^t is the smallest possible wage income in the model economy $(w^t \epsilon_{min})$ in year t. This specification is similar to Guvenen et al. (2009) and flexible enough to match three tax moments in the data. When $y = y_{min}^t$, the tax rate is b_0^t, the value of which I set to the statutory tax rate faced by the lowest income bracket in 1970 and 2000 - these were 14% and 15%, respectively. (b_1^t, b_2^t) are calibrated within the model to aggregate average tax rates and the top income percentile share of taxes. According to Piketty and Saez (2007), average tax rates were 23.3% and 27.4% in 1970 and 2000, respectively. Since this difference is not large, I calibrate both 1970 and 2000 to match an average tax rate of 27%, to eliminate any effects that come from increasing the tax burden of the aggregate economy, and focus only on differential taxation. This is especially relevant in order to conduct a revenue-equivalent welfare experiment. The top income percentile shares of taxes were 18.4% in 1970 and 27% in 2000, which will capture the gist of the numerical experiment.[31] Figure 6 plots these functions for the years $t = 1970$ and 2000.

[31] Between these two years, the increase in top income percentile share of taxes is rather smooth and monotonic. As explained in the appendix, when computing the transition I take a convex combination of (b_1^t, b_2^t) in $t = 1970$ and 2000 to fill in the years $t = 1971$ to 1999.

Targets To sum up, the current model has a total of 22 parameters as summarized in Table 5. Out of these, 7 are fixed, and the values of these parameters are summarized in Panel A of Table 5. These values are standard or explained in the previous subsection except for the persistence of labor efficiency, ρ, which is fixed at 0.95. This is close to estimates from Storesletten et al. (2004). Out of the 8 tax parameters in Panel B, 4 are fixed and 4 calibrated as explained above.

For the remaining 7, I calibrate the parameters so that the quantitative moments simulated from the model match data moments from 2000, as summarized in Panel C of Table 5. Five parameters are calibrated to match five wealth and earnings distribution statistics. Note that I do not directly target income statistics, so the performance of the model can be measured by how well it fits the income distribution. Two of these—the wage and business income shares of the top income percentile—are the 2000 values from Piketty and Saez (2003). The other three—the top wealth percentile share of aggregate wealth, the top earnings percentile share of aggregate earnings, and the Gini coefficient of earnings—are from the 2001 SCF. The remaining two moments are the mass of entrepreneurs and equilibrium interest rate.

- **Friction parameters (λ, κ)** Given the fixed mass of management of 17.7%, there are relatively more entrepreneurs when the collateral constraint is slack (large λ) and more managers when there are less frictions in the manager market (small κ). Similarly, a large λ leads to higher business income shares and a small κ leads to higher wage income shares. These two parameters are targeted to the mass of entrepreneurs and business income shares.[32] Since the CPS misses the high-end of entrepreneurs, for the mass of entrepreneurs I target the number 7.6% following Cagetti and De Nardi (2006)).

- **Project persistence (ω_1)** Buera (2008) shows how collateral constraints interact with the entrepreneurial savings motive in this class of models. Specifically, he shows the existence of a threshold where low ability entrepreneurs have no savings motive at all. In a similar environment, Moll (2010) shows that higher persistence in entrepreneurial ability leads to less capital misallocation, which implies higher degrees of wealth concentration. Given a value of χ, this implies that a higher persistence in q—i.e. a large ω_1—leads to more wealth concentration. This parameter is calibrated to match the top percentile share of aggregate wealth.

- **Max managerial ability ($\overline{m}$)** A large $\overline{m}$ leads to larger scales of operations for both entrepreneurs and managers. However, for very large $\overline{m}$, it becomes more likely that entrepreneurs will be

[32]The magnitude of the collateral constraint is similar to Cagetti and De Nardi (2006); Buera and Shin (2009).

constrained in equilibrium.[33] Hence the larger is $\overline{m}$, the larger the wage income share for rich households.

- **Worker variables (ν, σ_ε)** The average earnings and income flow of wage workers are determined by ν. For small ν, wages are relatively low compared to managerial compensation, and vice versa for large ν. Hence a small ν would imply a lesser degree of earnings concentration, which was 15.5% in the 2001 SCF. As discussed above, the conditional volatility of labor efficiency shocks, σ_ε, is mainly relevant for wage workers, who fall at the lower end of the earnings distribution. Given a level of concentration, this parameter determines the overall variation of earnings and is calibrated to the 2001 SCF value of 0.61.

I find the above six parameters along with (b_1^{2000}, b_2^{2000}) by a downhill simplex method, which finds local optima, in the neighborhood of a set of parameters found by accelerated random search, which finds global optima. For each iteration, β is chosen to match an annual interest rate of 4%.

Table 5 shows the fit of the model. There is a computational trade-off between matching wealth-related moments and earnings-related moments that complicates the calibration. This comes from the model having two different types of high income-earning occupations. Entrepreneurs earn their income from wealth and managers through earnings, but both distributions are essentially induced from the same underlying ability distribution. Hence, the main challenge of the exercise is to explain changes in the distribution of earnings and income without affecting the distribution of wealth when the ability distribution is the same, which hinges on the values of κ and λ.

Matching the degree of wealth concentration we observe in the data requires a sufficient mass of entrepreneurs in equilibrium. In the calibration, this is associated with a business income share of high income groups that is higher than in the data, which also concurs with the wage income share being lower than in the data. Forcing the model to exhibit a lower share of business income or higher share of wage income at the top would result in a drop in the concentration of wealth. So the calibration chooses a combination of parameters in the midrange to fit both. A tighter fit would require changing the parametric distributions of the underlying processes, which would complicate the analysis without adding much insight.

Regardless, the model delivers realistic degrees of wealth and income concentration for the year 2000, as shown in Table 6. Moreover, the 1970 steady state obtained from changing only the

[33] In fact, I calibrate the model so that all entrepreneurs are constrained.

wage income tax parameters and keeping all other parameters fixed, closely resembles empirical moments in 1970. Figures 1-3 show that the transition occurs fast enough so that steady state comparisons are not far off from explaining observational changes in the moments. As noted in Section 2, the transition does not explain why the shifts in top income sources precedes surges in top income shares. However, the trends of wage and business income shares move in opposite directions, almost mirroring each other, as in the data. The share of capital income slightly falls but without much fluctuations, also as in the data. Most importantly, wealth concentration has no trend even as earnings and income concentration rises.

4.2 Results

I first present the benchmark results that show that the tax policy change causes an increase in the concentration of income without increasing the concentration of wealth. Subsequent experiments highlight important model elements. In each case, I tabulate the distributional moments in the 1970 and 2000 steady states. Table 4 shows the top percentile/decile compositions of income, and Table 6 summarizes the top percentile/decile shares and the Gini coefficients of the wealth/earnings/income distributions. To clarify the driving force behind the distributional moments, I separately tabulate the compensation earned by the top managers in Table 7.

For the welfare analysis, I present the welfare gain (loss) of reverting to the 1970 tax code both with and without transition costs. The welfare trade-offs are explained in terms of contrasting the two frictions λ and κ. While the model lacks real world dimensions that would make it more suitable for an actual policy recommendation, the results indicate that progressive taxation has a negligible effect on welfare, contrary to common beliefs.

Steady State Comparisons When we go from 1970 to 2000, i.e., change the tax parameters (b_0^t, b_1^t, b_2^t) from $t = 1970$ to 2000, the concentrations of earnings and income are higher while the concentration of wealth is not - in fact, as shown in Table 6, it is lower. One caveat is that the increase in the concentration of earnings is much higher than that of income - the earnings share of the top earnings percentile increases from 10.9% to 15.5%, while income only increases from 19.3% to 20.4%. This is expected, since the changes in the distributional moments come from rich entrepreneurs being replaced by rich managers at the high end. Recall that managers earn most of their income through wage income while entrepreneurs earn more through business income. Since the entrepreneurs who are relegated to lower income fractiles in 2000 still have higher capital and business incomes than the top managers who earn most of their income through wages (managerial compensation), the occupational shifts are more strongly reflected in the changes in business and earnings statistics than total income.

This mechanism is confirmed in the change in the sources of income for high income groups, as shown in Table 4. These moments are more closely related to the occupations, and are much more sensitive to the tax change than the distributional moments. The fall in the business income share of the top income percentile reflects the relative decrease in the mass of rich entrepreneurs, although it is much larger than in the data (17.1 vs 5.3 percentage points). On the flip-side, the wage income share of the top income percentile reflects the relative increase in the mass of rich managers, which is also larger than in the data (20.5 vs 16.1 percentage points). Similar trends are confirmed in the top income deciles, while the effects are less than the top income percentile, which is in line with the data and expected from the model.

