Estate Taxation, Entrepreneurship, and Wealth*

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Abstract

We study the effects of abolishing estate taxation in a quantitative and realistic framework that includes the key features that policy makers are worried about: business investment, borrowing constraints, estate transmission, and wealth inequality. We use our model to estimate effective estate taxation. We consider various tax instruments to reestablish fiscal balance when abolishing estate taxation. We find that abolishing estate taxation would not generate large increases in inequality, and would, in some cases, generate increases in aggregate output and capital accumulation. If, however, the resulting revenue shortfall were financed through increased income or consumption taxation, the immensely rich, and the old among those in particular, would experience a welfare gain, at the cost of welfare losses for the vast majority of the population.

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1 Introduction

Since its introduction in 1916 the estate tax has been one of the most controversial taxes in the United States tax code.

The estate tax opponents call it the "death tax". Among the legislators supporting the abolition of the estate tax, representative Ron Paul (14th district of Texas) states: "The estate tax is immoral and counter-productive. ... My office has received hundreds of letters and emails from individuals and small business owners in my district. Theses people are not rich, but they have worked hard and saved to create an inheritance for their children..." Senator Patty Murray, from Washington State, states "I believe that we need to repeal the estate tax. It is bad for businesses. It's bad for workers and new job creation." President George W. Bush shares this view "The death tax results in unfair double taxation of income and it hurts America's small businesses, which are the engine of job creation."

The estate tax supporters see the estate tax as an extremely progressive tax and a very effective effective way to tax the richest (and dead) few. Representative Bart Stupak (1st district of Michigan) states "I have continuously supported reforming the estate tax, but a complete repeal is fiscally irresponsible, and serves to benefit only mega multi-millionaires while harming our economy...". Former Senator Tom Daschle, South Dakota adds "Do we really have to protect the billionaires? We are talking about the richest 2%." The estate tax supporters thus seem to believe that reducing estate taxation is a "Paris Hilton Benefit Tax Act," meaning that reduced estate taxes only benefit the heiresses and heirs of the largest fortunes in the country, rather than benefiting small entrepreneurs and family businesses. They also point out that the abolition of the "death tax" would imply replacing a tax on few rich and dead people with a "birth tax" on all citizens.

This paper studies the effects of abolishing estate taxation using a model that explicitly studies entrepreneurial entry, continuation decisions, investment and job creation, and transmission of estates across generations. While calibrated to match some other key aspects of the data, this framework matches the observed wealth inequality and wealth mobility for both entrepreneurs and workers, and replicates the observed consumption inequality.

We use our framework to provide a measure of effective estate taxation by matching aggregate estate taxes paid as a fraction of output and the fraction of estates that pay estate taxes. Given that our model provides such a good fit of observed net worth holdings, we argue that this is a good way to measure effective estate taxation. We find that the current statutory estate taxation code implies a large effective exemption level (about 5 million dollars per household), and a fairly low effective marginal tax rate (16%). These numbers are consistent with people rationally using legal exemptions, special provisions, and favorable valuation methods to lower the estate tax burden, and with previous estimates which used various other methods to estimate the schedule for the effective estate tax (see Gale, Hines and Slemrod for an overview [17]). They are also consistent with previous arguments according to which the exemption level is high enough to imply that the impact of estate taxes on family farms and businesses is not a major concern for most estates (see for example Harl [24] and Gale and Slemrod [19]).

We use our calibrated model to evaluate the aggregate and distributional effects of abolishing estate taxation. We compute the steady states before and after abolishing estate taxes, and the transition path of the economy between steady states. We consider alternative fiscal policies to reestablish fiscal balance when estate taxation is eliminated. First, we allow the government to cut government spending. Since government spending is unproductive in our framework, this should be the the scenario that is most favorable for abolishing estate taxes. Second, the government increases the tax on consumption. Third, the government increases the tax on total income.

We find that the effect of these policies on long-run inequality (both in terms of consumption and wealth) is small.

In contrast, the steady state aggregate effects on output and capital are positive and significant, compared to the small revenue raised by the estate and gift taxes (which is about 0.3% of GDP) when either government spending is cut, or when the tax rate on consumption is increased. Under those policies, aggregate output goes up by 1%-1.5%, while aggregate capital increases by 2.5%. The aggregate effects are instead much smaller when the tax rate on total income is increased. Even if the income tax increase required to make up for the shortfall in estate taxes is very small, this increased tax burden decreases the return from running a business. The majority of entrepreneurs would hence run their productive technologies on a smaller scale, which would imply smaller gains in aggregate output and capital.

These reforms have significant distributional implications. Looking at the welfare implications for the individual households, unsurprisingly the reform in which wasteful government spending is cut, is the reform that casts abolishing estate taxation in the most favorable light. In that case, increased investment by the entrepreneurs increases capital, and hence wages. Wages are the largest source of income for most of the population, therefore most of the households experience a welfare gain from this reform. The super-rich, and especially the old, benefit from the reduction in estate taxation. The rich who were below the estate taxation threshold before the reform, however, loose, because they receive a large fraction of income as capital income, and the interest rate goes down due to the increase in entrepreneurial savings and aggregate capital. About 80% of the young and 90% of the old households benefit from this reform, with an average welfare gain of the order or 0.2% of yearly consumption.

The reforms in which either the consumption or the income tax is raised to make up from the budget shortfall from abolishing estate taxation, instead, generate small welfare costs (of at most 1% of yearly consumption) for the vast majority of the population, while generating sizeable welfare gains for the richest few, and for the richest old in particular (on the order of 6% of yearly consumption). The average welfare costs of these reforms are about 0.2-0.3% of yearly consumption.

Our results thus suggest that most households alive today would find in their interest to oppose a reform in which a consumption or income tax were raised to compensate for decreased revenues from abolishing estate taxation.

To the best of our knowledge this paper is the first work that evaluates estate taxation reforms by using a quantitative, general equilibrium model that takes into account the effects of the reforms on the key channels that most worry legislators: wealth inequality, business activity, aggregate activity at large, and estate transmission, and that quantitatively matches a number of important features of the data, including wealth inequality.

