Entrepreneurs, Managers and Inequality

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ABSTRACT

Wealth is much more concentrated than income in the United States. But while the concentration of income has surged since the 1980s, the concentration of wealth has increased only modestly, if at all. I argue that these facts can be explained by occupational changes induced by the declining progressivity of the tax code. I construct a dynamic general equilibrium model of occupational choice in which individuals choose to become entrepreneurs, managers or workers. Entrepreneurs face collateral constraints which generate a strong incentive to save. Managers are matched competitively with firms and thus earn the highest wages. Less progressive taxation introduces more high-earning managers in equilibrium, causing managers to crowd out entrepreneurs in high income groups. This increases the concentration of income but not wealth. I calibrate the model to find that tax changes can account for approximately half of the observed differences between 1970 and 2000.

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1. Introduction

In the United States, wealth is much more concentrated than income. 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). 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 explain the degree of wealth concentration we observe in the data. See Cagetti and De Nardi (2005) for an excellent review.

The evolution of the income and wealth distributions over time has received less attention in the literature. It is a well known empirical fact that 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?[1,2]

We may get some answers when we consider the different sources of income, especially at the high end of the distribution. The post-1980s was a period of explosive increase in managerial compensation, with "the working rich replacing the traditionally rich" (Piketty and Saez (2003)). If highly paid managers, who earn most of their income in the form of wages, have a weaker savings motive than the traditionally rich, who earn most of their income in the form of business or capital income, studying how the occupations of high income households have changed over time can help us answer the questions posed above.

In this paper, I present a heterogeneous household model where the income sources and savings behavior of households differ depending on their occupations. The model attempts to explain not only steady state distributions but also the evolution of the distribution. Individuals choose to become a wage worker, an entrepreneur or a manager. I define entrepreneurs as individuals owning their own private firm (or business) and managers as individuals running a publicly owned corporate firm. There is a trade-off between becoming an entrepreneur or a manager - the former

[1] 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.

[2] The answers to these questions have direct welfare consequences. Higher degrees of inequality may be less problematic if accompanied by an increase in the average income of the entire economy. In contrast, a rise in income inequality without a rise in wealth inequality implies a rise in consumption inequality. Hence, the equity-efficiency trade-off is more severe than when only considering income inequality. For example, Attanasio and Davis (1996) find that relative wage differences can account for almost all of the relative consumption differences between different education groups, while Krueger and Perri (2006) find that conditional on individual characteristics, income shocks barely affect consumption.

faces collateral constraints but retains the entire surplus, while the latter is unconstrained but must split the surplus with public investors.

As in most entrepreneurial models, the model I construct creates a strong concentration of wealth due to collateral constrained entrepreneurs. In addition, competitive matching between corporate firms and managers implies 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.[3] When managers replace entrepreneurs at the high end of the income distribution, income becomes more concentrated because managers have higher earnings. This addresses the first question posed above.[4] At the same time, wealth does not become more concentrated because managers have a weaker savings motive, addressing the second question.

I quantify how much of the shifts at the high ends of the distributions (or equivalently, the growth of the corporate sector) can be explained by tax policy changes. 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 (as I document below), with the highest income groups paying as much as 70% of their income in taxes before the 1980s as opposed to 35% today.[5] 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. My quantitative results suggest that the decline in the progressivity of the tax code can account for approximately half of the observed changes in the concentrations of income and wealth.

The novel component of the model is the distinction between entrepreneurs and managers. Entrepreneurial models are useful for explaining both microeconomic behavior (e.g. principal-agent models of moral hazard, asymmetric information, limited commitment) and macroeconomic phenomena (e.g. wealth concentration, business cycles). From a macroeconomic perspective, however, it is difficult to differentiate an entrepreneur from a manager. While it is clear they play different roles at the macro-level, previous models usually treat these two identically.[6] 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. This leads to a natural distinction between corporate and non-corporate firms, which has also not been dealt with in previous models.

[3] 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).

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

[5] 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.

[6] 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*.

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 such models attempt to explain the 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 U.S. wealth distribution. Cagetti and De Nardi (2006) use a parsimonious overlapping generations model of occupational choice between becoming a worker and 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 is subject to the criticism that entrepreneurial models alone are not representative of the U.S.

But 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 large literature explores the role of entrepreneurial collateral constraints in the course of economic development, e.g. Moll (2010); Buera et al. (2010). In contrast, I build on such models by adding a new high income earning occupation, a manager, that competes with entrepreneurs, and explore how fiscal policy shifts can change the distribution of income and wealth in a developed economy. The creation of the managerial occupation is accomplished by 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 matching models in the business literature, e.g. Tervio (2008), Gabaix and Landier (2008).

In my model, the occupational choices and incomes of households are determined in 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 entrepreneuers, 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 matching 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. My results indicate that approximately half of the observed patterns in the data can be explained by the composition of occupations in the high income groups.

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 numerical policy experiment and calibration strategy. Section 5 discusses the results and the quantitative mechanisms of the model, and Section 6 concludes.

[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. However, his model is absent of 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 nor an abstract notion of technological change.

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 in the post-1980s that was not accompanied by a corresponding increase in wealth concentration
2. Concurrent explosion of managerial compensation and the corporate sector.

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

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.[8] Figure 1 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 1-2, 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,[9] along with older data from the 1962 Survey of Financial Characteristics of Consumers (SFCC) and 1963 Survey of Changes in Family Finances (SCFF).

Figure 2 plots the time series for the top 1% share of wealth from Scholz (2003) and my own calculations, both using the SCF.[10] It also plots wealth data based on estate tax returns from Kopczuk and Saez (2004).[11] 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, save 1986, which Scholz (2003) excludes for concern of spurious reporting, and 2004 and 2007, which I include.[12] 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

[8] 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).

[9] 1962, 1983, 1986, 1989, 1992, 1995, 1998, 2001, 2004, 2007.

[10] 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.

[11] 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.

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

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.

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 - wage, capital and business - Figure 3 plots the wage and capital income shares of the top income decile and percentile. 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 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 amount of their capital gains. Regardless, overall we observe that the wage share of income has increased and that the capital share has decreased in both the top income decile and percentile in the long run. This indicates the "crowding out" story of this paper - that the "savings rich" (entrepreneurs) have been replaced by the "earnings rich" (managers).

2.2 Entrepreneurs vs Managers

As noted in Cagetti and De Nardi (2006), a large fraction of the rich people are entrepreneurs. The main definition of an entrepreneur 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 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 near 6-fold in the post-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 ranked CEO and average annual earnings of the top 100 CEOs as published in Forbes Magazine, against the average annual wage from the National Income and Product Accounts (NIPA), from 1970 to 2000.[13] 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 classification for managerial occupations. This makes it difficult to determine how much of the

[13] 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.

population we can call managers, let alone conduct a direct comparison between the income and wealth levels of entrepreneurs and managers. To get around this issue, I instead look at the size of U.S. businesses by type of entity. The data are from the Statistics of Income (SOI) Division of the IRS, and includes all businesses from 1980 to present. In Figure 4(b), I plot the average and total size of receipts of corporations over non-farm sole proprietorships (NFSP).[14] Data before 1980 is not available, and the early 1980s show a peculiar trend, again due to business owners changing their business entity and/or reporting their income differently around the time of the Reagan tax reforms. Regardless, the long-run trend from 1980 onward shows a steady increase.

As noted in Frydman and Saks (2005), however, the strong correlation between the size of corporate firms and executive compensation only holds for the post-1980s, and prior to that CEO compensation is essentially flat. If we posit that there is a positive correlation between firm size and managerial compensation, as I do in this paper, it must be that there was a friction in earlier decades that has become less severe in recent years. The model I present points to progressive taxation as being that friction, which is the subject of the following subsection.

2.3 Tax Progessivity

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. 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.

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 .01 percentile richest households from Piketty and Saez (2007) against the statutory tax 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 fell 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 .01 percentile richest households in Figure 5(b).

[14] I exclude partnerships as many partnerships are in fact run by a manager.

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 does not address 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(b) shows parametrized average wage income tax functions for 1970 and 2000 that I calibrate from Piketty and Saez (2007), 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.

3. Model

I use a dynamic version of Lucas (1978)'s "managerial span of control" model. This is typical for quantitative models with entrepreneurs, e.g. Cagetti and De Nardi (2006), Buera et al. (2010). 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"[15], 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 matching between projects and managers. In any given period, the within period equilibrium displays competitive matching between projects and managers as in Tervio (2008), so that the returns to managerial talent is increasing in talent.

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

Entrepreneurs		Managers ↑		Entrepreneurs
- collateral constrained		Entrepreneurs ↓		Managers
- wealth concentration	⇒	managers save less,	⇒	- superstar wages
Managers		but out of larger pie		- less wealth concentration

Figure I: Mechanism of the model.

Figure I shows how my model can explain the facts presented in Section 2. The collateral constraints generate strong wealth concentration due to the entrepreneurial savings motive. Managers earn the highest wages due to competitive matching. Less progressive taxation induces managers to crowd out entrepreneurs in high income groups, leading to higher 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.

3.1 Setup

The benchmark model is set in discrete time $t = 0, 1, \ldots$ with a unit measure of individuals.[16] 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, capital and labor inputs as specified below. The project can be implemented, sold or simply forgone. $q = 0$ 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 v. Otherwise, m' is newly drawn from a distribution F with support $[0, \overline{m}]$.[17] 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 all markets competitive, i.e. there are no information or bargaining problems. 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

[16]The benchmark model I present is absent of idiosyncratic labor shocks and tax policy variables, which are only added for the calibration. Although taxes are critical for the quantitative exploration, they are not required to analyze the theoretical model as I do not explicitly model a government.

[17]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.