The exaggerated changes in the shares coupled with the smaller change in the concentration of total income explain why the concentration of wealth does not increase, to the extent that the top percentile share of wealth decreases by 4.1 percentage points. If the changes in the shares of income sources were smaller, that would indicate that more entrepreneurs remain rich enough to stay at the top of the wealth distribution. If the increase in the concentration of income were larger, it would indicate that rich managers earn so much more that their absolute amount of savings are larger than rich entrepreneurs even if they have a lower savings propensity. Hence the drop comes from the fact that the managers that are replacing the entrepreneurs at the top are not rich "enough" compared to the data. However, the fact that the concentration of wealth moves in the opposite direction of earnings and income demonstrates the strength of my occupational choice model to explain the distributional changes. Furthermore, such changes occur mainly at the very top of the distributions.

In Table 7, I show the maximum managerial compensation to average wage ratio ($W(\overline{m})/w$). Compared to the more than 1000% increase in the data, the model only exhibits an underwhelming 215% increase. However, there is only a small 0.3 percentage point drop in the mass of entrepreneurs, while there is also an increase in management of 0.3 percentage points, meaning that some projects get discarded in the 1970 steady state. Given that in the data, there was a large increase in the mass of management (that I did not model) even as the mass of entrepreneurs barely changed, the two-fold increase from 1970 to 2000 is very large, illustrating the strong competitive assignment effects.

The effect is even greater when one recalls that the computations are based on pretax income and not after-tax income. In a partial equilibrium model with taxes, it is obvious that a decrease in taxes will lead to higher after-tax compensation. However, holding managerial ability fixed, lower taxes would result in *lower* levels of pretax compensation. This is depicted in Figure 10 as movements *along* the demand and supply curves. But in this economy, the general equilibrium effects are such that both the demand and supply curves shift upward, so that even pretax compensation rises to higher levels with lower taxes. Therefore, even a small rise in $W(\overline{m})/w$ shadows a much larger increase in the average ability or managers in equilibrium, as illustrated in Figure 10.

To highlight the effect of tax progressivity, I conduct an experiment where I fix the wage income tax at a flat rate equal to the average rate in the 2000 steady state, which is approximately 27% in the benchmark calibration. The effect of removing progressivity can be seen in Tables 4-6. Contrast this with the 2000 benchmark. In Table 4, the wage income share of the top income groups slightly increases while business income shares barely change. In Table 6, the concentration of earnings barely changes while that of income slightly increases. At the same time, the concentration of wealth is 1 percentage point larger than in 2000, showing that in the benchmark calibration, this number is insensitive to tax progressivity rather than having a monotonic relationship. As rich managers become richer, they are able to save more, so that the concentration of wealth increases despite their lower savings propensity. However, the concentration of earnings is mediated due to the rise in wages in general equilibrium. This can also be seen in the last row of Table 7, where the managerial compensation to average wage ratio is virtually unchanged.

Models with only Entrepreneurs or Managers Up to now, I have treated κ as an exogenous parameter. In the model, it is a friction on project transfers (exchange of ideas), which is hard to measure empirically. It should be noted that κ is a different kind of financial friction from the entrepreneur's collateral constraint λ, which is a friction on the amount of debt. For example, imagine a hypothetical agent in the economy that owns a project but also has a high enough managerial ability. If she implements the project on her own, she faces collateral constraints on the amount of debt she can secure for her firm's operations. If she instead sells the project and becomes a manager, we can assume she became the manager of the project she sold (since all projects are identical), so that it may be viewed as raising equity by going public. In this sense, the action of selling a project may be viewed as the decision to go public, although the model in its stylized form oversimplifies the process to be considered a realistic representation of the stock market.

Smaller values of κ imply more projects sold in equilibrium and more managers. In other words, the effects are expected to be similar to replacing the progressive wage income tax with a flat tax. To this end, I set κ to half of its benchmark value.[34] The effects are somewhat mixed and the response much more sensitive compared to the flat tax case, as seen in Tables 4 and 6. The wage income share of top income groups and earnings concentration shoot up, and top managerial compensation becomes unambiguously high as seen in Table 7. However, there is a large drop in wealth concentration that coincides with a small drop in income concentration. This is due to the entrepreneurial occupation choice becoming so much less attractive.

In addition, general equilibrium effects are much stronger as it directly effects the aggregate production technology, i.e. production becomes too efficient. Factor demand increases, and the excessive demand for capital drives the interest rate up to an unrealistic 7.3%. On the other hand, since population is fixed, the increased demand for labor drives up wages which increases labor supply, so that the mass of entrepreneurs is too small. This further contributes to the drop in business income shares at the top, and confirmed in Table 4. Wealth concentration becomes lower, because top income groups now have similar savings propensities compared to the poor. Accordingly, the overall skewness of the income becomes too low compared to the data as shown in Table 6, closely reflecting the earnings distribution.

When $\lambda = 0$, the model reverts to one with only managers - or individuals with extremely high earnings shocks that occur with very small probabilities, à la Castañeda et al. (2003). Compared to the benchmark, this experiment decreases the income of entrepreneurs and increases the income of managers, and the distributional changes are similar to the small κ experiment, as shown in Tables 4, 6, and 7. The income distribution closely reflects the earnings distribution, while the loss of the rich entrepreneurs drops the concentration of income, as well as that of wealth. In fact, all distributions become much more similar to one another.

The opposite is true when $\kappa = 1$, which is equivalent to a model with only entrepreneurs, à la Buera and Shin (2009). Compared to the 2000 benchmark economy, now income is much more concentrated than earnings, and closely tracked by wealth. Conceptually, what this experiment is doing is increasing the income of entrepreneurs and eliminating any chance of non-entrepreneurs becoming rich, which causes the surge in the concentration of income. The earnings distribution reflects only wage workers, who are now extremely poor compared to the entrepreneurs, and as

[34] At benchmark model parameters, setting $\kappa = 0$ behaves similarly to the $\lambda = 0$ economy below.

expected, the surge in income concentration is associated with an increase in wealth concentration.

These experiments not only highlight the opposing effects of these two parameters, but quantitatively shows that previous models with only entrepreneurs, or very high earnings shocks that are realized with small probabilities, will move the income and wealth concentrations in the same direction, and hence will not be able to maintain a steady level of wealth concentration concurrently with an increase in income concentration.[35]

There are two key points to take away from the benchmark results and experiments. The first is that tax changes fed into the model can qualitatively explain the increase in the concentrations of earnings and income from 1970 to 2000, without increasing that of wealth. The second is that while the magnitude of the change is not quantitatively exact, this is under the assumption that none of the underlying model parameters change, including the capital and business income tax rates. In particular, the mass of management as measured by $\frac{1-\omega_0}{2-\omega_0-\omega_1}$ in the model, has increased from 13% to 18% in the data (Section 2). Even when keeping this parameter fixed, the model generates the qualitatively correct response of the mass of management increasing by forcing some of the projects to be discarded. The friction parameters (λ, κ) are also expected to have changed from 1970 to 2000, to the extent that they represent financial innovations, and the experiments show that model moments are sensitive to these values. I refrain from changing such parameters in order to focus on the sole effect of the tax change.

Welfare Analysis and Consumption Inequality I have shown that the decline in progressive taxation from 1970 to 2000 can explain the observed changes regarding inequality. A classic question regarding taxation is the equality-efficiency trade-off. To address this question, I conduct a simple welfare computation. By construction, tax revenues are equivalent in the benchmark 1970 and 2000 steady states. Table 8 shows the percentage increase (decrease) of consumption at all individual states—consumption equivalent value (CEV)—in 2000 required to obtain the utility levels in 1970, along with the percentage change in aggregate variables. AC, AY, KS, KD denote the percentage change in aggregate consumption, output, capital supply and demand, respectively. In particular, KD denotes capital demand used only for production. It is worthwhile noting that aggregate capital supply and demand do not increase by the same amount. The 0.7 percentage point discrepancy shows that the expenditure on projects (mass times price of sold projects) is

[35] Alternatively, I could keep $\lambda = 0$ or $\kappa = 1$ and conduct a tax experiment. This has the same anticipated effects in the $\lambda = 0$ case, but in the $\kappa = 1$ case, not much happens since none of the top income groups earn wage incomes.

relatively larger in 1970. Since the mass of sold projects decreases, this means that the price of a project is higher in 1970.