Our findings are based on a life-cycle model with perfect altruism across generations and period-by-period occupational choice. Some households have the ability to employ capital and labor more productively than others, and potential and existing entrepreneurs face borrowing constraints because contracts are imperfectly enforceable.

This framework builds on Cagetti and De Nardi [11] by allowing the entrepreneurs to hire workers, by introducing progressive income and estate taxation, proportional consumption taxation, and by computing the transition paths of the economy in response to tax changes[1].

Despite the relevance of estate taxation reforms and its big impact in the policy circles, few papers study it in the context of quantitative models capable of matching the extreme concentration of wealth observed in the data. This is because constructing such a model, computing it, and calibrating it to the data are not easy tasks (see Quadrini and Ríos-Rull [38] and Cagetti and De Nardi [12] for a discussion.)

Castañeda, Díaz-Giménez, and Ríos-Rull [13] and Laitner [30] are exceptions in that they study estate taxation in the context of quantitative models that are, to some extent, capable of matching the extreme concentration of wealth observed in the data. Neither of these papers, however, model entrepreneurial business formation, job creation, and investment, which, according to many legislators, is a a key channel affected by estate taxation.

Further supporting the importance of explicitly modeling entrepreneurship, previous literature has shown that entrepreneurship is a key determinant of investment, saving, wealth holdings, and wealth inequality (See Quadrini and Ríos-Rull [39], Quadrini [36] and [37], Gentry and Hubbard [20], and Cagetti and De Nardi [11]), and is important to evaluate the effects of some income tax reforms (Meh [34], Kitao [27]).

Section 2 provides a brief overview of estate taxation in the United States. Section 3 describes our model. Section 4 discusses our calibration procedure. Section 5 evaluates the fit of our model against a number of important features of the data that we do not match by construction. Section 6 evaluates the effects of abolishing estate taxation while using various instruments to re-establish fiscal balance, and section 7 concludes.

[1]See Conesa and Krueger [14] for an earlier example computing the economy's transition path in a Beweley model.

2 A brief overview of estate taxation in the United States

Among the most recent literature Gale, Hines, and Slemrod [17], Aaron and Gale [1], and Gale and Perozek [18] provide overviews and discussions on estate and gift taxation. Here we only focus on the features of both statutory and effective estate taxation that are most important given our purposes.

Federal law imposes an integrated set of taxes on estates, gifts, and generation skipping transfers. The gross estate includes all of the decedent's assets. In the process of going from the gross estate to the net, taxable estate, there are some of the important steps[2]:

1. The allowed estate tax implied exemption level was $675,000.

2. Assets are typically evaluated at fair market value. Closely held business, however, are allowed to value real property assets at their "use value" rather than their highest alternative market-oriented value. The maximum allowed reduction in value was $770,000.

3. In addition, it is often possible to substantially discount asset value when such assets are not readily marketable or the taxpayers' ownership does not correlate with control.

4. Interests in certain qualified family businesses were also allowed an extra deduction of up to $ 625,000 in 2000 for the value of the business being transferred.

[2] We focus on the characteristics of the 2000 tax code. See Johnson, Mikow, and Britton Heller [8], and Brownlee [10] for a historic perspective on Federal Estate taxation.

5. One can apply unlimited deductions for transfers to a surviving spouse.

After determining the net estate, that is, the gross estate appropriately valued less deductions, the statutory tax rate is applied. The “applicable credit amount” implied that in 2000 at least the first $675,000 were not taxable. The marginal federal tax rate for a taxable returns above that amount was starting at 37% and topping out at 55%

Credit is given for state inheritance and estate taxes. Most states now levy “soak-up taxes” that only shift revenues from the federal to the state treasuries without adding to the total tax burden on the estate.

Just by looking at the simple scheme above, once can see that a rich couple could immediately double the standard exemption level just by leaving the children assets up to the deduction upon the death of the first decedent, and then applying the deduction a second time upon death of the other spouse.

Judicious application of valuation schemes and extra deduction for the presence of a family business further increase the exemption level and brings down the effective estate tax rate above the exemption level. Schmalbeck [40] describes many (legal) estate taxes avoidance schemes to reduce the estate tax burden and provides some measures of effective estate taxes after such schemes are implemented.

Gale and Slemrod [19] argue that simply by using legal valuation techniques, exemptions, and various deductions, a couple with a $4 million dollar business could pass it to their heir without paying any estate taxes, and without having to engage in any complicated tax avoidance scheme. They also argue that this threshold can be increased even further using other legal schemes.

Britton Eller, Erard, and Ho [33] focus on tax noncompliance by using audit data. They find that overall (illegal) estate tax evasion to be about 13%

of the potential tax base.

Aaron and Munnell [2] and Kopczuk et al. [28] also argue that there are many ways to reduce effective estate taxation.

Although many experts agree that effective estate taxation can be substantially reduced by appropriate estate management and valuation (this can be done, in part, even after the death of the decedent), there is considerable uncertainty about how much people can and do reduce the estate tax burden by using both legal and illegal ways. Wolff [46] and Poterba [35] study this by comparing tax revenues and the distribution of estates reported in tax forms with the hypothetical one that would be implied by the Survey of Consumer Finances using mortality probabilities and many other assumptions. While Wolf argues that the estate tax captures only about 25% of the potential tax base, Poterba concludes that it catches most of it. Similarly, there is uncertainty about the effective progressivity of the estate tax and on its exact exemption level. Some argue that it is easier to decrease the tax burden for smaller estates (which are also less likely to be audited). Others argue that given the economies of scale for tax avoidance and evasion the tax burden might actually be lower for larger estates.

There is, in contrast, no dispute about the observed revenues from the estate and gift tax, and about the fraction of estates that do pay estate taxes. In terms of revenue, only about 2% of the estates of adult decedents do pay any estate taxes, and their revenue is about 0.3% of US output (See for example Gale and Slemrod [19]).