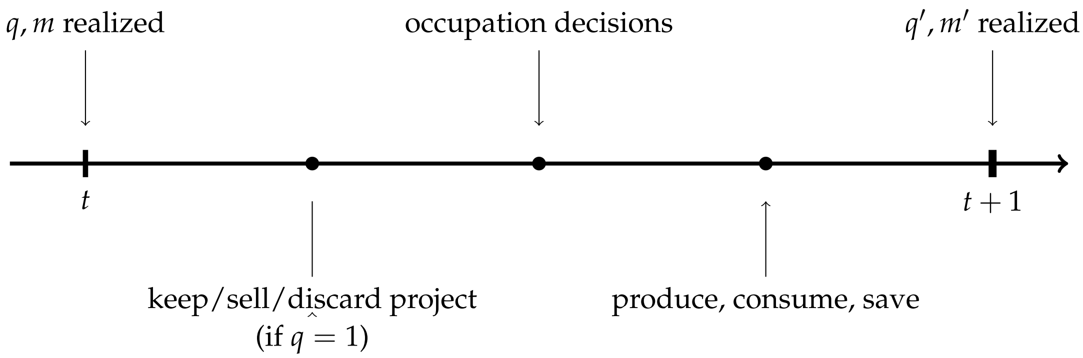


Figure II: Sequence of events.

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 projects (i.e., the intermediaries) sold by individuals. 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 II.

Preferences

Preferences are standard and identical across individuals. Given a history of states $\{x^t\}_{t=0}^{\infty}$ and a 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

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

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. k and l are the amount 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 and factor decisions without collateral constraints. These are given by

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

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, 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, buy projects from individuals wishing to sell them, and hire managers to run the purchased projects. 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.[18] This type of constraint has been used widely in the literature, e.g.

[18] 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. (2010). 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.

Kiyotaki and Moore (1997); Buera and Shin (2009). Since a constrained entrepreneur will always rent up to her limit, her indirect profits and factor decisions are

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

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

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

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. However, she must also pay a fixed cost of $\kappa \geq 0$ to enter the project market, so her net income flow from selling the project is $p - \kappa$. The fixed cost κ is meant to capture all bargaining or information problems, such as those analyzed in Silveira and Wright (2010).[19]. Denote the individual's occupation decision as $o \in \mathcal{O} = \{o_1, o_2, o_3\}$, where o_1, o_2, o_3 is the choice of becoming a worker, manager or entrepreneur, respectively. Obviously, only individuals with $q = 1$ can choose $o = o_3$.

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

$$\phi(x) = \begin{cases} w & \text{if} \quad o = o_1 \\ W(m) & \text{if} \quad o = o_2 \end{cases}$$

if $q = 0$, and

$$\phi(x) = \begin{cases} w + p - \kappa & \text{if} \quad o = o_1 \\ W(m) + p - \kappa & \text{if} \quad o = o_2 \\ \pi(m,a) & \text{if} \quad o = o_3 \end{cases}$$

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

[19]However, this is not the main friction associated with selling the project, as discussed in Section 3.3.

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

$$\begin{aligned} V(x) &= \max_{a'} \left\{ u(c) + \beta \mathbb{E} \left[V(x') | q, m \right] \right\} \\ \text{s.t.} \quad c + a' &= \phi(x) + (1 + r)a \end{aligned}$$

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

$$\mathbb{E} \left[V(x') | q, m \right] = \sum_{q'} \Omega(q, q') \left[v V(q', m, a') + (1 - v) \int_0^{\overline{m}} V(q', m', a') F(dm') \right].$$

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 $P = \{R, r, w, p, W(m)\}$, 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: $\int_{q=1, o \neq o_3} \mu(dx) = \int_{o=o_2} \mu(dx)$,*
4. *capital and labor markets clear:*

$$\begin{aligned} \int a(x)\mu(dx) &= \int_{o \in \{o_2, o_3\}} k(x)\mu(dx) + \int_{q=1, o \neq o_3} p\mu(dx) \\ \int_{o=o_1} \mu(dx) &= \int_{o \in \{o_2, o_3\}} l(x)\mu(dx) \end{aligned}$$

   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 $R = r + \delta$. 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*. Whether the RCE is also a managerial equilibrium will depend on μ. To establish existence of the stationary RCE, I first establish the conditions under which we have a managerial equilibrium. 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. 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 $p \geq \kappa$. When $p = \kappa$ they are indifferent between selling and discarding. Hence κ serves as a lower bound for p and there are two possible types of equilibria:

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

Since all projects are identical, $p > \kappa$ in equilibrium implies that the demand for projects meets supply. If $p = \kappa$, 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 $o = o_3$, so they do not participate in the manager market. Hence the pool of available managers is $\int_{\{q=0\}\cup\{q=1,o\neq 3\}} \mu(dx) \geq M$. Since these individuals have either discarded or sold their projects, 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), applied to CEO markets in recent work by Tervio (2008) and Gabaix and Landier (2008). Perfect competition implies that the agents with the highest ability are hired as managers. Hence there is an ability threshold $\hat{m}$ such that $o = o_1$ if $m \leq \hat{m}$ and $o = o_2$ 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

$$\begin{aligned} W(m) &= w + \int_{\hat{m}}^{m} \pi_m^*(\tilde{m}) d\tilde{m} \\ &= w + \pi^*(m) - \pi^*(\hat{m}) \end{aligned}$$

Therefore the return the project generates for the intermediary, d, is determined by

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

The remaining task is to determine the threshold $\hat{m}$. First, individuals implement their project, or equivalently $o = o_3$, if and only if

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

Second, individuals sell their project if and only if

$$p - \kappa > 0 \quad \text{and} \quad \max\{w, W(m)\} + p - \kappa > \pi(m, a),$$

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

$$\begin{cases} p > \kappa & : \quad \pi^*(\hat{m}) = (1+r)p + w \quad \text{and} \quad g(1) - \int_{o=o_3} \mu(1, dm, da) = \int_{o=o_2} \mu(dq, dm, da) \\ p = \kappa & : \quad \pi^*(\hat{m}) = (1+r)\kappa + w, \end{cases}$$

where g is the p.d.f. associated with G. When $p = \kappa$, 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 $p > \kappa$, we can now express the manager market clearing condition as

$$\int_{o=o_1} \mu(1, dm, da) = \int_{\hat{m}}^{\overline{m}} \mu(0, dm, da), \tag{3}$$

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 $p = \kappa$.

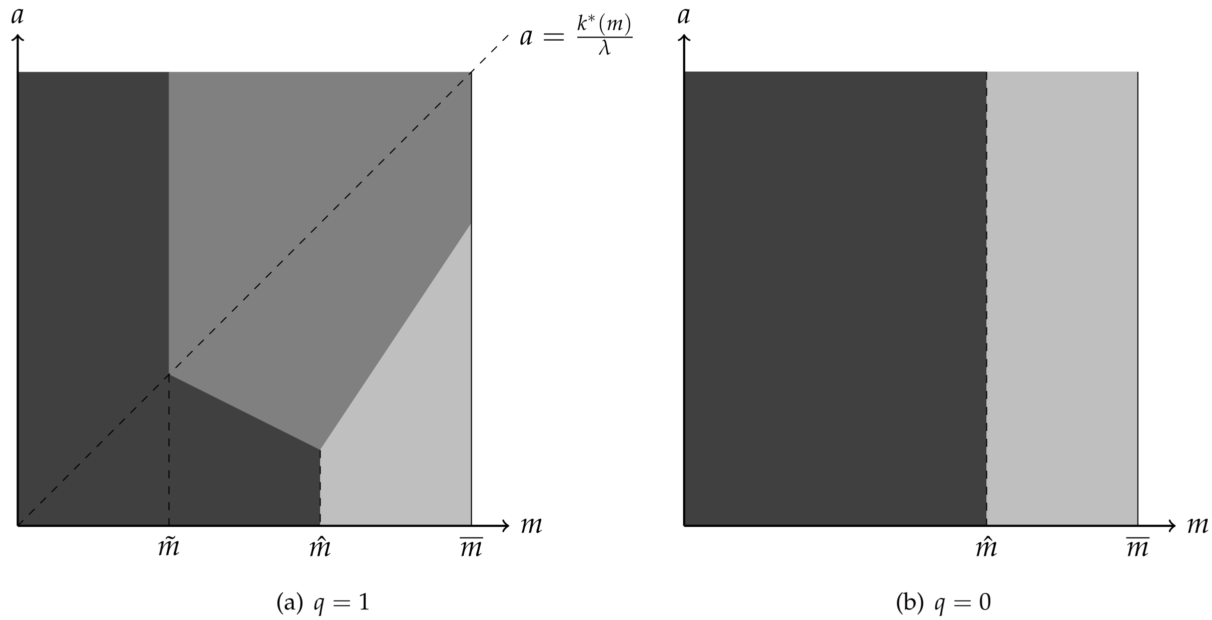


Figure III: Occupation decision thresholds.

Individuals' occupation choices and μ are depicted in Figure III. The dark gray, light gray and gray regions are the individuals who choose $o = o_1, o_2$ and o_3, respectively. Figure III(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 III(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.

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

For $m \in [0, \tilde{m})$, all individuals sell (or discard) their projects and become workers regardless of their asset levels. The 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 III(a) must equal the mass of individuals in the light gray region of Figure III(b).[20] Individuals in the light gray region of Figure III(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 $x \in \{0, 1\} \times [0, \overline{m}] \times [0, \bar{a}]$.*

In the appendix, I show that Assumption 1 indeed holds in the RCE. The assumption means

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

that individuals never find it optimal to accumulate assets above a certain level, and that for every (q, m)-state, there exists a positive mass of individuals for all asset levels $a \in [0, \bar{a}]$. Given this assumption, we have shown:[21]

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

1. *Managers exist in equilibrium if and only if $\pi^*(\overline{m}) - w \geq (1+r)\kappa$.*
2. *Occupation decisions are such that*

$$o(1,m,a) = \begin{cases} o_1 & \text{if} \quad m \leq \hat{m} \quad \text{and} \quad \pi(m,a) \leq w + p - \kappa \\ o_2 & \text{if} \quad m > \hat{m} \quad \text{and} \quad \pi(m,a) > W(m) + p - \kappa \\ o_3 & \text{otherwise,} \end{cases}$$

$$o(0,m,a) = \begin{cases} o_1 & \text{if} \quad m \leq \hat{m} \\ o_2 & \text{if} \quad m > \hat{m}. \end{cases}$$

Proof: See Appendix B.1. □

If Condition 1 in Proposition 1 does not hold, even hiring the best manager does not generate enough profit to compensate for a project seller's entry cost. In this case, 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 *A stationary RCE exists.*

Proof: See Appendix B.2. □

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 5 discusses the results. Before turning to the numerical analysis, however, I point out several novel aspects of the model.