The first row in Table 8 shows that across steady states, an unborn agent is 2.7% worse off under 1970 taxes in consumption equivalent terms. There are many mechanisms underlying this number, which is exemplified by comparing the changes in aggregate variables. Despite the higher savings propensity of the rich in 1970, which has more entrepreneurs, the stock of aggregate capital is 7.3% smaller. However, aggregate output is only 0.2% less under 1970 taxes. Since both entrepreneurial and managerial outputs are subject to frictions, this means that at the aggregate level, the friction κ has a larger bite than λ, so that less capital is required for the same amount of aggregate production in 1970. Despite this, aggregate consumption still decreases by 6.1%. In the 1970 steady state with more entrepreneurs, individuals have more incentive to save in anticipation of becoming an entrepreneur (transitioning from $q = 0$ to 1), and entrepreneurs have more incentive to save in anticipation of losing a project (transition from $q = 1$ to 0). Hence they save more of their output which, given the drop in aggregate capital, leads to a larger drop in consumption despite output being almost the same.

However, this still translates into a welfare loss of only 2.7% in the 1970 steady state. The unborn agent's equilibrium income path is smoother (decrease in income inequality) in the 1970 steady state, and given that high income groups save more under 1970 taxes, his consumption plan is even smoother. Since risk averse agents prefer a flat consumption plan, the drop in average consumption is countervailed by the drop in consumption variation.

To incorporate transition costs, I assume that the economy begins from the 2000 steady state. In 2001, agents suddenly wake up to new tax parameters, which are identical to those from the 1970 steady state and that they now know will stay constant forever. The second row of 8 tabulates these results. Now, CEV denotes the percentage increase in consumption required in the 2000 steady state to achieve the expected utility level in 2001, when the transition begins, i.e. $CEV \equiv x$ such that

$$\int_{ss} \mathbb{E}_{2000} \sum_{t=2000}^{\infty} \beta^{t-2000} u(c_t^{ss} \cdot (1+x)) \mu(dq, dm, da) = \int_{ss} \mathbb{E}_{2001} \sum_{t=2001}^{\infty} \beta^{t-2001} u(c_t^{tr}) \mu(dq, dm, da).$$

In other words, the LHS is the expected utility from increasing 2000 steady state equilibrium consumption by x percent, and the RHS is the expected utility induced from equilibrium consumption along the transition path, both integrated over the 2000 stationary distribution. To decompose the transition costs, I also tabulate the increase (decrease) in AY and AC by comparing their 2000 steady state values with their present discounted average values along the transition path in 2001. Specifically, I compute

$$AY^{tr} = \frac{1+r}{r} \cdot \sum_{t=2001}^{\infty} \frac{Y_t}{(1+r)^{t-2001}}$$

$$AC^{tr} = \frac{1+r}{r} \cdot \sum_{t=2001}^{\infty} \frac{C_t}{(1+r)^{t-2001}}$$

where Y_t and C_t are equilibrium aggregate output and consumption, respectively, along the transition path, and compare these values against the 2000 steady state values of AY and AC. Such computations are not applicable to capital, since capital is a stock.

Since capital is less in the new steady state, the additional capital available along the transition path is actually a gain rather than a cost. This is seen in columns AY and AC. More capital is available for both production and consumption along the transition path than in the new steady state. The increased output further boosts consumption. Given the increased efficiency in production, there is a 2.7% increase in output compared to the old steady state, while now consumption drops by only 3.9%. Combined, the unborn risk averse agent prefers the status quo by less than a percent.

These results demonstrate the relationship with my model to the recent literature on "capital misallocation." In an economy with only entrepreneurs, the economy is more production-efficient when wealth is more concentrated (e.g. Banerjee and Moll (2010)). In my environment with managers, once we also assume that the manager-project assignment process is also subject to frictions, production is still more efficient when there are more entrepreneurs, although it is associated with a drop in aggregate capital. The model is also related to consumption inequality. From the budget constraint, consumption is simply the remainder of income after taking account of savings and taxes. Hence, when income inequality decreases and wealth inequality stays stable, consumption inequality necessarily decreases, which countervails the utility drop coming from the decrease in average consumption of the risk averse agent. Moreover, the transition costs are in fact positive, because the decumulation of aggregate capital increases output and consumption along the transition path.

5. Conclusion

Standard models cannot simultaneously explain the evolutions of the U.S. income, earnings and wealth distributions. I instead construct a model of occupational choice where individuals choose to become entrepreneurs, managers or workers. The model can qualitatively replicate the increase in income concentration since the 1980s, which was driven by an increase in earnings concentration and not accompanied by an increase in wealth concentration. Quantitatively, approximately 30% of this change can be explained by a change in the tax code. Specifically, this is due to high-income households choosing managerial rather than entrepreneurial occupations when tax conditions are more preferable for higher levels of managerial compensation. I also contrast the welfare implications of switching back to tax conditions in the 1970s, i.e. to an economy with relatively more entrepreneurs as opposed to managers and find that welfare drops only by less than 1% in consumption equivalent terms, including transition costs.

The model can be extended to international comparisons. Most continental European countries have more progressive taxes than the U.S. Just as I compare the U.S. in recent years to earlier years, I could compare the U.S. with other countries with different tax policies. In addition, I could explain why we only observe superstar CEOs in the U.S. and not in continental Europe.[36]

Finally, since the model is novel, it can also be used to revisit previous studies of financial development and capital misallocation that have been analyzed using entrepreneurial models with collateral constraints. In addition to the collateral constraint faced by entrepreneurs, the model introduces a new type of friction that arises during project transfers. When taking into account that not all production will always rely on entrepreneurs, especially in more developed countries, financial development can have different impacts on productivity growth and the persistence of capital misallocation depending on the relative importance of these two frictions.

[36] Saez and Veall (2005) find that while inequality trends in Canada are similar to the U.S., major tax policy changes were absent. They suggest a "brain-drain" story in which the Canadian economy responded to U.S. policy to prevent the outflow of talent, even though there were no domestic policy shifts. Their story is corroborated by the fact that the francophone Quebec did not display the inequality trends observed in U.S. and Canada.

Appendices

A. Proofs

Proof of Proposition 1 *Part (1)*. Suppose not, that there are no managers in equilibrium. With no managers, the economy is one where all production is carried out by self-employed entrepreneurs, and no project can sell at a positive price. But since $\mu(\cdot, da) > 0$ for any (q, m) pair, there is a positive mass of individuals with $q = 1$ but sufficiently small a that they do not implement the project. Then for any $e_1 \geq 0$, intermediaries can purchase one of these projects at $e_2 > 0$, offer a compensation of $(1-\kappa)\pi^*(\overline{m}) - (1+r)e_2 - e_1$ to a wage worker with managerial ability $\overline{m}$ s.t.

$$(1-\kappa)\pi^*(m) - (1+r)e_2 \geq w$$

and still generate non-negative profit e_1. Such a manager exists since F is ergodic with support $[0, \overline{m}]$. Hence there must be at least one manager, a contradiction.

Part (2) then follows from the text.

Proof of Proposition 2 The proof assuming stationarity is standard. Assume $\beta(1+r) < 1$. The value function exists and attains the supremum of the sequence problem by Theorem 9.12 in Stokey and Lucas (1989). Note that once we assume incomes are stationary (or equivalently, that prices (r, w) are constant), the equilibrium determination of ϕ does not matter and the individual's problem is identical to one where she receives a stochastic endowment depending on her individual state x. The only difference from a standard savings model is that the endowment is dependent on her current asset level when she is a collateral-constrained entrepreneur. The endowment of a constrained entrepreneur is uniformly bounded above by that of a non-constrained one which is assumed to be bounded above by $W(\overline{m})$. Since endowments are bounded above, once we assume CRRA preferences Proposition 4 in Aiyagari (1993) applies so that assets are also bounded above. Furthermore since (q, m) are exogenously ergodic, Assumption 1 is satisfied. Existence and uniqueness of a stationary RCE is a straightforward application of Proposition 5 in Aiyagari (1993), from which we can also verify that $\beta(1+r) < 1$, a standard implication of incomplete markets models.