In the process of calibrating our model we propose a complementary and novel way to assess the burden of estate taxation. We assume a simple form for estate taxation that allows for an exemption level and a constant tax rate above such exemption level, and we use our model generated data to match the fraction of estates paying estate taxes, and estate tax revenues as a fraction of output. Interestingly, we find numbers that fall well within the bounds proposed by the previous literature. Given that our model matches asset holdings so well both for entrepreneurs and workers, and given the considerable uncertainty about effective estate tax avoidance and evasion, we see this as a useful way to proceed.

Legislation passed in 2003 has statutory marginal tax rates gradually decrease each year, and statutory exemption levels to gradually increase every year until 2010. In 2010, all estates are be taxed at 0%. In 2011, however, these temporary cuts are scheduled to vanish, and the statutory taxation schedule is to revert to much higher levels. Many interpret this path as compelling evidence that a reform is needed.

3 The model

Since we compute the transition dynamics between the steady states corresponding to a given policy experiment, we make time subscripts explicit whenever relevant.

3.1 Demographics

We adopt a life-cycle model with intergenerational altruism. To make the results quantitatively interesting, we need short time periods. To make the model computationally manageable, we have to keep the number of stages of life small. To reconcile these two necessities, we adopt a modeling device introduced by Blanchard [9] and generalized by Gertler [21] to a life-cycle setting.

Our model period is one year long. Households go through two stages of life, young and old age. A young person faces a constant probability of aging during each period $(1 - \pi_y)$, and an old person faces a constant probability of dying during each period $(1 - \pi_o)$. When an old person dies, his offspring enters the model, carrying the assets bequeathed to him by the parent.

Appropriately parameterized, this framework generates households for which the average length of the working period and the retirement period is realistic. There is a continuum of households of measure 1.

3.2 Preferences

The household's flow of utility from consumption is given by $\frac{c_t^{1-\sigma}}{1-\sigma}$. The households discount the future at rate β and are perfectly altruistic toward their descendants.

3.3 Technology

Each person possesses two types of ability, which we take to be exogenous, stochastic, positively correlated over time, and uncorrelated with each other. Entrepreneurial ability (θ_t) is the capacity to invest capital and labor more or less productively using one's own production function. Working ability (y_t) is the capacity to produce income out of labor by working for others.

The entrepreneurs can borrow, invest capital, hire labor, and run a technology whose return depends on their own entrepreneurial ability: those with higher ability levels have higher average and marginal returns from capital and labor. When the entrepreneur invests k_t production net of depreciation is given by

$$f(k_t, n_t) = \theta(k_t^{\gamma}(1 + n_t)^{(1-\gamma)})^{\nu} + (1 - \delta)k$$

where ν, $\gamma \in [0,1]$, and n is hired labor ($n \geq 0$). We normalize the labor of the entrepreneur to 1. Entrepreneurs thus face decreasing returns from investment, as their managerial skills become gradually stretched over larger and larger projects (as in Lucas (1978)). While entrepreneurial ability is exogenously given, the entrepreneurial rate of return from investing in capital is endogenous and is a function of the size of the project that the entrepreneur implements.

There is no within-period uncertainty regarding the returns of the entrepreneurial project. The ability θ_t is observable and known by all at the beginning of the period. We therefore abstract from problems arising from partial observability, costly state verification, and from diversification of entrepreneurial risk.

Workers can save (but not borrow) at a riskless, constant rate of return.

Many firms are not controlled by a single entrepreneur and are not likely to face the same financing restrictions that we stress in our model. Therefore, as in Quadrini (2000), we model two sectors of production: one populated by the entrepreneurs and one by "non-entrepreneurial" firms. The non-entrepreneurial sector is represented by a standard Cobb-Douglas production function:

$$F(K_t^c, L_t^c) = A(K_t^c)^{\alpha}(L_t^c)^{1-\alpha} \tag{1}$$

where K_t^c and L_t^c are the total capital and labor inputs in the non-entrepreneurial sector and A is a constant. In both sectors, capital depreciates at a rate δ.

3.4 Credit market constraints

As in Marcet and Marimon [32], Kehoe and Levine [26], Albuquerque and Hopenhayn[3], Cooley, Marimon, and Quadrini [15], and Cagetti and De Nardi [11], the borrowing constraints are endogenously determined in equilibrium and stem from the assumptions that contracts are imperfectly enforceable.

Imperfect enforceability of contracts means that the creditors will not be able to force the debtors to fully repay their debts as promised, but that the debtors fully repay only if it is in their own interest to do so. Since both parties are aware of this feature and act rationally, the lender will lend to a given borrower an amount (possibly zero) that will be in the debtor's interest to repay as promised.

In particular, we assume that the entrepreneurs who borrow either can invest the money and repay their debt at the end of the period or can run away without investing it and be workers for one period. In the latter case, they retain a fraction f of their working capital k_t (which includes own assets and borrowed money) and their creditors seize the rest. We assume that labor services are paid at the end of the period, hence entrepreneurs are not contrained in the amount of labor that they hire.

In the absence of market imperfections, the optimal level of capital is only related to technological parameters and does not depend on initial assets. In our framework, instead, the higher the amount of the entrepreneur's own wealth invested in the business, the larger the amount that the borrower would lose in case of default. Hence, the lower the incentive to default, and the larger the sum that the creditor is willing to lend to the entrepreneur. Hence, the entrepreneur's assets act as collateral, but the loan is not necessarily fully collateralized.

As a result, not all potentially profitable projects receive appropriate funding. Households with little wealth can borrow little, even if they have high ability as entrepreneurs. Since the entrepreneur forgoes his potential earnings as a worker, he will choose to become an entrepreneur only if the size of the firm that he can start is big enough, that is, if he is rich enough to be able to borrow and invest a suitable amount of money in his firm.

3.5 Government and taxation

The government is infinitely lived. It levies taxes, pays a pension p_t to each retiree, provides a certain level g_t of public purchases (which do not enter the households' utility function), and pays interest on the accumulated debt. During every period, tax revenues from income, consumption, and estate taxes are equal to government purchases, pension payments, and interest payments on the debt.