3.3 Discussion

The main mechanisms of the model are the entrepreneurial collateral constraints and the competitive matching between projects and managers. Since output increases in managerial ability,

[21]If we assume that individual states are not observable, we can no longer define a competitive equilibrium. However, we can obtain identical results by assuming a perfect Bayesian equilibrium where the intermediaries and individuals play a two-stage game in the manager market, with the intermediaries first buying projects and then hiring managers. In that case, κ can be interpreted as a signaling cost. Contact author for details.

the unconstrained planner's solution has the best managers running all the projects regardless of ownership, thus the competitive matching component is efficient. It is the collateral constraints and other frictions to be discussed below that prevent the economy from achieving the first-best. On the other hand, the economy is more efficient than one without a manager market, as in 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 market has an additional inefficiency that deserves 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, the project market reduces the aggregate amount of capital that can be used for production. Hence there is an inherent efficiency loss in the project market regardless of whether there is an associated fixed cost for entry. This assumption is equivalent to assuming that it is impossible in my model to contract on the the split of surpluses before production.[22] This additional assumption to project transfers creates an economy-wide trade-off between having a non-corporate firm versus a corporate firm, and is measured quantitatively in Section 5.

In essence, the intermediaries are making a portfolio decision between project and capital investment. This raises the question of why it is not the individuals making the portfolio decision. While it would be more interesting to let individuals make the decision, I choose to model the economy in this way because it is hard to find a real world interpretation that would differentiate the two assets. 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 the 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.

Finally, 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

[22]Thanks to Neng Wang for pointing this out.

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.[23]

4. Calibration

The framework presented in this paper 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.

I add taxes in the model as exogenous parameters to quantify the effects of a change in the tax code. The parameterized tax functions are separately calibrated and assumed to be injected into the model as an exogenous variation. With taxes, individuals now make their occupational decisions based on after-tax rather than pretax income. Now suppose 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. Given tax parameters, to be explained below, from 1970, I first calibrate a stationary equilibrium to empirical moments from 1970. Holding fixed the parameters that give me the best match, I change only the tax function parameters to those from 2000, and compute another stationary equilibrium that corresponds to 2000.

However, this is merely a steady state comparison. Since I am interested in whether the change in tax policy can actually explain the evolution of the income and wealth distributions, I compute the transition path of the economy assuming that it was at a steady state in 1970. While the experiment is limited in the sense that the future time path of the tax function parameters are assumed to be perfectly foreseen by the agents starting in 1971 and I cannot add aggregate uncertainty, it does provide a robustness check as to whether the economy adjusts fast enough and responds strongly enough to the exogenous tax code variation so that we observe the changes induced by tax policy shifts within the 30 years.

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 C for the details of the numerical procedure. My approach is to use a parsimonious version of the model to reduce the number of parameters to be calibrated and

[23] 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.

focus only on the data moments of interest. Before I discuss how the parameters are chosen, I first add some discipline to the model which I explain in detail below.

4.1 Exogenous Processes

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

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

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. (2010). I assume a "shifted" truncated Pareto distribution with shape parameter s:

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

so that there is a finite upper bound for abilities, $\overline{m}$, and the lowest ability manager has zero productivity.[24,25]

Along with (λ, κ), (ω_0, ω_1, v) and $(s, \overline{m})$ will govern the distribution and relative mass of different occupations. These parameters are important because they also determine the sources of income within and relative income between different income groups. To create variation in the lower income groups and also facilitate numerical clearing of the labor market in the calibration, I also 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 (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.

4.2 Preferences and Technology

The utility function is standard and parametrized as

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

[24] The shift and truncation is primarily to facilitate numerical approximation.

[25] 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.

Relative risk aversion is fixed at $\gamma = 2$, which is in the range of values consistent with previous studies. In contrast, the subjective 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 $\nu = 2\alpha$ and $\delta = .06$, respectively. This leaves $\alpha + \nu$ as a parameter to calibrate. The collateral constraint λ along with the fixed cost parameter κ are critical parameters that affect the measure of entrepreneurs, and hence the relative measure of managers in the high income groups.

4.3 Tax Variables and Accounting

Capital and business income in the model are taxed at flat rates according to effective marginal tax rates (EMTR) estimated by Gravelle (2004). Her estimates show no strong trend or variation as shown in Figure 6(a). I use the non-corporate EMTRs to tax business income and total EMTR to tax capital income.

I assume a functional form for the average tax rate on wage income, ATR, as in Gouveia and Strauss (1994, 2000),

$$ATR(y) = b_0 \left[1 - \left(b_2 \left(y/AW\right)^{b_1} + 1\right)^{-1/b_1}\right]$$

with the only difference being that y refers only to wage income instead of total income as in their papers, and AW is the average wage. For the calibration I set AW equal to average annual wages from NIPA, while in the model, it is set to equal w, the competitive wage. b_0 is the asymptotic marginal and average tax rate and b_1 is a curvature parameter.[26] b_2 is a level parameter for normalization.

For consistency, I tax each source of income identically, both in the data and the model. To obtain a realistic wage income tax schedule from the data, I refer to Piketty and Saez (2007), which reports total taxes paid by different income groups, and Piketty and Saez (2003) for the sources of incomes of each group. I first assume that capital and business incomes are taxed at flat rates estimated by Gravelle (2004). Then I subtract that portion of taxes from total taxes paid, and attribute the remainder to a wage income tax. Thus I construct data points that correspond to $(y, ATR(y))$ pairs. I fit the above function to these data points for the years 1970-2000. Figure 6(b) plots these functions for the years 1970 and 2000.

For accounting purposes, I divide the sources of income in the 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 to minimize tax incidence. In other words, wages $w\epsilon$ and managerial compensation $W(m)$ are accounted

[26]Previous literature has made extensive use of this function, e.g. Castañeda et al. (2003); Scholz et al. (2006). Note that b_1 by itself does not serve as a measurement for the degree of progressivity.

for as wage income, while entrepreneurs are assumed to report their income as both wage income or self-employment income to take advantage of the hypothetical tax code. Specifically, entrepreneurs are assumed to report a wage income of RWI and business income of $\pi(m,a) - RWI$, where RWI solves

$$RWI = \underset{y \in [0, \pi(m,a)]}{\text{argmax}} \ (1-\tau_b)(\pi(m,a) - y) + (1 - ATR(y))y$$

where τ_b is the flat rate on 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." Future research will differentiate project qualities, but for now I ignore this and simply disregard the income earned from selling a project.

4.4 Targets

To sum up, the current model has a total of 14 parameters as summarized in Table 4. Out of these, 4 are fixed, and the values of these parameters are summarized in the Panel A of Table 4. These values are standard except for the persistence of labor efficiency, ρ, which is fixed at .95. This is close to estimates from Storesletten et al. (2004). For the remaining 10, I calibrate the parameters so that the quantitative moments simulated from the model match U.S. data moments, as summarized in the Panel B of Table 4. Although there are no obvious one-to-one relationships between any of the parameters and moments, I now describe how each parameter is mainly identified from certain moments in the data.

While my model focuses on the differentiation between entrepreneurs and managers, data corresponding to the managers in my model are scant. Therefore I mainly target available data for entrepreneurs from which I indirectly infer the corresponding moments for managers. All firms in the model come from projects, and in the stationary distribution the mass of non-workers (entrepreneurs plus managers) is determined by the mass of individuals with $q = 1$, i.e. $\frac{1-\omega_0}{2-\omega_0-\omega_1}$. This parameter is calibrated so that the equilibrium mass of entrepreneurs in the model matches the empirical mass of entrepreneurs in the data. This number varies across studies, from 7.6% (Cagetti and De Nardi (2006)) to 12% (Quadrini (2000)). I target a median value of 9.8%. Given a mass of entrepreneurs, the share of aggregate capital employed by the non-corporate sector is determined by the collateral constraint λ. For this number I target 40% following Quadrini (2000).

The rest of the parameters are calibrated to match 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. Although the benchmark model is calibrated to 1970 U.S., I target the 1962-1963 SFCC/SCFF for the top percentile wealth share and Gini coefficients of wealth and earnings, as there is no other reliable source for data on wealth. All other moments are taken from Piketty and Saez (2003).

The Pareto distribution parameters $(s, \overline{m})$ determine the mass of high income earning managers and the level of their earnings. The shape parameter s is chosen so that the top percentile share of earnings is 5.2%. The upper bound $\overline{m}$ is calibrated so that the ratio of the highest level of compensation over the competitive wage, $W(\overline{m})/w$, is 38.6, the ratio of average earnings of the top 100 CEOs over the average wage in the data. The conditional volatility of labor efficiency shocks, σ_ϵ, is only 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 Gini coefficient of earnings, which is .52. Likewise, given s, the managerial share of corporate income $1 - \alpha - \nu$ determines the wage income share of the top income percentile, which was 45.6% in 1970.

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. In my model, this implies that higher persistence in q leads to more wealth concentration. However, higher persistence in ability m leads to *less* concentration, as managers with high ability will have less incentive to save when persistence is strong. So the persistence parameters $\omega_0 + \omega_1$ and v jointly determine the concentration of wealth.[27] These two parameters are calibrated to the top percentile share and Gini coefficient of wealth, which were 32.2% and .77 in 1963, respectively. For individuals with $q = 1$, the friction κ determines whether or not the individual becomes an entrepreneur. Since the only source of business income is from implementing a project, κ determines the business income share of the top income percentile, which was 30% in 1970. Finally, β is chosen to match an annual interest rate of 5%.