B. Numerical Procedure

I first discretize the state space for asset holdings a using 96 grid points. Since m is assumed to follow a continuous distribution, I use a Gauss-Legendre quadrature with 10 grid points when computing the expectation over the value function. For the simulation, we need to include two additional points, $m = 0$ and $m = \overline{m}$, for interpolating the policy function. Finally, the AR(1) labor efficiency process $\{\epsilon_t\}$ is discretized into 5 points according to Rouwenhorst (1995)'s binomial method as described in Kopecky and Suen (2009). Under the stationarity assumption, all aggregate variables and hence prices are constant. For the calibration, I fix $r = 4\%$ and use the following algorithm to compute an equilibrium:

1. Guess β and w.
2. Check for existence of a managerial equilibrium, and guess $\hat{m}$.
3. For each (β, w) pair and guess for $\hat{m}$, generate occupational choices and implied incomes, and iterate on the value function to get policies and the stationary distribution μ.
4. Repeat from 2 until manager market clears.
5. Repeat from 1 until capital and labor markets clear.

To compute the stationary distribution, I fix an exogenous process for (q, m, ϵ) and simulate the optimal policies of 120,000 individuals for 200 periods. The distribution in the 200th period is taken to be the stationary distribution from which I compute distributional statistics.[37] Both during value function iteration and simulation, points off the grid are computed by (tri-)linear interpolation. For the experiments, I fix β at its calibrated value and iterate on r instead.

The 6 model parameters and 2 tax parameters (b_1^{2000}, b_2^{2000}) that minimize the distance between model statistics and empirical targets from 2000 are found by applying an 9-dimensional downhill simplex method. Once the 2000 steady state is found, I fix the 7 model parameters (which now includes β) and recalibrate (b_1^{1970}, b_2^{1970}) to the average tax rate and top percentile share of total taxes in 1970, iterating on r instead of β. Global uniqueness of such parameters are not guaranteed, so I repeat the exercise starting from multiple initial values found from accelerated random search.

[37] Increasing the number of individuals and periods did not change statistics at the equilibrium.

C. The Transition Path

In addition to the transition used for the welfare experiment that starts from the 2000 steady state, I also compute the transition path starting from the 1970 steady state. In 1971, agents suddenly wake up to new tax parameters, which they now know will change for 30 years until it reaches 2000 values. For all years between 1970 and 2000, I assume that (b_1^t, b_2^t) are a convex combination of their 1970 and 2000 values. The tax rate faced by the lowest income bracket b_0^t is taken directly from the data for all years. Figures 1-2 shows the simulated wealth, earnings and income concentration series along this numerically computed transition path, and Figure 3 the composition of income for the top percentile and decile.

While the starting values for the levels of income concentration and wage income share for the high income groups are too high and low, respectively, the figures show that they reach similar levels in 2000 along the transition path, as those to the steady state 2000. This confirms that the economy responds strongly enough to the tax code so that the 2000 steady state gives us a realistic description of the economy in 2000. One shortcoming of the model is that the rise in top income group wage shares coincides with the increase in earnings and income concentration, while in the data the former precedes the latter. I conjecture that changes in social norms or adjustment costs for occupational switches may account for this, but do not explore these directions as the current paper deals more with long run predictions.

Computing the Transition Path Ríos-Rull (1997) describes how to compute transitions between steady states. However, his method relies on a single representative firm, and cannot be applied as is to my model. I extend his method to my model as follows:

1. Compute the initial and terminal stationary distributions (F_0 and F_∞, respectively) as above.
2. At time 1, agents suddenly gain perfect foresight of all tax variables into the indefinite future. Pick T large, assuming that $F_T \simeq F_\infty$. This implies that $V_T \simeq V_\infty$.
3. Guess a path for prices $\{r_t, w_t, \hat{m}_t\}_{t=1}^T$. Starting from V_T, solve out for $\{V_t\}_{t=1}^{T-1}$ using backward induction.
4. Starting from F_0, simulate the economy for T periods. Check market clearing for each period, and update the whole sequence of guesses as required.
5. Repeat from 3 until markets clear in all periods.
6. Check whether $F_T \simeq F_\infty$. If not, repeat from 2 with larger T.

In the simulation I set $T = 200$. Increasing to $T = 500$ does not change the results. For each evaluation, I use a bisection method for each period, *independently of other periods*, to update the guesses on prices. While this method is not guaranteed to work in general, I check the method with different initial guesses on the path of prices. The equilibrium survives all robustness checks.

D. Tables

Year	Gini	Percentage share of wealth held by:						
		Top 1%	Top 5%	Top 10%	Top 20%	Next 20%	Next 20%	Last 40%
1963	0.77	32.2	52.3	64.1	78.1	14.5	6.3	1.2
1983	0.78	33.5	55.4	66.9	79.4	12.8	5.9	1.9
1986	0.78	35.2	55.3	66.0	78.6	12.9	6.0	2.6
1989	0.79	29.9	54.0	66.9	80.6	13.1	5.2	1.1
1992	0.77	30.0	54.4	67.0	80.1	13.2	5.4	1.3
1995	0.79	34.8	56.0	67.9	80.6	12.5	5.5	1.4
1998	0.80	33.8	57.1	68.5	81.4	12.4	5.1	1.1
2001	0.81	32.2	57.3	69.6	82.5	11.9	4.5	1.1
2004	0.81	33.2	57.4	69.4	82.9	11.8	4.4	1.0
2007	0.82	33.6	60.3	71.4	83.4	11.3	4.5	0.9

Table 1: Size distribution of wealth in the United States

The data series are from the SCF. Fractile shares are ranked according to the variable NET WORTH. Calculations by author.

Year	Gini	Percentage share of earnings earned by:						
		Top 1%	Top 5%	Top 10%	Top 20%	Next 20%	Next 20%	Last 40%
1962	0.52	6.2	18.7	30.9	50.0	27.8	17.2	5.0
1982	0.57	9.6	23.5	35.9	55.1	26.4	14.8	3.7
1985	0.58	10.9	26.0	37.8	56.1	25.5	14.9	3.6
1988	0.60	10.6	26.9	39.9	58.8	25.0	13.4	2.7
1991	0.61	10.5	26.8	39.8	59.1	25.0	13.2	2.8
1994	0.61	12.0	28.0	40.5	59.1	24.6	13.3	2.9
1997	0.59	11.3	26.6	39.1	57.7	24.7	13.8	3.8
2000	0.61	15.5	30.7	42.7	60.4	22.8	12.7	4.1
2003	0.61	13.6	29.2	42.0	60.5	23.3	12.7	3.5
2006	0.63	15.9	32.0	44.4	62.5	22.6	12.0	2.9

Table 2: Size distribution of earnings in the United States

The data series are from the SCF. Fractile shares are ranked according to annual wage income and salaries. Calculations by author. The years are intentionally labeled as one year before the release of the actual SCF dataset, as those datasets contain the flow values from the previous year.

Year	Gini	Percentage share of income earned by:						
		Top 1%	Top 5%	Top 10%	Top 20%	Next 20%	Next 20%	Last 40%
1962	0.43	8.3	19.6	29.9	46.0	24.0	16.6	13.4
1982	0.48	13.6	27.0	37.1	52.2	21.3	14.2	12.3
1985	0.49	13.6	26.8	36.9	52.0	21.8	14.4	11.7
1988	0.54	16.9	31.5	42.3	57.2	20.0	12.7	10.1
1991	0.50	11.7	26.3	37.5	53.6	21.7	13.6	11.2
1994	0.52	14.3	28.7	39.3	54.9	20.8	13.5	10.9
1997	0.53	16.6	31.0	41.2	56.2	20.5	12.8	10.6
2000	0.56	20.0	35.3	45.4	59.6	18.9	11.7	9.9
2003	0.54	16.8	31.8	42.6	57.7	19.6	12.3	10.5
2006	0.57	21.3	37.0	47.1	60.9	18.2	11.2	9.7

Table 3: Size distribution of income in the United States

The data series are from the SCF. Fractile shares are ranked according to total income. Calculations by author. The years are intentionally labeled as one year before the release of the actual SCF dataset, as those datasets contain the flow values from the previous year.

	Top 1%:			Top 10% :		
	Cap	Lab	Ent	Cap	Lab	Ent
Data (1970)	24.3	45.6	30.0	14.7	52.8	20.2
Model (1970)	13.7	25.8	60.5	13.9	53.7	32.4
Data (2000)	11.8	61.7	26.5	8.9	72.3	18.8
Model (2000)	10.3	46.3	43.4	12.6	61.8	25.5
Flat labor tax	10.1	46.5	43.4	12.2	62.5	25.4
$\kappa/2$	9.3	83.0	7.7	14.6	80.6	4.8

Table 4: High-end statistics - Sources of total income (%)

"Cap," "Lab," and "Ent" refer to capital, labor, and entrepreneurial income, respectively. Refer to text for the specific definitions of these variables in the data and the model.