We model progressive taxation of total income (as in Altig and Carlstrom [5]), and we allow the tax schedules to be different for entrepreneurs and non-entrepreneurs (including workers and retirees). We adopt Gouveia and Strauss' [23] functional form and assume the average federal tax rate $\tau^i(Y_t)$ on total income Y_t is given by

$$\tau^i(Y_t) = b^i - b^i(s^i Y_t^{p^i} + 1)^{-\frac{1}{p^i}}, \tag{1}$$

where $i = e, w$: entrepreneurs and workers. Gouveia and Strauss [23] have shown that this functional form is flexible enough to approximate well the effective average tax rate. As explained in the calibration section, we estimate the parameters b^i, s^i, and p^i from microeconomic data, separately for entrepreneurs and non-entrepreneurs.

Total income taxes paid by each household are given by

$$T_t^i(Y_t) = \tau^i(Y_t)Y_t + \tau_t^s Y_t,$$

where τ_t^s captures state and other income taxes (other than federal). The government also levies a sales tax on consumption, at rate τ_t^c. Estates larger than a given value e_t are taxed at rate τ_t^b on the amount in excess of e_t. The tax rates τ_t^s, τ_t^c, and τ_t^b are potentially time-varying, depending on the policy experiment under consideration.

3.6 Households

At the beginning of each period the current ability levels are known with certainty, while next period's levels are uncertain. Each young individual starts the period with assets a_t, entrepreneurial ability θ_t, and worker ability y_t and chooses whether to be an entrepreneur or a worker during the current period.

An old entrepreneur can decide to keep the activity going or retire, while a retiree cannot start a new entrepreneurial activity.

The young's problem

The value function of a young person is

$$V_t(a_t, y_t, \theta_t) = \max\{V_t^e(a_t, y_t, \theta_t), V_t^w(a_t, y_t, \theta_t)\}, \tag{2}$$

where $V_t^e(a_t, y_t, \theta_t)$ is the value function of a young individual who manages an entrepreneurial activity during the current period. The term $V_t^w(a_t, y_t, \theta_t)$ is the value function if he chooses to be a worker during the current period.

The young entrepreneur's problem can be written as

$$V_t^e(a_t, y_t, \theta_t) = \max_{c_t, k_t, n_t, a_{t+1}} \{u(c_t) + \beta\pi_y E_t V_{t+1}(a_{t+1}, y_{t+1}, \theta_{t+1}) + \beta(1-\pi_y) E_t W_{t+1}(a_{t+1}, \theta_{t+1})\} \tag{2}$$

subject to

$$Y_t^e = \theta(k_t^\gamma(1+n_t)^{(1-\gamma)})^\nu - \delta k_t - \bar{r}_t(k_t - a_t) - \bar{w}_t n_t \tag{3}$$

$$a_{t+1} = Y_t^e - T_t^e(Y_t^e) + a_t - (1+\tau_t^c)c_t \tag{4}$$

$$u(c_t)+\beta\pi_y E_t V_{t+1}(a_{t+1}, y_{t+1}, \theta_{t+1})+\beta(1-\pi_y)E_t W_{t+1}(a_{t+1}, \theta_{t+1}) \geq V_t^w(f\cdot k_t, y_t, \theta_t) \tag{5}$$

$$a_t \geq 0 \tag{6}$$

$$n_t \geq 0 \tag{7}$$

$$k_t \geq 0. \tag{8}$$

The term Y_t^e represents the entrepreneur's total profits. The expected value of the value function is taken with respect to (y_{t+1}, θ_{t+1}), conditional on (y_t, θ_t). Eq. (5) determines the maximum amount that an entrepreneur with given state variables can borrow. The term $W_t(a_{t+1}, \theta_{t+1})$ is the value function of the old entrepreneur at the beginning of the period, before deciding whether to stay in business or retire. We have

$$V_t^w(a_t, y_t, \theta_t) = \max_{c_t, a_{t+1}} \{u(c_t)+\beta\pi_y E_t V_{t+1}(a_{t+1}, y_{t+1}, \theta_{t+1})+\beta(1-\pi_y)W_{t+1}^r(a_{t+1})\} \tag{9}$$

subject to eq. (6) and

$$Y_t^w = \bar{w}_t\, y_t + \bar{r}_t\, a_t \tag{10}$$

$$a_{t+1} = (1+\bar{r}_t)a_t - T_t^w(Y_t^w) - (1+\tau_t^c)c_t, \tag{11}$$

where $\bar{w}_t$ is the equilibrium wage rate.

The old's problem

Since the old entrepreneur can choose to continue the entrepreneurial activity or retire, his state variables are his current assets a_t and his entrepreneurial ability level θ_t. His value function is given by

$$W_t(a_t, \theta_{t+1}) = \max\{W_t^e(a_t, \theta_t), W_t^r(a_t)\}, \tag{12}$$

where $W_t^e(a_t, \theta_t)$ is the value function for the old entrepreneur who stays in business, and $W_t^r(a_t)$ is the value function of the old retired person. Define the inherited assets, net of estate taxes, as $a_{t+1}^n = a_{t+1} - \tau_{t+1}^b \cdot \max(0, a_{t+1} - e_{t+1})$. We have

$$W_t^e(a_t, \theta_t) = \max_{c_t, k_t, n_t, a_{t+1}} \{u(c_t) + \beta\pi_o E_t W_{t+1}(a_{t+1}, \theta_{t+1}) + \beta(1-\pi_o) E_t V_{t+1}(a_{t+1}^n, y_{t+1}, \theta_{t+1})\} \tag{13}$$

subject to eq. (3), eq. (4), eq. (6), eq. (7), eq. (8) and

$$u(c_t) + \beta\pi_o E_t W_{t+1}(a_{t+1}, \theta_{t+1}) + \beta(1 - \pi_o) E_t V_{t+1}(a_{t+1}^n, y_{t+1}, \theta_{t+1}) \geq W_t^r(f \cdot k_t). \tag{14}$$

The child of an entrepreneur is born with ability level (θ_{t+1}, y_{t+1}). The expected value of the child's value function with respect to y_{t+1} is computed using the invariant distribution of y_t, while the one with respect to θ_{t+1} is conditional on the parent's θ_t and evolves according to the same Markov process that each person faces for θ_t while alive. This is justified by the assumption that the child of an entrepreneur inherits the parent's firm.