5. Results

I first compare the two stationary economies and show how much of the change in distributional moments between 1970 and 2000 can be explained by the policy shift, i.e. Gini coefficients, top percentile/decile shares of income/wealth, top percentile/decile composition of income, etc. To illustrate from where these changes are coming, I present the percentage share of each income source for different income groups. I also present the results from the steady state to steady state transition. Finally, I shut down the progressivity of the wage income tax schedule to show that my results are indeed being driven by less progressive taxation. When interpreting distributional moments, keep in mind that all calculations are based on pretax income, both in the data and the model.

5.1 Steady State Comparisons

As shown in Table 4, current results fit the data fairly well. There is a fundamental trade-off between matching wealth-related statistics and earnings-related statistics that complicates the calibration. The trade-off comes directly from the model having two different types of high income-

[27] Assuming that q and m are correlated did not have any quantitatively significant differences.

Regime	$W(\overline{m})/w$	C/N
Model (1970)	36.0	1.42
Model (2000)	306.4	1.60
Flat labor tax	647.0	1.96

Table I: Model mechanism.

earning occupations. Entrepreneurs earn their income from wealth and managers through earnings, but both distributions are essentially induced from the same underlying 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 underlying distribution is the same.

Matching the degree of wealth concentration we observe in the data requires a sufficient mass of entrepreneurs in equilibrium. As a consequence, the wage income share and business income share of high income groups is too low and too high, respectively. As shown in Table 5, income concentration is also much higher than the data. This is because both entrepreneurs and managers have too high incomes in the model. Forcing the model to exhibit a lower share of business income for high income groups would result in a higher concentration of earnings and vice versa, both of which are already higher than the data in the current calibration. Finding a better match with the data is a crucial direction for future research.

Regardless, the model delivers realistic degrees of wealth and income concentration as shown in Table 5. In particular, the 2000 steady state induced from the different tax code shows that the model fits well with 2000 moments. The concentration of wealth does not increase while the concentrations of earnings and income increase, in fact it slightly decreases. The reason for the exaggerated effect can be traced back to the change in the sources of income for high income groups, as shown in Table 6. As noted above, the current calibration results in entrepreneurs having too high incomes. Thus, the changes in the distributional moments come mainly from the entrepreneurs falling out from the high end of the distribution as the model indicates, but the fall in the business income share of the high income groups is too large, which causes a decrease in wealth concentration.

In Table I, I show the maximum managerial compensation to competitive wage ratio ($W(\overline{m})/w$) and the ratio of total capital employed by corporate and non-corporate firms (C/N). The increase is small relative to the data shown in Figure 4(a). The relative change in the size ratio between corporate and non-corporate firms is also very small. However, even this small change blows up managerial compensation to a whopping 306.4 times the competitive wage in 2000 from 36.0 in 1970 in the model, illustrating the strong competitive matching effects.

The effect is even greater when one recalls that the calculations 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 IV as movements *along* the demand and supply curves. But in this economy, the general equilibrium effects are

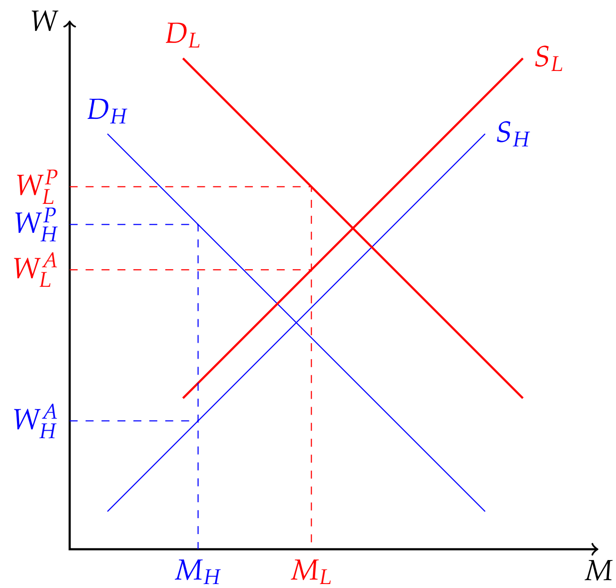


Figure IV: Equilibrium managerial compensation with lower taxes.

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.

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 $\mathbb{E}W/w$ shadows a much larger increase in the mass of managers and their average ability in equilibrium.

5.2 Transition Path

Figures 1-2 shows the simulated income and wealth concentration series along the numerically computed transition path, and Figure 3 the composition of income for the top decile and percentile. 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 display clear trends that overall track the data, reaching similar relative levels in 2000 compared to 1970. This confirms that the economy responds strongly enough to the tax code so that the terminal steady state gives us a realistic description of the economy in 2000.

Although the annual changes in distributional statistics are exaggerated, notice that they move in the same direction as in the data. This is reassuring, given that the only exogenous change in the simulation is taxation - while there are many other forces that were affecting the real economy throughout the model period, the model shows that changes in taxation and tax progressivity can have played a role. For the same reason, the model cannot explain changes prior to the 1980s, during which there were no significant changes in tax policy.

While the ups and downs in the trend are not very unrealistic, the huge downward swings in the periods around 1995 are noticeable. This is due to the ratio of the business and wage income tax rates I inject into the model, which I posit is reflecting the temporary increase in tax progressivity during the Clinton era. Given that the steady state differences are solely due to changes in taxation, the annual changes on a perfectly foreseen transition path are also exaggerated when the trend is reversed, more so because business and capital tax rates are also lower than the per-1980s era.

However, one may still wonder how there could be such a huge discontinuity along a perfectly foreseen transition path. This is due to my separating the managerial equilibrium out of the dynamics as an independent market. In addition, the perfect foresight equilibrium is the quickest adjustment path possible. Due to these two assumptions, individuals switch between occupations optimally every period, implying sensitive changes to the exogenous variation in the tax code. Whenever there are huge jumps in individual occupational choices across two adjacent time periods we may observe drastic changes in the distributional moments, as my model is deliberately constructed so that occupational choices determine the equilibrium. One way to get around this problem would be to add persistence to occupational decisions, so that occupations are chosen one period in advance, or adding a fixed cost to switching occupations. Moreover, if the path is not perfectly foreseen so that prices do not change as flexibly, this should also help to shrink the magnitude of the swings. [*Addition of these assumptions are in progress.*]

5.3 Experiments: Flat wage income tax rates and κ

The major policy shift in my specification is the progressivity of wage income taxation. The effect of less progressive taxation should be straightforward - the mass of the corporate sector, and hence managers, should rise. This increases earnings and income concentration disproportionately to wealth concentration. To check the effect of the progressivity, I conduct an experiment where I fix the wage income tax rate at a flat rate equal to the level rate at which a worker earning the competitive wage, w, would be taxed, which is approximately 30% in the benchmark calibration. The effect of removing progressivity can be clearly seen in Tables 5-6. In Table 5, the concentrations of earnings and income increase without a corresponding increase in the concentration of wealth. In Table 6, the wage and business income shares of high income groups are higher and lower, respectively, than both 1970 and 2000. This confirms the model mechanism, i.e. that the desired empirical results are delivered by a shift in occupation choices triggered by a less progressive tax system. The same driving force of the explosive increase in managerial compensation is also confirmed in the last row of Table I.

Up to now, I have been silent about the role of κ and have treated it as an exogenous parameter. In the model, it is a friction on the 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. While the latter is a friction on the amount of debt, the former is a friction on equity. 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

CEV	AC	AY	KS	KD	$TX1$	$TX2$
-7.2%	-5.4%	-0.6%	2.5%	2.6%	23.3%	26.8%

Table II: Aggregate impact of change in tax code.

(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, but I refrain from this interpretation in this paper as I make oversimplifying assumptions about the project market for it to be a realistic representation of the stock market.

Eliminating κ would seem to imply more projects sold in equilibrium and hence more managers, in other words, identical effects to replacing the progressive wage income tax with a flat tax. However, this is not the case due to general equilibrium effects. Indeed, at first glance the distributional statistics in Tables 5 and 6 seem to suggest a lower value for κ in the benchmark calibration, as it achieves lower concentration of earnings without affecting the wealth distribution. Notwithstanding, it fails to match all other moments except for the two concentration moments. The interest rate when $\kappa = 0$ is an unrealistic 13.6%, more than twice as much as the benchmark calibration. In addition, the mass of entrepreneurs (and managers) decrease to levels far below target. In short, the $\kappa = 0$ case creates a high demand for factor inputs, and the Cobb-Douglas technology and profit maximization imply that the equilibrium wage rate is also much higher, consistent with a smaller share of entrepreneurs or managers in equilibrium. This implies that both business income and managerial compensation are lower because a larger share of income is being allocated to lower income groups. This can be seen in Table 6. The top percentile is earning most of their income from capital income, not labor or business income which is the major source of income for entrepreneurs or managers. The top decile starts to include more wage workers, as can be seen by their higher share of wage income. Accordingly, the overall skewness of the income becomes too low compared to the data as shown in Table 5.

5.4 Tentative Welfare Analysis

I have shown that the change in tax policy can explain the observed changes regarding inequality. A classic question regarding taxation is the equality-efficiency tradeoff. To partially address this question, I conduct a simple welfare calculation. Table II shows the additional consumption equivalent value (CEV) at all states in 1970 required to obtain the utility levels in 2000, along with the percentage change in aggregate variables. AC, AY, KS, KD denote aggregate consumption, output, capital supply and demand, respectively, while $TX1$ and $TX2$ denote the tax-GDP ratio for 1970 and 2000.[28] Perhaps surprisingly, there is a slight drop in output despite the higher efficiency in product. This is mainly because there is less accumulation of capital, as individuals have less incentive to anticipate the project shock, as can be seen in the drop of aggregate capital.