Parameter	Value	Source / Target		
	A. Fixed Parameters (7)			
γ	2.00			
δ	0.06	Buera et al. (2011)		
α	0.30	″		
ρ	0.95	Storesletten et al. (2004)		
$\frac{1-\omega_0}{2-\omega_0-\omega_1}$	.177	mass of management, IPUMS CPS March 2000		
χ	0.887	CEO turnover rate 1990-2000, Murphy and Zabojnik (2007)		
s	1	size distribution of firms, Axtell (2001)		
8	B. Tax Parameters (8)		1970	2000
τ_k	0.35	tax rate on capital income, Gravelle (2007)	-	-
τ_b	0.20	tax rate on capital income, Gravelle (2007)	-	-
b_0	(0.14,0.15)	statutory tax rate of lowest income bracket (%)	14.0	15.0
b_1	(0.05,0.07)	average aggregate tax rate (%)	27.0	27.0
b_2	(0.99,0.50)	top income percentile share of taxes (%)	18.4	27.7
	C. Calibrated Parameters (7) to 2000 US		Data	Model
λ	5.01	mass of entrepreneurs (%)	7.6	6.4
κ	0.80	business income share of top income percentile (%)	23.7	43.4
ω_1	0.93	top wealth percentile share of aggregate wealth (%)	32.2	27.0
$\overline{m}$	464.00	wage income share of top income percentile (%)	61.7	46.3
ν	.39	top earnings percentile share of aggregate earnings (%)	15.5	15.5
σ_ε	0.33	Gini coefficient of wage income	0.61	0.58
β	0.97	annual interest rate (%)	4.0	4.0

Table 5: Benchmark Model Parameters

Mass of management is obtained from the IPUMS CPS March 2000, and entrepreneurs the average of Quadrini (2000); Cagetti and De Nardi (2006). Top percentile shares and Gini of earnings and wealth are from the 2001 SCF and income shares from Piketty and Saez (2003).

Regime	Gini	Percentage share of wealth or income held by: Top 1%	Top 5%	Top 10%	Top 20%	Next 20%	Next 20%	Last 40%
Wealth								
Data (1963)	0.77	32.2	52.3	64.1	78.1	14.5	6.3	1.2
Model (1970)	0.76	31.1	52.3	63.5	77.5	13.9	6.3	2.3
Data (2001)	0.81	32.2	57.3	69.6	82.50	11.9	4.5	1.1
Model (2000)	0.76	27.0	50.7	63.3	78.3	13.8	5.9	2.0
Flat labor tax	0.78	28.0	52.9	65.4	80.1	12.9	5.4	1.7
$\kappa/2$	0.69	14.5	35.9	51.4	70.8	18.3	7.9	2.9
$\lambda = 0$	0.72	17.5	40.7	56.1	74.6	16.5	6.7	2.2
$\kappa = 1$	0.83	36.1	63.0	74.4	85.7	9.4	3.7	1.2
Earnings								
Data (1970)	0.52	6.2	18.7	30.9	50.0	27.8	17.2	5.0
Model (1970)	0.55	10.9	27.1	44.1	57.8	23.5	8.9	9.8
Data (2000)	0.61	15.5	30.7	42.7	60.4	22.8	12.7	4.1
Model (2000)	0.58	15.5	31.2	47.2	60.0	22.1	8.5	9.3
Flat labor tax	0.58	15.5	31.1	47.1	59.9	22.2	8.5	9.4
$\kappa/2$	0.60	18.3	34.5	49.8	62.6	20.9	7.8	8.8
$\lambda = 0$	0.60	18.7	35.0	50.1	62.9	20.6	7.8	8.7
$\kappa = 1$	0.51	4.9	24.3	36.7	53.5	24.0	11.7	10.7
Income								
Data (1970)	0.43	8.3	19.6	29.9	46.0	24.0	16.6	13.4
Model (1970)	0.61	19.3	36.6	49.9	64.8	18.5	8.8	7.9
Data (2000)	0.56	20.0	35.3	45.4	59.6	18.9	11.7	9.9
Model (2000)	0.62	20.4	37.4	50.7	65.0	18.4	8.6	7.9
Flat labor tax	0.62	20.7	37.5	50.9	65.1	18.4	8.5	8.0
$\kappa/2$	0.59	16.9	33.2	47.1	62.3	19.3	9.9	8.5
$\lambda = 0$	0.59	17.1	33.3	47.5	62.6	19.5	9.5	8.5
$\kappa = 1$	0.72	35.9	52.9	64.1	74.4	14.5	5.4	5.7

Table 6: Size distribution of wealth, earnings and income in model economy

I also report Gini coefficients in the first column. Note that NET WORTH (wealth) in the 2001 SCF data is measured at the end of 2000, and hence is compared with the model in 2000. The Gini coefficient for earnings is from the 1962-63 SFCC/SCFF.

$W(\overline{m})/w$	Data	Model	Flat tax	$\kappa/2$	$\lambda = 0$
1970	29.7	25.0	-	-	-
2000	342.2	53.7	53.3	70.2	72.7

Table 7: Model Mechanism

Data moments are top 100 rank CEO pay from the Forbes survey over average annual wage from NIPA.

	CEV	KS	KD	AY	AC
no transition costs	-2.7%	-7.3%	-8.1%	-0.2%	-6.1%
with transition costs	-0.9%	″	″	2.7%	-3.9%

Table 8: Aggregate impact of change in tax code

The first row is simply a steady state welfare comparison between 2000 and 1970 (with 2000 as the reference point). The second row takes into account transaction costs. The new steady state is assumed to be reached in 200 years.