A retired person (who is not an entrepreneur) receives pensions and social security payments (p_t) and consumes his assets. His value function is

$$W_t^r(a_t) = \max_{c_t, a_{t+1}} \{u(c_t) + \beta\pi_o W_{t+1}^r(a_{t+1}) + \beta(1-\pi_o)E_t V_{t+1}(a_{t+1}^n, y_{t+1}, \theta_{t+1})\} \quad (15)$$

subject to eq. (6) and

$$a_{t+1} = (1+\bar{r}_t)a_t + p_t - T_t^w(p_t + \bar{r}_t a_t) - (1+\tau_t^c)c_t. \quad (16)$$

The expected value of the child's value function is taken with respect to the invariant distribution of y_t and θ_t.

3.7 Equilibrium definition

Let $x_t = (a_t, y_t, \theta_t, s_t)$ be the state vector, where s distinguishes young workers, young entrepreneurs, old entrepreneurs, and old retired. From the decision rules that solve the maximization problem and the exogenous Markov process for income and entrepreneurial ability, we can derive a transition function $M_t(x_t, \cdot)$, which provides the probability distribution of x_{t+1} (the state next period) conditional on the current state x_t.

An equilibrium is given by the following functions

$$\left\{\begin{array}{l}\text{a risk free interest rate } \bar{r}_t \text{ and wage rate } \bar{w}_t,\\ \text{taxes } (T_t^w(.),\ T_t^e(.), \tau_t^c,\ \tau_t^b,\ e_t) \text{ and social security payments } p_t,\\ \text{allocations } c_t(x), \text{ and } a_t(x), \text{ occupational choices,}\\ \text{entrepreneurial labor hiring } n_t(x), \text{ and investments } k_t(x),\\ \text{and a distribution of people over the state variables } x_t\text{: } m_t(x),\end{array}\right.$$

such that, given $\bar{r}_t$, $\bar{w}_t$, and government taxes and transfer schedules:

- The functions c_t, a_t, n_t and k_t solve the maximization problems described above.

- The capital and labor markets clear. Total labor supplied by the workers equals the total labor employed in the non-entrepreneurial sector and total labor hired by the entrepreneurs. Total household savings in the economy equal the sum of the total capital employed in the non-entrepreneurial and entrepreneurial sectors plus government debt.

- The marginal product of labor and the marginal product of capital (net of depreciation) in the non-entrepreneurial sector are equal to $\bar{w}_t$ and $\bar{r}_t$.

- The government budget constraint balances at every period: total taxes collected equal government purchases, transfers, and interest payments on government debt,

$$\int (T_t^x(Y_x)+\tau_t^c c(x)+I_o(x)\tau_t^b(1-\pi_o)\cdot\max(0, a_{t+1}(x_t)-e_t))dm_t(x) = p_t\pi_r+g_t+\bar{r}_t D_t.$$

 The integral is over all of the population, I_o is an indicator function that is equal to one if the person is old and zero otherwise, and π_r is the fraction of retired people in the population. In steady state $D_t = \bar{D}$.

- The distribution of people m_t is induced by the transition matrix of the system as follows

$$m'_{t+1} = M_t(x_t, \cdot)'m(t)'.$$

 In steady state $m_t = m^*$ is the invariant distribution for the economy and debt, prices, and government policies are constant and the individual's decision rules are time-independent.

3.8 The transition path between steady states

Our economy starts from an initial steady state in which there is estate taxation. Unexpectedly, the government abolishes estate taxes and makes up for the shortfall of government revenues by changing one of the following three instruments:

1. government spending,
2. the consumption tax,
3. the proportional part of the tax on total income.

When we use either the income or the consumption tax, we allow the government to adjust this policy instrument for ten years, and after this period the tax is set at its final steady state level. The level of the tax during these years is determined by the requirement that the government budget constraint has to be satisfied in present value. The shape of the tax change over this time period is constrained to be piecewise linear over two five-years subperiods. That is, during these ten years the government could, for example, raise the chosen tax instrument for five years, and then lower it down to its final steady state value for other five years. In these experiments government expenditure is kept fixed as a fraction of total output both during the transition and in the final steady state.

For all final steady states we set government debt to be the same constant fraction of total output as in the initial steady state.

When we change government spending as a result of the abolition of the estate tax, we keep all other tax rates fixed at their initial steady state value, and we take government debt to be a constant fraction of output also during the transition path. Budget balance for the government then implies how much government expenditure is.

As soon as people learn about the new policy, the households reoptimize their behavior taking as given the new path of government policy and prices. Barring any other changes, the economy will eventually settle down on a final steady state as a result of the new tax code (the final steady state). During the intervening years, the economy will be in a transition.

The transition will take longer than the period over which taxes change because the distribution of people over state variables will take a while to reach its steady state level, and because of general equilibrium effects (the prices will take a while to get close to their steady state levels).

4 Calibration

Tables 1 and 2 list the parameters of the model. Table 1 lists the parameters that we take as given and do not use to match model-generated moments with moments in the data. Table 2 lists the parameters of the model that we choose so that the data generated by the initial steady state of the model matches some relevant counterpart of the observed data.