[28]The baseline experiment is controlled so that the median tax payer faces the same rate as in the data. For the welfare calculations, I control for the tax-GDP ratio, so the calibrated results for the rest of the statistics are slightly different from the baseline model.

Moreover, more assets are used in the purchase of projects,[29] also reducing the amount of output in equilibrium. Given that income inequality is much larger in the 2000 model economy while output does not change much, the average level of consumption drops, and when accounting for uncertainty the welfare loss is even larger than the drop in consumption.

While not reported, when maintaining government revenue equivalence there is a small increase in output of approximately 1%, but there is still a drop in aggregate consumption and welfare, of approximately 3% and 5%, respectively. [*These numbers will be posted soon along with a serious equality-efficiency tradeoff analysis.*]

These results demonstrate the different implications my model has for the relationship between inequality and growth, compared to the recent literature on "capital misallocation." As long as there is some persistence in projects and ability, an economy with only entrepreneurs and no managers is more production-efficient when wealth is more concentrated (e.g. Banerjee and Moll (2010)). In my environment with managers, however, shifting production from an entrepreneur to a manager is more production-efficient in the aggregate. Since this is associated with a weaker entrepreneurial savings motive, overall the economy becomes more production-efficient when wealth is less concentrated.

6. Conclusion

Standard models cannot simultaneously explain the evolutions of the U.S. income, earnings and wealth distributions. I construct a model of occupational choice where individuals choose to become entrepreneurs, managers or workers. The model fits 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. 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 different welfare implications between previous entrepreneurial models and my model which incorporates a manager market.

At the time of writing, I am re-calibrating the tax function to match aggregate and top income percentile tax rates. In addition to delivering better quantitative results, this would give us a better understanding of the effects of different tax policies. The model I present, which focuses on high income groups, is suitable for this purpose as empirical findings suggest that most tax policies affect only the highest income groups. The re-calibrated tax functions would also allow for a rigorous comparison between equality and efficiency.

The model can be extended to international comparisons. Most continental European countries have more progressive taxes than the U.S. Just as I compare U.S. in recent years to earlier years, I could instead compare it with other countries with different tax policies. In addition, I could

[29] It is worthwhile noting that aggregate capital supply and demand do not increase by the same amount. The .1% discrepancy shows that the expenditure on projects increases in 2000, which is not surprising given that more managers are being hired so that both the mass and value of projects should increase.

explain why we only observe superstar CEOs in the U.S. and not in continental Europe.[30]

Finally, recent findings from Parker and Vissing-Jorgensen (2010) reveal that contrary to popular beliefs, the income of high income households is more exposed to aggregate fluctuations than that of low income households. Notably, this was not the case prior to the 1980s. In my model, the collateral constrained entrepreneurs would have less volatile income than the unconstrained managers. Hence, when there are more managers in the high income group their income will become more volatile and vice versa. However, a quantitative exploration of this question would require incorporating aggregate uncertainty into the model which poses significant numerical challenges. In a companion paper I propose an algorithm to simplify this problem and address this very question.

[30] 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. Tables and Figures

Table 1: Size distribution of wealth in the United States

Year	Gini	Percentage share of wealth held by:						
		Top 1%	Top 5%	Top 10%	Top 20%	Next 20%	Next 20%	Last 40%
1963	.773	32.2	52.3	64.1	78.1	14.5	6.3	1.2
1983	.778	33.5	55.4	66.9	79.4	12.8	5.9	1.9
1986	.768	35.2	55.3	66.0	78.6	12.9	60.	2.6
1989	.790	29.9	54.0	66.9	80.6	13.1	5.2	1.1
1992	.786	30.0	54.4	67.0	80.1	13.2	5.4	1.3
1995	.791	34.8	56.0	67.9	80.6	12.5	5.5	1.4
1998	.800	33.8	57.1	68.5	81.4	12.4	5.1	1.1
2001	.805	32.2	57.3	69.6	82.5	11.9	4.5	1.1
2004	.809	33.2	57.4	69.4	82.9	11.8	4.4	1.0
2007	.816	33.6	60.3	71.4	83.4	11.3	4.5	.9

The data series is from the SCF. Fractile shares are ranked according to the variable NET WORTH, defined as total assets minus total debt excluding pensions. Calculations by author.

Table 2: Size distribution of earnings in the United States

Year	Gini	Percentage share of earnings earned by:						
		Top 1%	Top 5%	Top 10%	Top 20%	Next 20%	Next 20%	Last 40%
1962	.521	6.16	18.7	30.9	50.0	27.8	17.2	5.0
1982	.571	9.6	23.5	35.9	55.1	26.4	14.8	3.7
1985	.580	10.9	26.0	37.8	56.1	25.5	14.9	3.6
1988	.604	10.6	26.9	39.9	58.8	25.0	13.4	2.7
1991	.606	10.5	26.8	39.8	59.1	25.0	13.2	2.8
1994	.606	12.0	28.0	40.5	59.1	24.6	13.3	2.9
1997	.589	11.3	26.6	39.1	57.7	24.7	13.8	3.8
2000	.610	15.5	30.7	42.7	60.4	22.8	12.7	4.1
2003	.613	13.6	29.2	42.0	60.5	23.3	12.7	3.5
2006	.633	15.9	32.0	44.4	62.5	22.6	12.0	2.9

The data series is from the SCF. Fractile shares are ranked according to annual wage income and salaries. Calculations by author.

Table 3: Size distribution of income in the United States

Year	Gini	Percentage share of income earned by:						
		Top 1%	Top 5%	Top 10%	Top 20%	Next 20%	Next 20%	Last 40%
1962	.428	8.3	19.6	29.9	46.0	24.0	16.6	13.4
1982	.484	13.6	27.0	37.1	52.2	21.3	14.2	12.3
1985	.489	13.6	26.8	36.9	52.0	21.8	14.4	11.7
1988	.540	16.9	31.5	42.3	57.2	20.0	12.7	10.1
1991	.501	11.7	26.3	37.5	53.6	21.7	13.6	11.2
1994	.515	14.3	28.7	39.3	54.9	20.8	13.5	10.9
1997	.530	16.6	31.0	41.2	56.2	20.5	12.8	10.6
2000	.562	20.0	35.3	45.4	59.6	18.9	11.7	9.9
2003	.540	16.8	31.8	42.6	57.7	19.6	12.3	10.5
2006	.574	21.3	37.0	47.1	60.9	18.2	11.2	9.7

The data series is from the SCF. Fractile shares are ranked according to total income. Calculations by author.

Table 4: Benchmark Model Parameters

Parameter	Value	Source / Target	Data	Model
		A. Fixed Parameters (4)		
γ	2.00			
δ	.06	Buera et al. (2010)		
α/ν	.50	aggregate capital-labor ratio		
ρ	.95	Storesletten et al. (2004)		
		B. Calibrated Parameters (10)	Data	Model
$\frac{1-\omega_1}{2-\omega_0-\omega_1}$	.24	mass of entrepreneurs (%)	9.8	9.3
λ	5.58	size of non-corporate sector (%)	40.0	45.0
s	1.22	top earnings percentile share of aggregate earnings (%)	6.2	9.9
σ_ε	.35	Gini coefficient of wage income	.52	.56
$\alpha + \nu$	.60	wage income share of top income percentile	45.6	27.5
$\overline{m}$	1268.38	max compensation over average wage	38.6	36.0
$\omega_0 + \omega_1$	1.87	top wealth percentile share of aggregate wealth (%)	32.2	31.3
υ	.88	Gini coefficient of wealth	.77	.74
κ	50.79	business income share of top income percentile (%)	30.0	53.5
β	.98	annual interest rate (%)	5.0	5.8

Table 5: Size distribution of wealth and income in model economy

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	32.20	52.30	64.10	78.10	14.50	6.30	1.20
Model (1970)	0.74	31.28	53.01	64.27	76.25	12.89	7.11	0.38
Data (2001)	0.81	32.20	57.30	69.60	82.50	11.90	4.50	1.10
Model (2000)	0.70	26.53	45.77	57.10	71.88	15.91	8.26	3.96
Flat labor tax	0.72	27.95	45.82	58.05	73.54	15.38	7.68	3.40
$\kappa = 0$	0.66	28.58	42.52	52.06	66.12	18.49	10.37	5.02
Earnings								
Data (1970)	0.52	6.16	18.70	30.90	50.00	27.80	17.20	5.00
Model(1970)	0.56	9.90	28.96	42.47	57.89	23.04	9.98	9.10
Data (2000)	0.61	15.50	30.70	42.70	60.40	22.80	12.70	4.10
Model (2000)	0.60	17.60	34.72	48.06	61.90	20.95	8.96	8.19
Flat labor tax	0.64	24.35	40.05	52.49	65.18	19.21	8.22	7.39
$\kappa = 0$	0.51	6.32	25.18	37.43	52.69	26.08	10.05	11.17
Income								
Data (1970)	0.43	8.30	19.60	29.90	46.00	24.00	16.60	13.40
Model (1970)	0.61	20.84	35.35	49.95	62.80	20.50	8.48	8.22
Data (2000)	0.56	20.00	35.30	45.40	59.60	18.90	11.70	9.90
Model (2000)	0.63	24.26	38.71	52.92	65.05	19.38	7.86	7.71
Flat labor tax	0.65	28.60	42.58	56.06	67.39	18.17	7.24	7.20
$\kappa = 0$	0.53	12.86	28.07	41.65	55.72	22.80	10.92	10.57