E. Figures

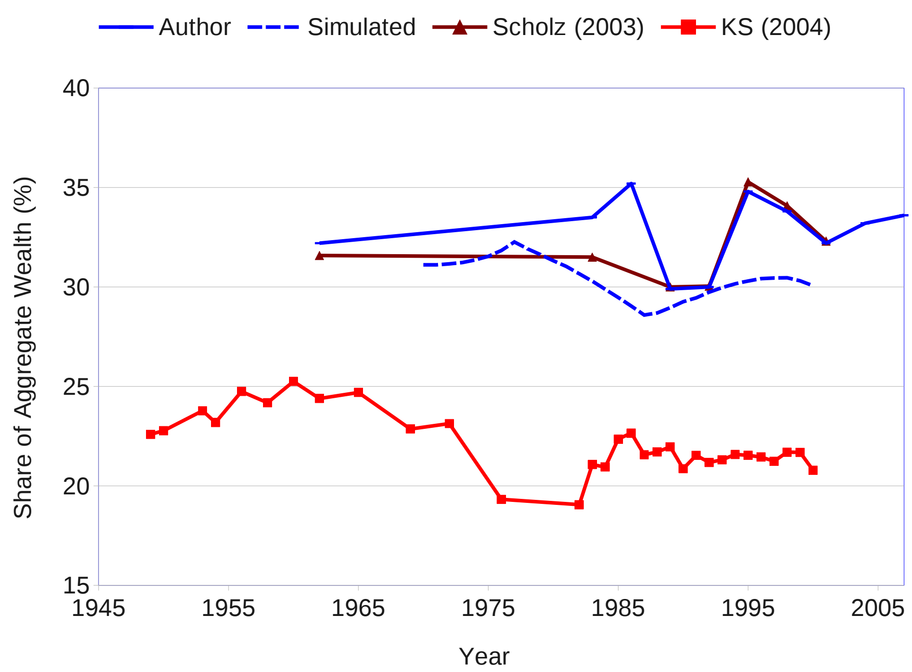
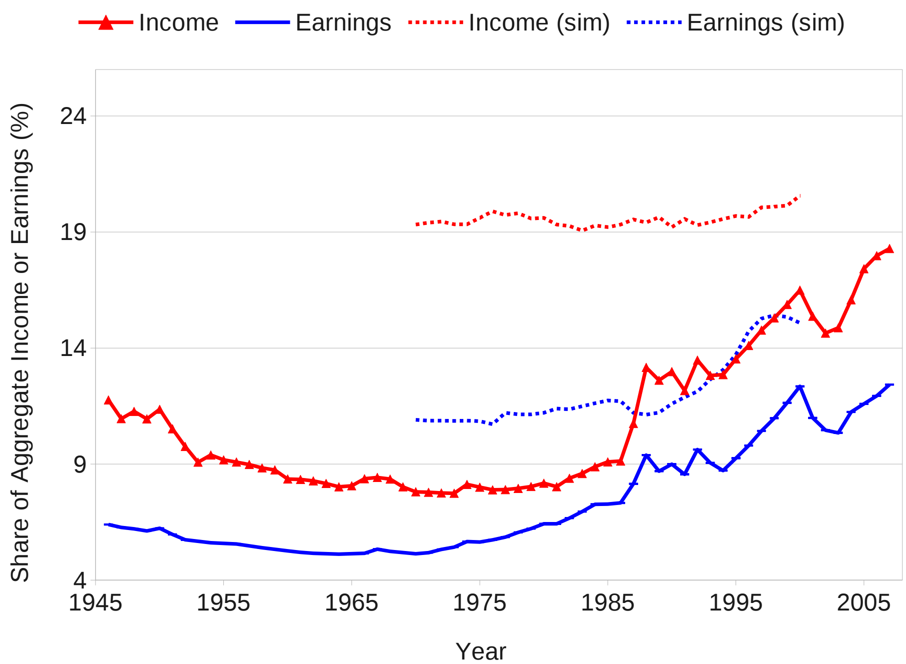
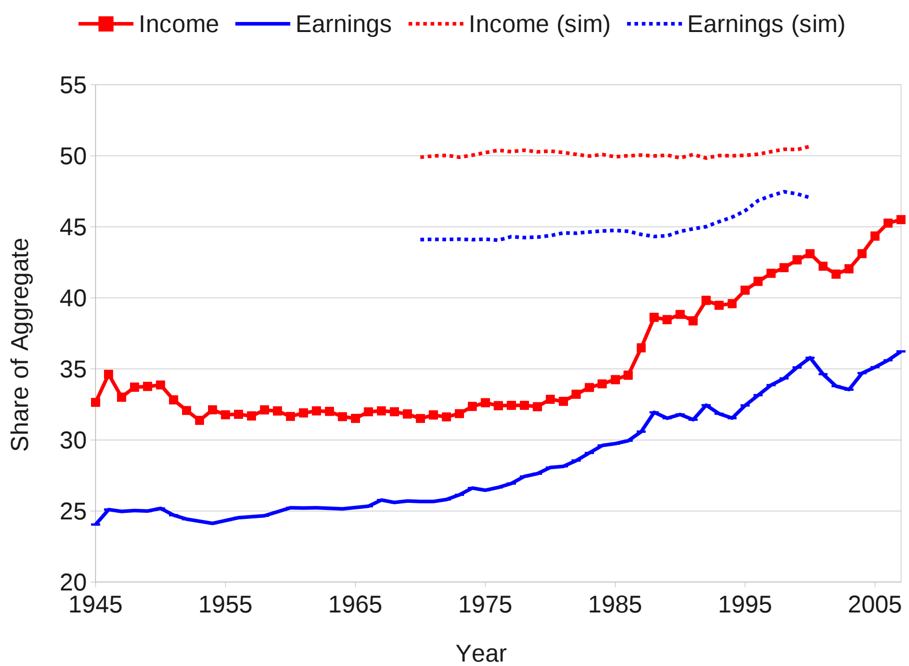


Figure 1: Top percentile wealth shares, different authors.

Scholz (2003) uses SCF 1963, 1983, 1989, 1992, 1995, 1998, and 2001. Author's computations include 1986, 2004 and 2007. Kopczuk and Saez (2004) uses estate tax returns as reported to the IRS. Dashed lines are the simulated series.



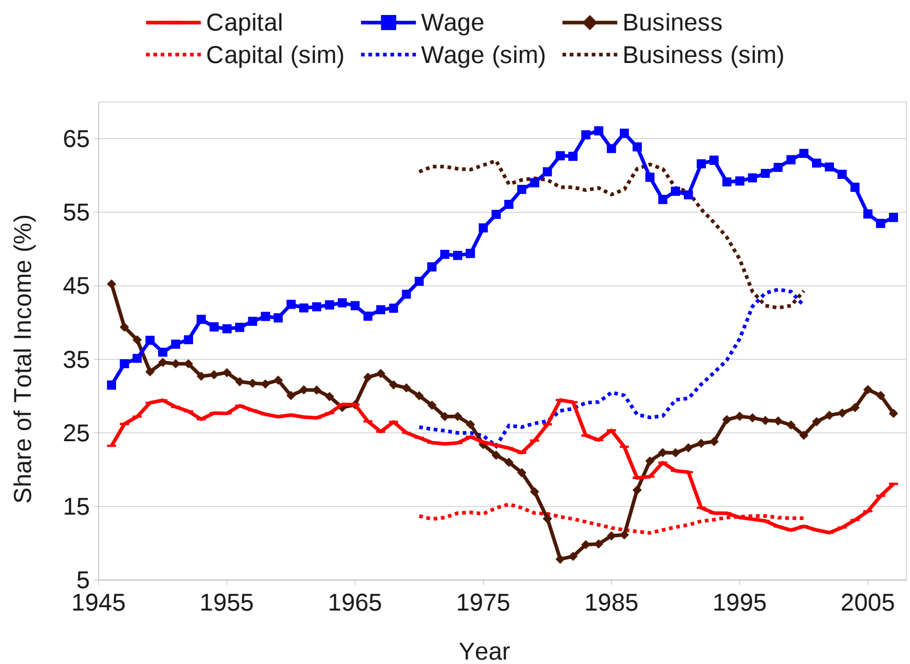
(a) Top percentile shares



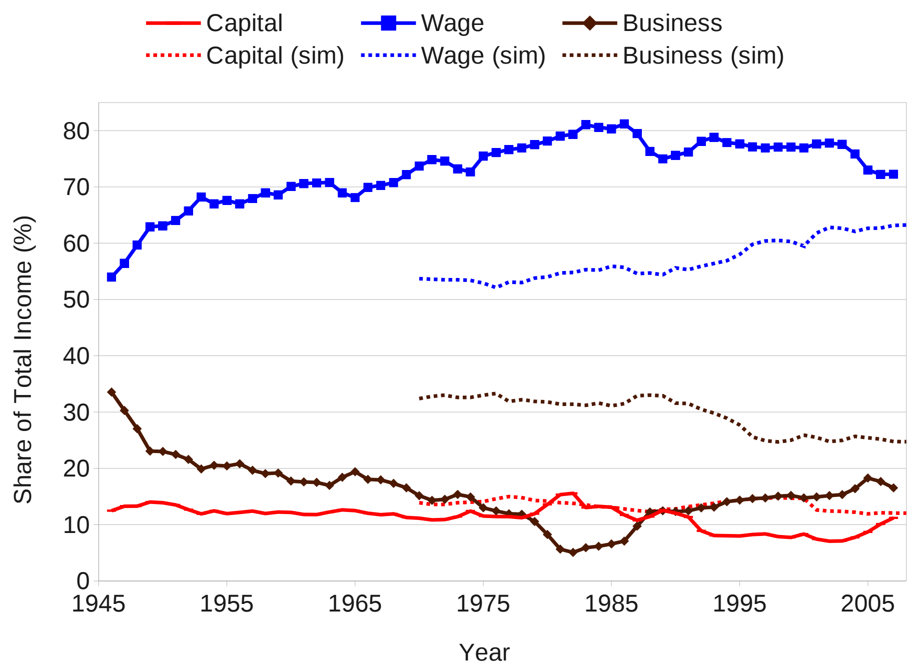
(b) Top decile shares

Figure 2: Concentration of total and wage incomes.

Top income group shares of total and wage incomes compared to aggregate, 1946-2007. From Piketty and Saez (2003) based on income and estate tax returns as reported to the IRS. Dashed lines are the simulated series. Note that the model is calibrated to the SCF, according to which concentration levels are higher than in Piketty and Saez (2003), so the simulated series lies above the data.