Regarding the first set of parameters, we take the coefficient of relative risk aversion to be 1.5, a value close to those estimated, among others, by Attanasio et al. [6]. As is standard in the business cycle literature, we choose a depreciation rate δ of 6% and the capital share in the non-entrepreneurial production function of .33. The probability of aging and of death are such that the average length of the working life is 45 years and the average length of the retirement period is 11 years. This implies that the fraction of young people in the population is about 80%. The logarithm of the income y process for working people is assumed to follow an AR(1). We take its persistence to be .95, as estimated, for instance, by Storesletten et al. [44]. The variance is chosen to match the Gini coefficient for earnings of .38, the average found in the PSID. We assume that the income process and the entrepreneurial ability processes evolve independently; the exact values for the income and ability processes are described in Appendix A. The social security replacement rate is 40% of average gross income. (see Kotlikoff et al. [29].)

The average of the ratio between government purchases and GDP over 1990-99 was 18.7% (Economic Report of the President, 2000).

As in Altig et al. [4], we take the tax rate on consumption to be 11%. The ratio of total indirect taxes to personal consumption expenditure in the NIPA accounts has been quite stable around 11%-12% from 1989 to 1999.

We pick the level of government debt (as a fraction of output) so that, given the equilibrium interest rate, every period the total interest payments on government debt equal 3% of output (as in Altig et al. [4]).

We estimate the parameters of the tax function on total income using PSID data for 1989. See Appendix B for details. Figure 1 displays our estimated average tax rates as a function of total income for the whole population and for the subpopulations of entrepreneurs and workers.

In previous work (Cagetti and De Nardi [11]) we have discussed the relevant empirical counterpart to the entrepreneur in our model. We have argued that our entrepreneurs are the self-employed business owners that actively manage their own firm(s). We identify them in the Survey of Consumer Finances (SCF) with those that declare that they are self-employed, that they own a business, and that they actively manage it.

Table 2 lists the remaining parameters of the model and their corresponding values in the baseline calibration. We consider only two values of en-

Parameter	Value	Source(s)
Preferences, technology, and demographics		
σ	1.5	Attanasio et al. [6]
δ	.06	Stokey and Rebelo [43]
α	.33	Gollin [22]
A	1	normalization
π_y	.98	average working life: 45 years
π_o	.91	average retirement life: 11 years
Labor income process and social security payments		
y, P_y	see appendix A	Huggett [25], Lillard et al. [31]
p	40% average yearly income	Kotlikoff et al. [29]
Public expenditure, government debt, and taxes		
g	18.7% GDP	NIPA
D	see text	Altig et al. [4]
τ_c	11%	Altig et al. [4]
b_w	.32	our estimates
b_e	.26	our estimates
s_w	.22	our estimates
p_w	.76	our estimates
p_e	1.4	our estimates
s_e	.42	our estimates

Table 1: Fixed parameters and their sources.

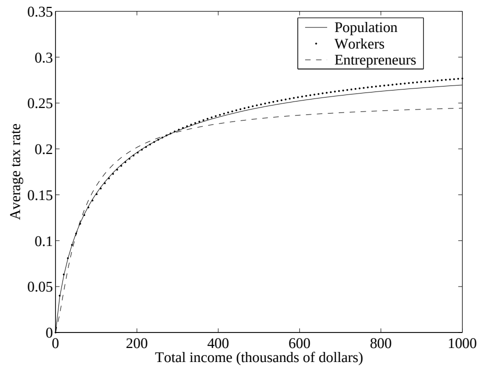

Figure 1: Estimated average tax rates for the whole population, workers, and entrepreneurs.

trepreneurial ability: zero (no entrepreneurial ability) and a positive number. This implies that P_θ is a two-by-two matrix. Since its rows have to sum to one, this gives us two parameters to calibrate. We also have to choose values for ν, the degree of decreasing returns to scale to entrepreneurial ability, γ, the share of income going to entrepreneurial working capital, f, the fraction of working capital the entrepreneur can keep in case he defaults, the estate tax rate, and its corresponding exemption level.

In total, these are nine parameters to be used to match nine moments of the data. We use the first seven to target the following moments generated by the model: the capital-output ratio (3.0), the fraction of entrepreneurs in the population (7.6 percent), the fraction of entrepreneurs exiting entrepreneurship during each period (22%), the fraction of workers becoming entrepreneurs during each period (2.5%), the ratio of median net worth of entrepreneurs to that of workers (7), the fraction of people with zero wealth (7-13%), the fraction of entrepreneurs hiring workers on the labor market (60%). We choose the other two parameters to match the revenue from estate and gift taxes (0.3% of output) and the fraction of the estates that pay estate taxes (2%). Our

Calibrated Parameter	Value
β	.9
θ	[0, 0.6]
P_θ	see text
ν	.88
γ	.84
f	75%
τ_b	16%
e	120

Table 2: Calibrated parameters.

calibration matches all of these targets well.

While our calibrated share of income that goes to entrepreneurial working capital might appear high compared to the one that people use in the aggregate economy (.33-0.40), it should be noted that this high number is necessary to match the empirical observation that 40% of entrepreneurs hire no labor on the market.

5 Results: evaluating our model generated data against the actual data.

We now compare some important features of the actual data for the U.S. economy with the corresponding features of our model-generated data. A good fit of the model to aspects of the data that were not matched by construction in our calibration procedure increases our faith in the policy projections generated by the model.

5.1 Wealth distribution

Table 3 compares some data for the U.S. economy (from the 1989 SCF, the data from other years are similar) and for the model-generated data, and Figures 2 and 3 compare the wealth distribution for the same U.S. data and for the model, respectively, for the whole population and for the subpopulation of entrepreneurs.

Our framework with entrepreneurial choice fits the observed wealth distribution very well, both for the whole population, and for the subpopulation of the entrepreneurs. See Cagetti and De Nardi [11] for a discussion on the role of entrepreneurship in shaping wealth concentration, on the relationship between borrowing constraints and entrepreneurial entry, and on entrepreneurial returns.