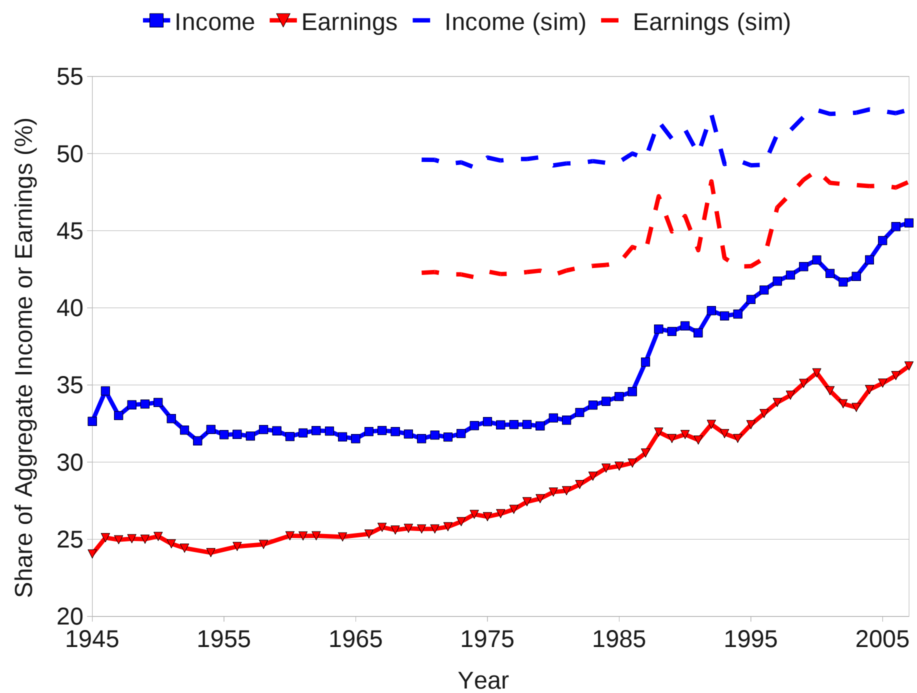
Distributional statistics in simulated economies, 1970 vs 2000 and experiments. Note that NET WORTH (wealth) in the 2001 SCF data is measured at the end of 2000, and hence is compared with the model in 2000. The Gini coefficient for earnings is from the 1962-63 SFCC/SCFF.

Table 6: High-end statistics - Share of total income (%)

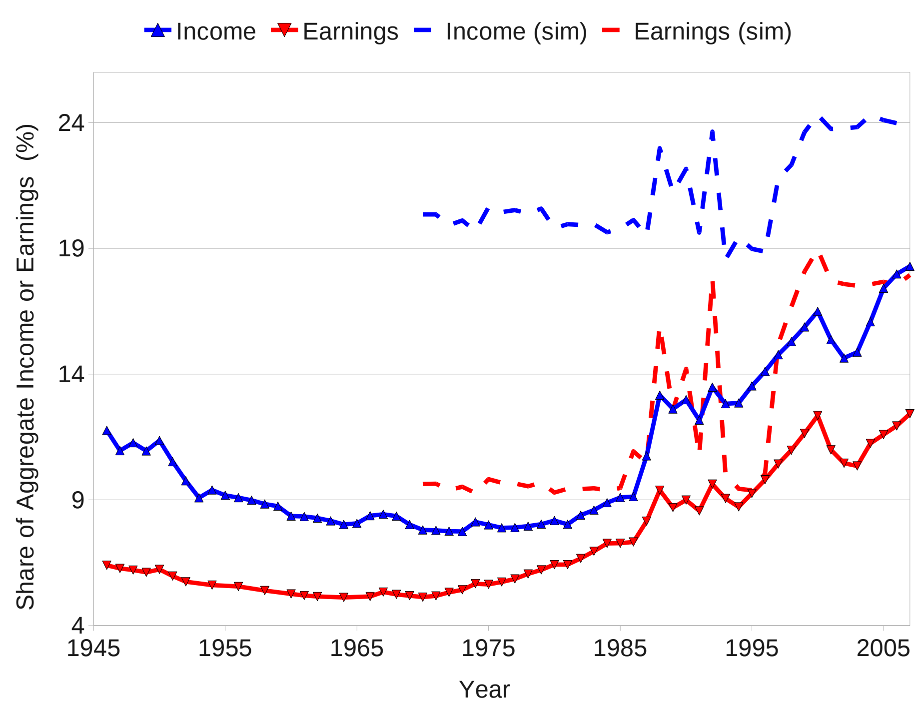
Regime	Top 1%:			Top 10% :		
	Cap	Lab	Ent	Cap	Lab	Ent
Data (1970)	24.3	45.6	30.0	14.7	65.2	20.2
Model (1970)	19.02	27.53	53.45	16.15	53.98	29.86
Data (2000)	11.8	61.7	26.5	8.9	72.3	18.8
Model (2000)	9.94	49.48	40.58	11.18	63.07	25.75
Flat labor tax	7.06	62.03	30.92	8.97	68.53	22.50
$\kappa = 0$	40.84	23.78	35.38	23.09	61.96	14.95

Composition of top percentile and top decile income from data, model and experiments.

Figure 1: Concentration of total and wage incomes

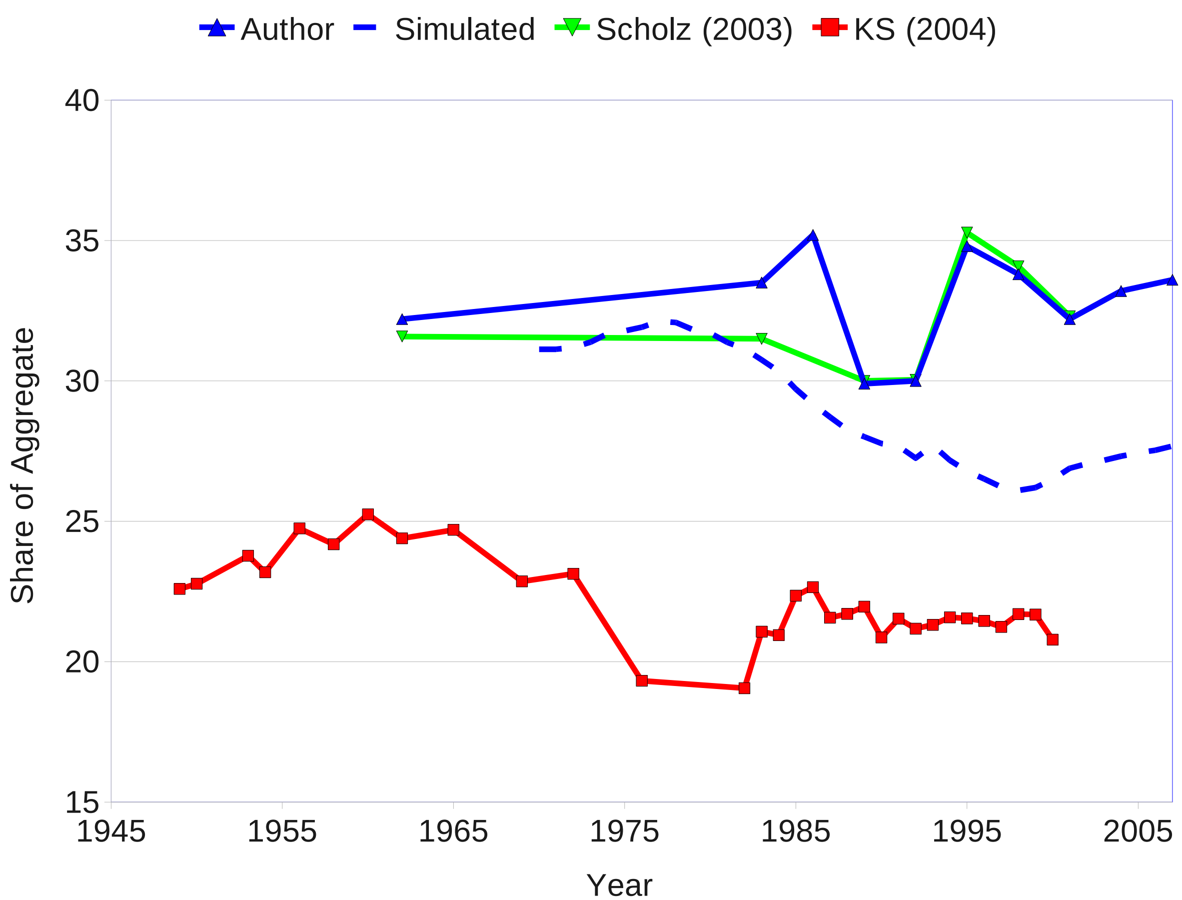


(a) Top decile shares of total and wage incomes,1946-2007. From Piketty and Saez (2003) based on income and estate tax returns as reported to the IRS. Dashed lines are the simulated series.



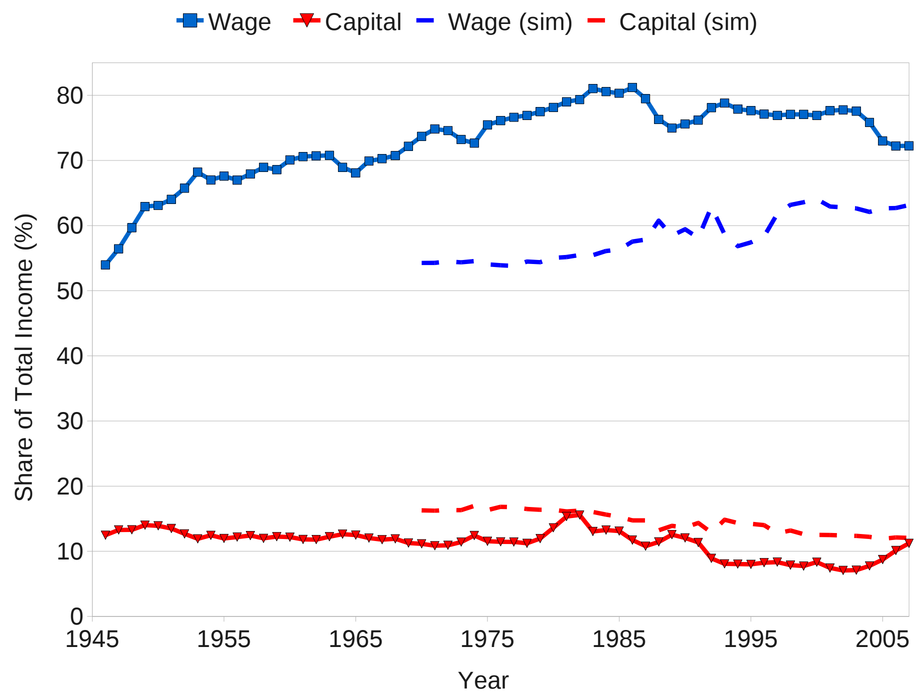
(b) Top percentile shares of total and wage incomes,1946-2007. From Piketty and Saez (2003) based on income and estate tax returns as reported to the IRS. Dashed lines are the simulated series.