(a) Top income percentile



(b) Top income decile

Figure 3: Income decomposition of top income groups.
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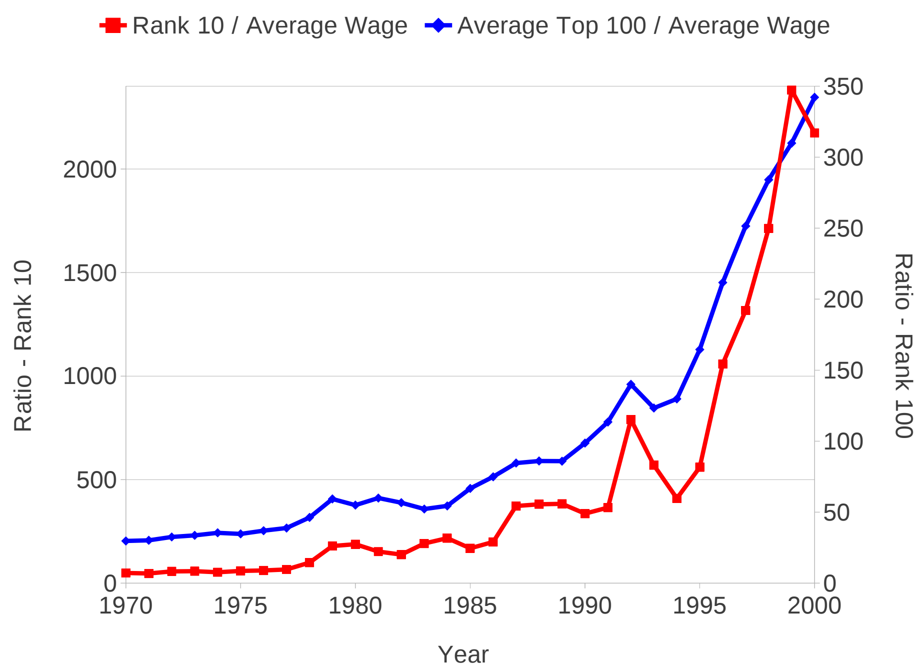
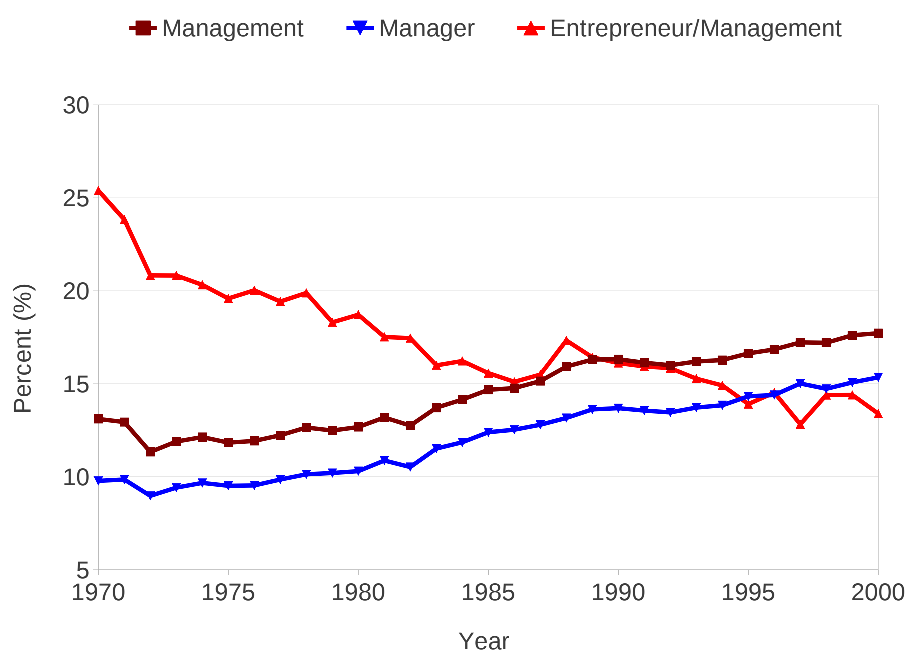
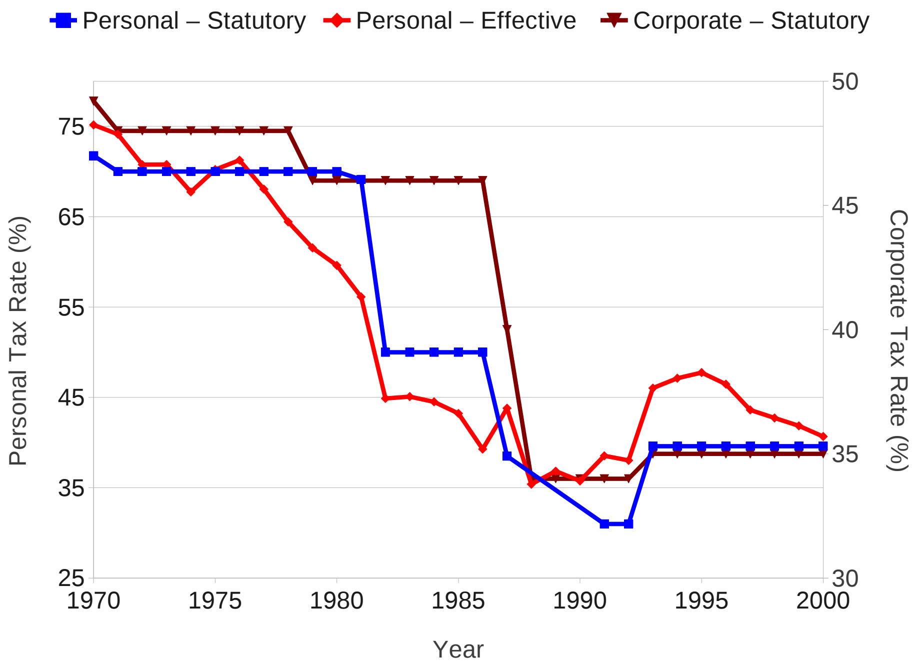


(a) Executive compensation over average annual wage, 1970-2000. Average annual wage is computed from NIPA. Executive compensation is either the top 10 rank (left axis) or top 100 (right axis) rank CEO pay from the Forbes survey.

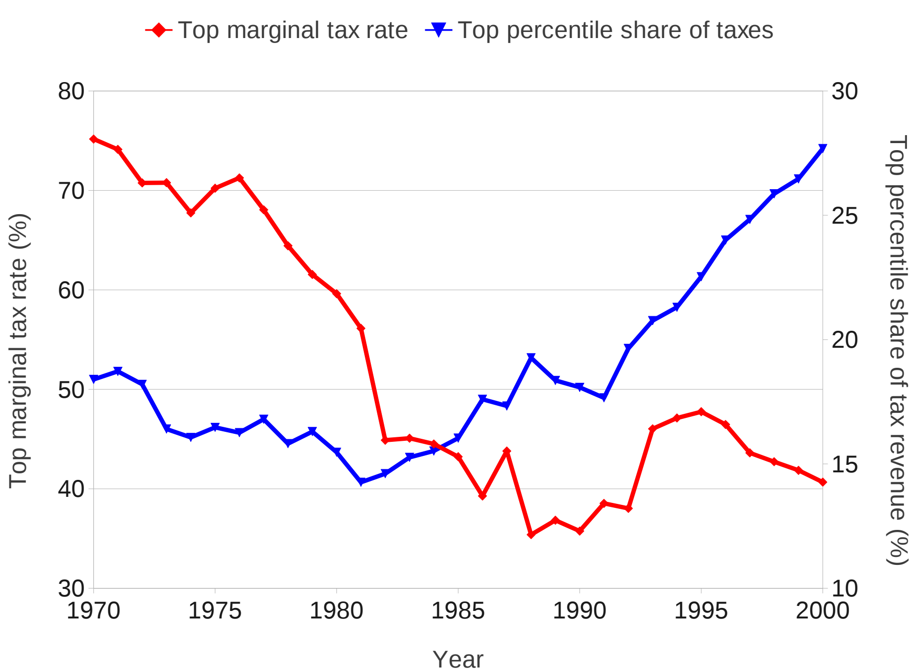


(b) Fraction of households involved in management and managers, i.e. those who are not entrepreneurs, defined as self-employed business owners. In red is the fraction of entrepreneurs among households involved in management. From IPUMS CPS March, 1970-2000.

Figure 4: Executive compensation and manager-entrepreneur occupation ratios



(a) Top marginal tax rates, 1970-2000. Personal effective top marginal tax rates are proxied by the effective tax rates of the top .01 percentile richest households, computed in Piketty and Saez (2007).



(b) Top marginal tax rate and share of tax revenue paid by top income percentile, 1970-2000. Personal effective top marginal tax rates are proxied by the effective tax rates of the top .01 percentile richest households, computed in Piketty and Saez (2007).