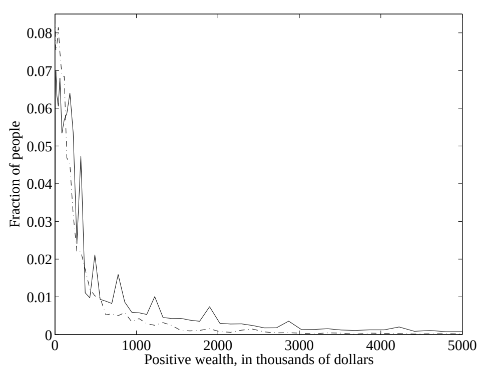

Figure 2: Distribution of wealth for the whole population. Dash-dot line: data; solid line: baseline model.

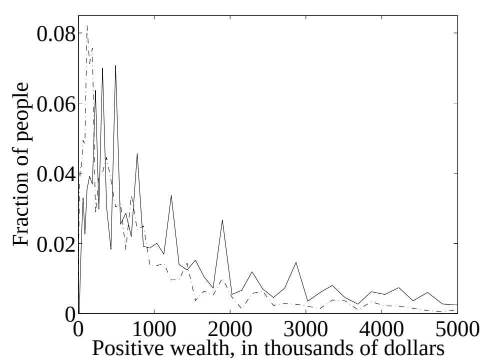

Figure 3: Distribution of the entrepreneurs' wealth. Dash-dot line: data; solid line: baseline model.

		Percentage wealth in the top			
	Wealth Gini	1%	5%	20%	40%
U.S. data	.78	30	54	81	95
Model	.82	30	60	85	95

Table 3: Baseline calibration.

5.2 Wealth mobility

To evaluate the policy implications of the model it is also important to evaluate whether the dynamics of the model are consistent with those in the observed data. Given that wealth is our main interest, we evaluate here the wealth dynamics of the model.

Unfortunately the SCF, which is the data set specifically designed to study wealth and the behavior of the wealthy (see Cagetti and De Nardi [12] for a discussion on this point) does not have a panel dimension. Hence, it cannot be used to study wealth dynamics at the household level. We therefore use data from the wealth supplement of the Panel Study of Income Dynamics (PSID), which does have a panel dimension, and also asks questions that allow us to distinguish the self-employed business owners from the workers. The PSID wealth supplement is available every five years. We report the transition dynamics for the 1989-1995 period (the results from the other years look similar).

To understand the relationship between mobility and occupational choice, we follow the same approach followed by Quadrini ([36] and [37]). We compute net worth terciles for the whole population of both self-employed business owners and workers. We divide the population according to occupational mobility as follows: workers that remain workers, workers that become entrepreneurs, entrepreneurs that remain entrepreneurs, and entrepreneurs that switch to being workers. For each of these subcategories we compute wealth mobility across net worth terciles.

Table 4 reports both the results and the number of observations corresponding to each cell. We can see that in our sample the total number of workers that remain workers is 2214, the total number of workers that switch to being entrepreneurs is 75, the total number of entrepreneurs that switch to being workers is 49, and the number of entrepreneurs that stay entrepreneurs is 206. These numbers are important because they highlight how some of the transition matrices are based on a small number of observations and should therefore be taken with caution.

This said, the transition matrices indicate more wealth upward mobility for the entrepreneurs that stay entrepreneurs than for the workers that stay workers. Although the mobility matrices off the main diagonal (workers to entrepreneurs and entrepreneurs to workers) are based on a very small a sample size, they seem to broadly indicate that the workers that become entrepreneurs are more upwardly mobile than those that remain workers, and that the entrepreneurs that switch to being workers are more downward mobile than those that remain entrepreneurs.

We compute the analogous occupation and wealth mobility transition matrix generated by our model (also over a five year period). The results are in table 5. The transition matrices estimated using our model include all of the population, and therefore do not have a small sample problem.

Table 5 shows that our model matches extremely well the wealth transitions of the workers to workers (the one for which the PSID has more observations), and that also matches quite well the important patterns of the PSID data that

Staying workers			Switching workers		
0.79	0.18	0.03	0.47	0.44	0.08
0.21	0.64	0.15	0.04	0.42	0.54
0.02	0.23	0.75	0.00	0.23	0.77
number of observations for each cell					
661	148	29	17	16	3
163	507	115	1	11	14
16	135	440	0	3	10
Switching entrepreneurs			Staying entrepreneurs		
0.75	0.25	0.00	0.50	0.33	0.17
0.20	0.70	0.10	0.21	0.51	0.28
0.06	0.29	0.65	0.02	0.07	0.91
number of observations for each cell					
6	2	0	6	4	2
2	7	1	9	22	12
2	9	20	3	10	138

Table 4: Wealth mobility: data from the PSID 1989 to 1994.

we have discussed above, such as more upward mobility for the entrepreneurs, and for the workers that become entrepreneurs.

5.3 Consumption inequality

Table 6 reports data from the consumption distribution in the United States[3] and in our benchmark model economy. The first row displays the U.S. distribution of consumption of non-durable goods, while the second row reports the U.S. distribution of consumption of non-durable goods plus imputed services of consumer durables. These two lines show that these distributions are very

[3]Data from the 1991 wave of the Consumer Expenditure Survey (CEX). Computations by Castañeda et al. [13].

Staying workers			Switching workers		
0.76	0.23	0.01	0.16	0.60	0.24
0.22	0.58	0.20	0.01	0.28	0.71
0.00	0.21	0.79	0.00	0.01	0.99
Switching entrepreneurs			**Staying entrepreneurs**		
0.38	0.45	0.17	0.03	0.14	0.83
0.08	0.42	0.50	0.02	0.08	0.92
0	0.03	0.97	0.00	0.01	0.99

Table 5: Wealth mobility: model.

	Top groups		
Economy	1%	5%	10%
US (ND+)	4%	14%	24%
US (ND)	5%	15%	25%
Benchmark (C96)	5%	18%	29%
Benchmark (C99)	8%	26%	38%
Benchmark	16%	36%	46%

Table 6: Consumption distribution: data and model.

similar.

The third and fourth row of table 6 report the same statistics for the data generated by our benchmark economy when we respectively eliminate the wealthiest 4% and 1% of the model economy households from the sample, while the last row displays the consumption statistics for the whole sample.