Figure 2: Top percentile wealth shares, different authors.

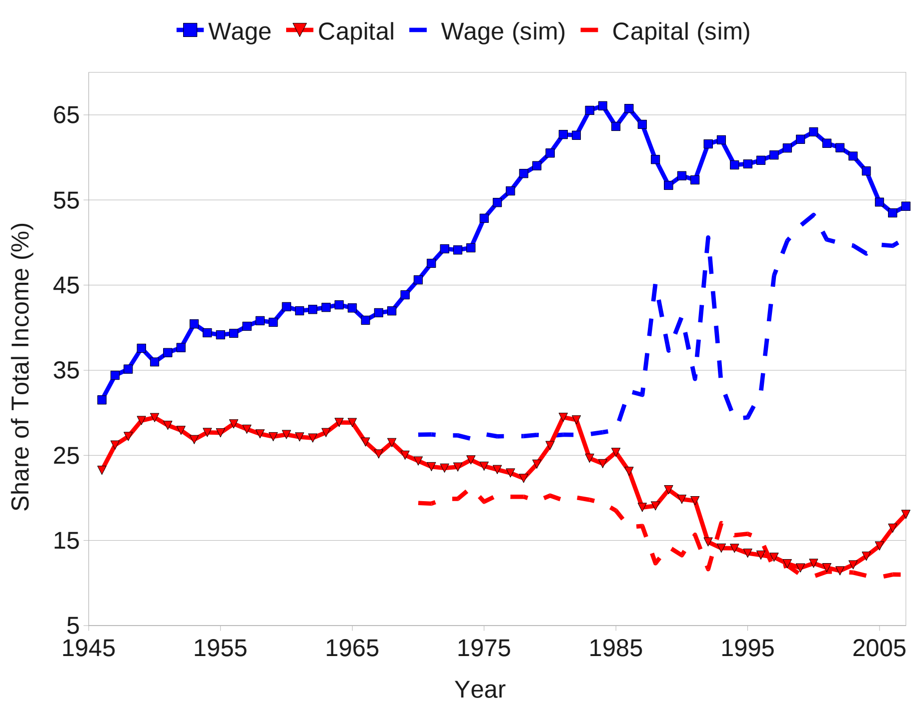


Scholz (2003) uses SCF 1963, 1983, 1989, 1992, 1995, 1998, and 2001. Author's calculations include 1986, 2004 and 2007. Kopczuk and Saez (2004) uses estate tax returns as reported to the IRS. Dashed lines are the simulated series.

Figure 3: Shares of wage and capital income, 1946-2007

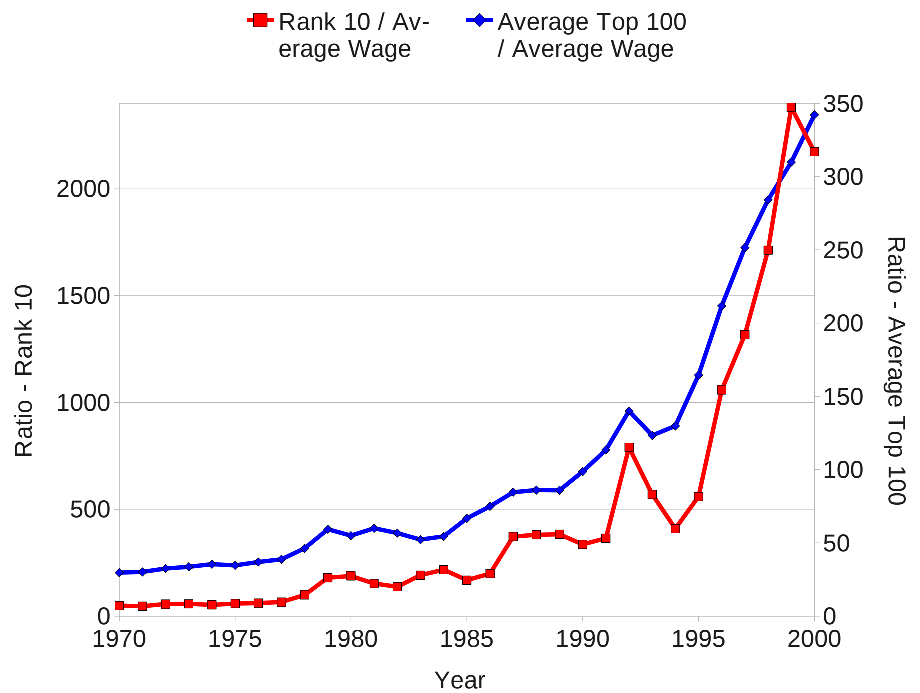


(a) Shares of wage, business and capital income for the top income decile, 1946-2007. From Piketty and Saez (2003) based on tax returns as reported to the IRS. Dashed lines are the simulated series.

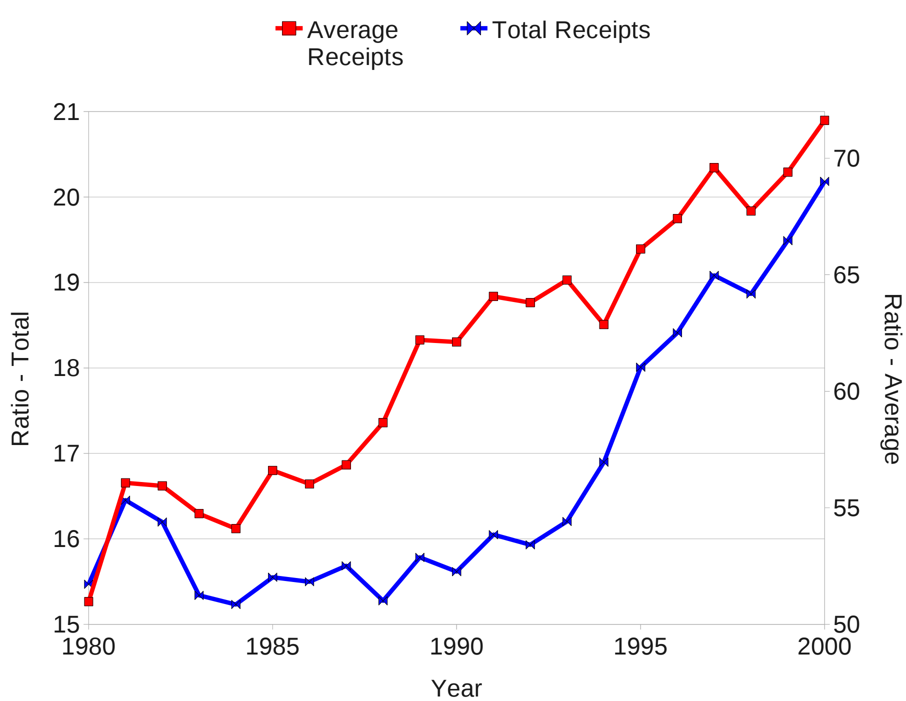


(b) Shares of wage, business and capital income for the top income percentile, 1946-2007. From Piketty and Saez (2003) based on tax returns as reported to the IRS. Dashed lines are the simulated series.

Figure 4: Executive compensation and size of corporate sector

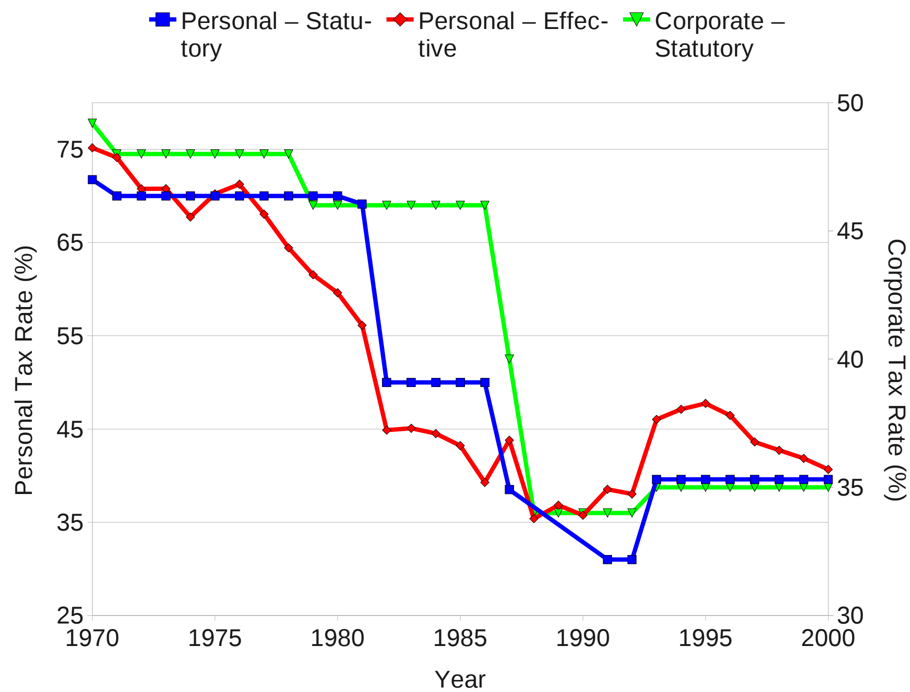


(a) Executive compensation over average annual wage, 1970-2000. Average annual wage is calculated from the National Income and Product Accounts. Executive compensation is either the top 10 rank CEO pay (left axis) or the average pay of the top 100 executives (right axis) from the Forbes survey.