Figure 5: Tax progressivity

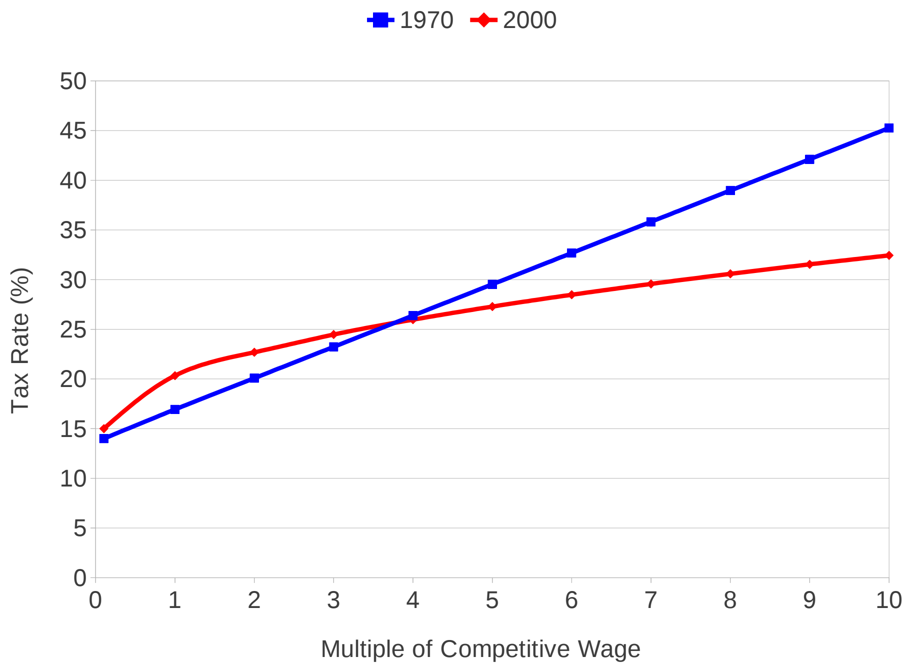


Figure 6: Calibrated wage income average tax functions, 1970 vs 2000.

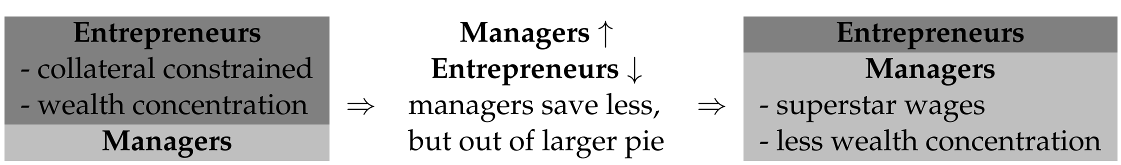


Figure 7: Mechanism of the model

An exogenous change that induces the top income group to be composed by more managers as opposed to entrepreneurs will deliver the observed empirical shifts in the distribution.

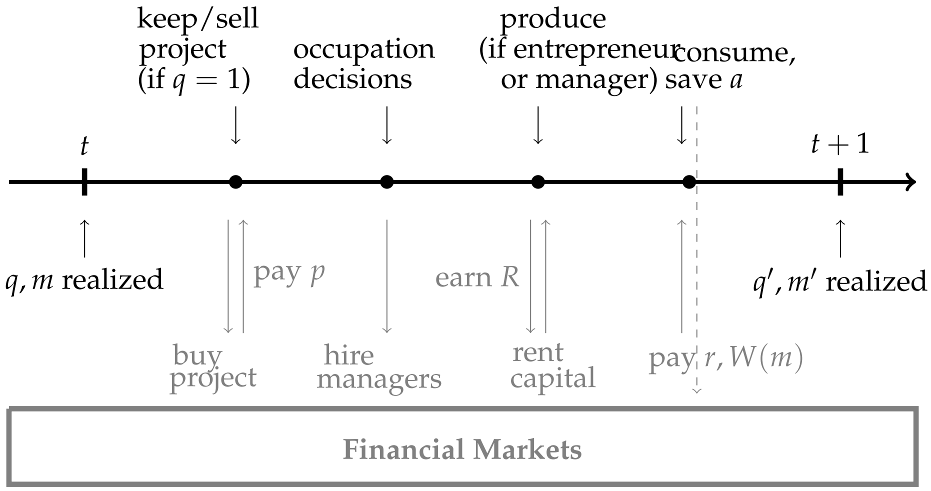


Figure 8: Sequence of events

While all prices and decisions are determined simultaneously in equilibrium, the diagram helps understand the underlying mechanisms of the model.

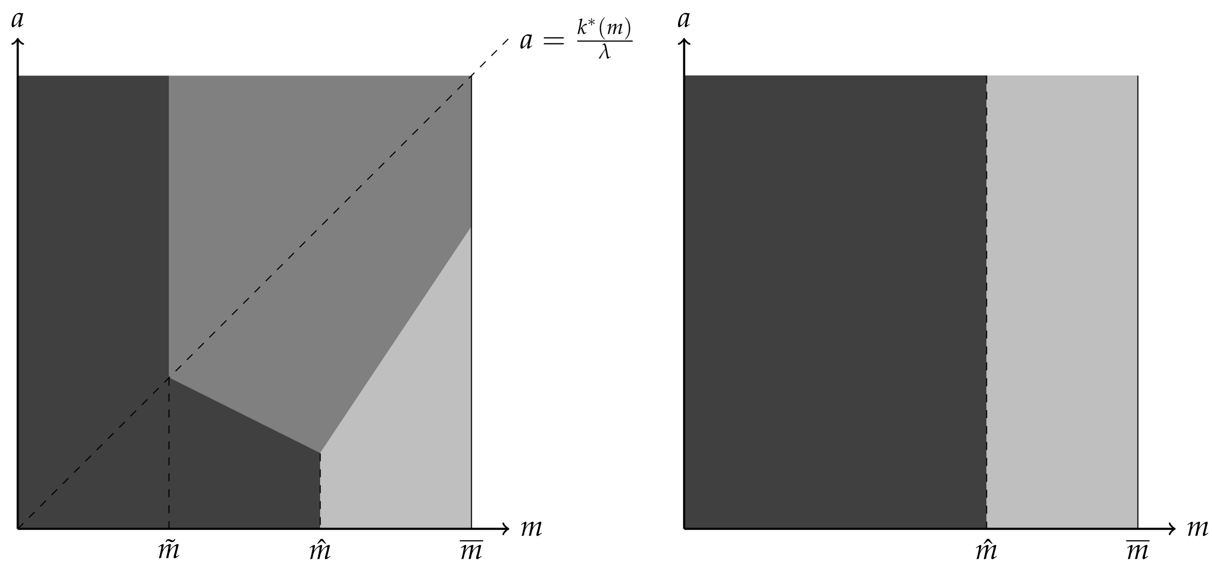


Figure 9: Occupation decision thresholds

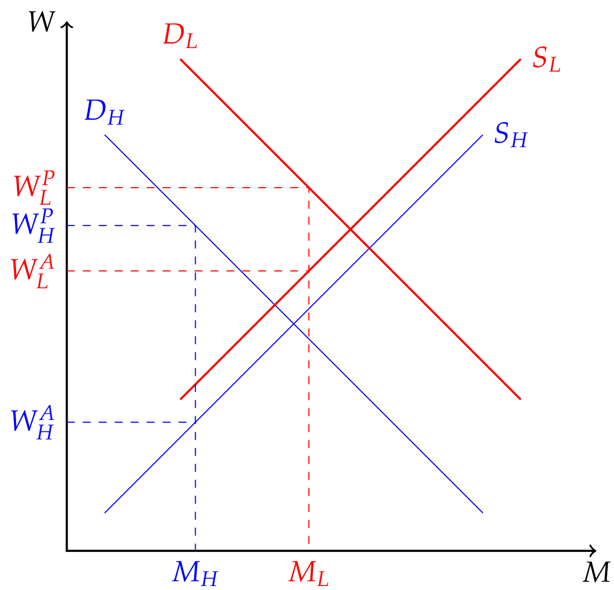


Figure 10: Equilibrium managerial compensation with lower taxes.

M denotes the quantity of managers and W their compensation for a fixed level of managerial ability. When taxes are high, the equilibrium mass of managers is M_H, who earn pretax and after-tax compensations of W_H^P and W_H^A, respectively. With lower taxes, the equilibrium shifts to M_L, where managers earn pretax and after-tax compensations of W_L^P and W_L^A, respectively.

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