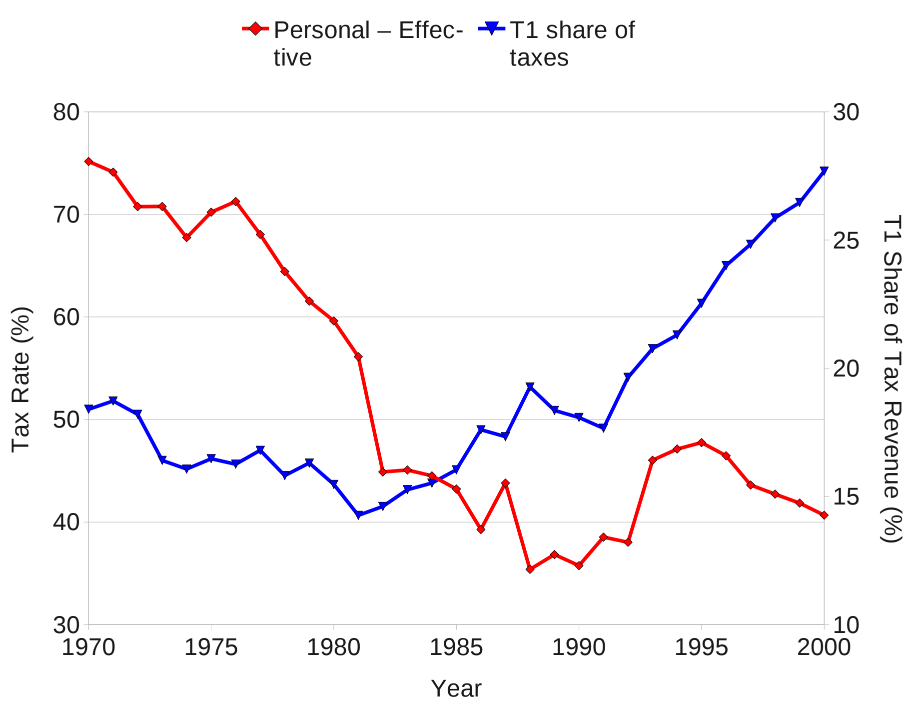


(b) Relative size of corporate over non-farm sole proprietorship receipts, 1980-2000. Based on the IRS Integrated Business Data.

Figure 5: Tax progressivity

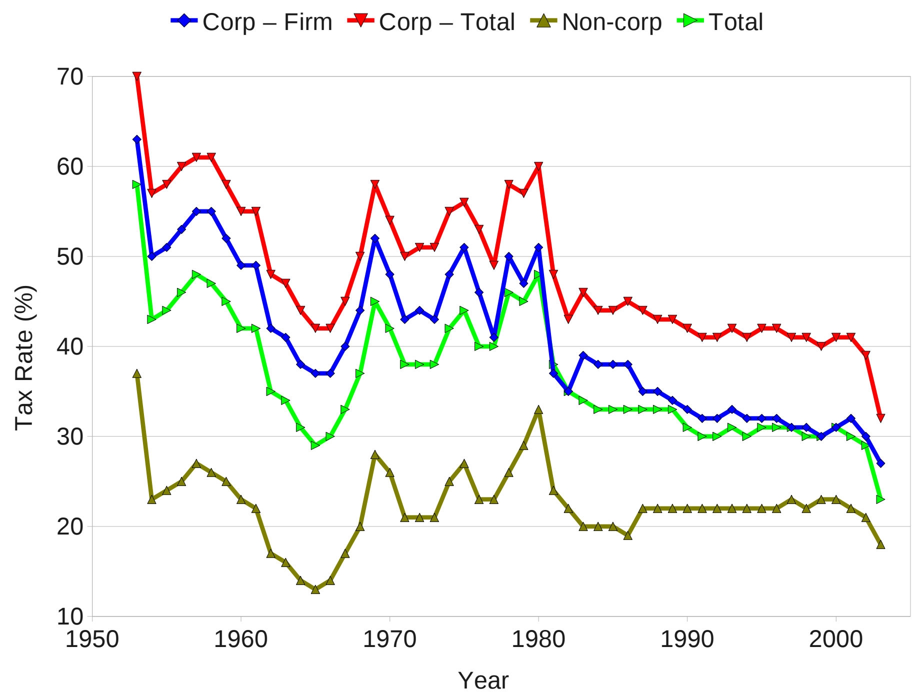


(a) Top marginal tax rates, 1970-2000. Personal effective top marginal tax rates are proxied by the effective tax rates of the top .01 percentile richest households, calculated in Piketty and Saez (2007).

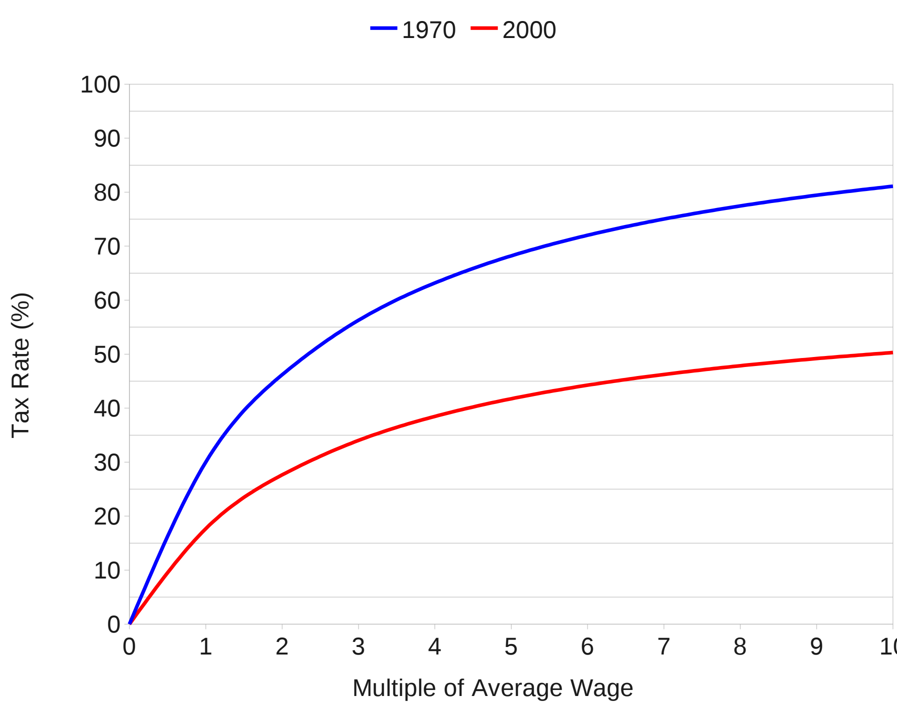


(b) Top marginal tax rate and share of tax revenue paid by top income percentile, 1970-2000. Personal effective top marginal tax rates are proxied by the effective tax rates of the top .01 percentile richest households, calculated in Piketty and Saez (2007).

Figure 6: Taxes used for calibration



(a) Effective marginal tax rates on capital income, 1953-2003. Corp-Firm refers to the EMTR faced by individual firms, which would be equal to the statutory marginal tax rate without subsidies. Corp-Total refers to the total rate of corporate investment, and Non-corp to the EMTRs faced by proprietorships and partnerships. Total is a weighted economy-wide tax rate on investment.



(b) Calibrated wage income tax functions, 1970 vs 2000. See text for details.

B. Proofs

B.1 Proof of Proposition 1

Part (1). Sufficiency is straightforward. Note that $\pi^*(\hat{m}) - w = d \leq \pi(\overline{m}) - w$ is the profit an intermediary can make by selling a project. By equation (1), we must have $d \geq (1+r)p \geq (1+r)\kappa$, otherwise there will be no individuals willing to sell their project. For necessity, suppose not, that $\pi^*(\overline{m}) - w \geq (1+r)\kappa$ but 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 for all $m \geq \overline{m}$. As long as the condition holds, intermediaries can purchase one of these projects at $\kappa + \varepsilon_1$, offer a compensation of $w + \varepsilon_2$ to a wage worker with managerial ability $\overline{m}$, and still generate non-negative profit. Hence there must be at least one manager, a contradiction. *Part (2)* then follows from the text.

B.2 Proof of Proposition 2 (Sketch)

The proof assuming stationarity is standard. 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, 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. However, the "endowment" of a constrained entrepreneur is uniformly bounded above by that of a non-constrained one, and hence Proposition 4 in Aiyagari (1993) applies. This also ensures that $\mathcal{H}$ satisfies the Feller property, so Assumption 1 is satisfied. Existence and uniqueness of a stationary RCE then is a straightforward application of Proposition 5 in Aiyagari (1993).

C. Numerical Procedure

I first discretize the state space for asset holdings a using 90 grid points. Since m is assumed to follow a continuous (truncated Pareto) 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). After discretizing the state space for (m, ϵ, a), the general scheme for computation is in two big parts:

C.1 Computing the Stationary Equilibrium

Under the stationarity assumption, all aggregate variables and hence prices are the constant, so I use the following algorithm:

1. Guess r and w.
2. Check for existence of a managerial equilibrium, and guess $\hat{m}$.
3. For each (r, 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 calculate the stationary distribution, I fix an exogenous process for (q, m, ϵ) and simulate the behavior of 140,000 individuals for 300 periods. The distribution in the 300th period is taken to be the stationary distribution from which I compute distributional statistics. Both during value function iteration and simulation, points off the grid are calculated by (tri-)linear interpolation.

C.2 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 in Appendix C.1.
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 $\{r_t, w_t, \bar{m}\}_{t=1}^{T}$. 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 $T = 300$. 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. While this method is not guaranteed to work in general, I check the method with different guesses and parameter values. The equilibrium survives all robustness checks.

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