The large differences in these distributions highlight the extreme sensitivity of the inequality statistics to the lack of oversampling of the richest households and to the amount of top-coding (a point discussed by Davies and Shorrocks [16] in the context of the wealth distribution). Consumption is measured with significant measurement error even in the CEX, which is the best data set for household-level consumption for the United States. For example, if one aggregates the consumption CEX data, the CEX underestimates consumption by 35% compared to National Income and Products Accounts (NIPA). On these points see Slesnick [42], and more recently, Attanasio, Battistin and Ichimura [7].

Given the problems with the consumption data sets, and given how well a mismeasured consumption distribution from our model fits the data, we consider this check as additional evidence of the validity of our model and its calibration.

6 Abolishing estate taxation

For each policy we first discuss the long-run outcomes, we then describe the transition path to the new steady state, and we finally analyze the welfare costs and benefits.

The welfare costs and benefits are expressed in terms of the fraction of consumption needed to have someone indifferent between the new and the old tax system, taking the whole transition path into account. Positive numbers indicate gains from the tax reform. The horizontal axis represents one's net worth at the moment the reform is announced. The solid line is the cumulative distribution of either young or old people people at the time of the announcement of the reform. The scale for this variable is on the right-hand side of the graph. The other two lines display the welfare gain or loss for a person with the middle ability level as a worker and, respectively, the lowest ability level as an entrepreneur (dashed line) and the highest ability level as an entrepreneur (dash-dot line). For all policy experiments, the welfare costs and benefits for workers of other ability levels are very similar to the ones that reported.

K	Y	Interest rate	Perc. Entr.	Perc. wealth held by top 1%	5%	10%	20%
Benchmark economy							
9.02	3.00	3.33%	7.6	29.5	59.5	73.6	85.4
No estate tax, lower g							
+2.4%	+1.3%	3.14%	7.6	30.5	60.6	74.2	85.8
No estate tax, higher τ_c							
+2.7%	+1.4%	3.12%	7.6	30.5	60.6	74.2	85.8
No estate tax, higher τ_s							
+.8%	+0.1%	3.22%	7.6	30.4	60.3	74.0	85.7

Table 7: Abolishing the estate tax and adjusting another policy instrument, comparing initial and final steady states.

6.1 Abolishing estate taxation and adjusting government purchases

Government purchases are unproductive in this framework. It is therefore unsurprising that in the model economy (see Table 7, line 2) cutting the estate tax at the expense of government purchases raises total output (by 1.3%) and capital (by 2.4%). The interesting finding here is that this effects are substantial when compared to the small revenue coming from the estate tax.

The elimination of the estate tax increases output by a factor of four times the revenue raised by the estate tax, and raises capital by at least a factor of eight. Abolishing estate taxation benefits the newborn entrepreneurs, who inherit larger estates and can run larger firms and make money more quickly as a result. More funds in the economy are thus invested in the more produc-

Perc. consumption by top			
1%	5%	10%	20%
Benchmark economy			
16.1	35.5	46.1	59.4
No estate tax, lower g			
16.7	36.1	46.6	59.7
No estate tax, higher τ_c			
16.7	32.6	46.7	59.8
No estate tax, higher τ_s			
16.5	35.9	46.3	59.6

Table 8: Abolishing the estate tax and adjusting another policy instrument, consumption distributions, comparing initial and final steady states.

tive technology, the entrepreneurial one. This increase in investment is further amplified by the reduction in the interest rate, which represents the opportunity cost of funds for the entrepreneurs. This price change benefits all of the entrepreneurs.

Despite the resulting increases in investment, capital, and output, the government revenues from consumption and income taxes are not enough to make up from the shortfall in government revenues due to the abolition of the estate tax, and the government has to cut government purchases as a fraction of output as a result. However, while the revenue from estate taxes in initial steady state is 0.3% of output, the government has to cut spending only by 0.05% as a fraction of output (with respect to the initial steady state) because of the increase in output (and thus tax revenues) generated by the abolition of estate taxes.

Another interesting finding from this experiment is that abolishing estate taxation changes long-run consumption and wealth inequality very little. Table 8 reports the consumption distributions.

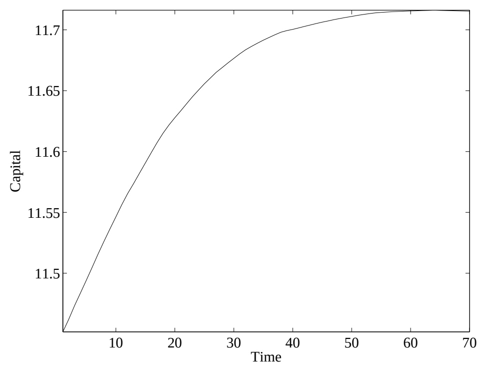

Figure 4: Total capital over time after eliminating estate taxes and reducing government spending.

Figure 4 plots the path of total capital in the economy starting from the initial steady state and transiting to the final steady state of the economy. When the estate tax is eliminated and government spending is cut accordingly, total capital increases for about 50 years. Aggregate output follows a very similar path.

Figures 5 and 6 display the welfare gains and losses (expressed as a fraction of yearly consumption) from switching to the economy with no estate taxes and reduced government spending.

The solid line represents the cumulative distribution of either the young or the old people at the time of the reform. This line, together with the consumption compensation lines, shows that almost 80% of the young and over 90% of the old benefit from this reform. The young make up for 80% of the population.

Who gains from this reform? The largest gains are experienced by the old, and especially by the rich among them, but people in the lower-middle class (defined as having net worth below half a million dollar) also benefit.

Those that are very rich, and especially the old among them, benefit from the break in estate taxation. The immensely rich old experience a consumption gain of 7%, while the gain of their young counterparts is less than 1%. This is because the old are much closer to the time of their demise, and thus value the estate tax break more. (The scales at the left of each of the two graphs refer to the consumption compensation.)

Those whose net worth is below half a million dollars gain because of the increase in wages resulting from more aggregate capital accumulation. For them, wage income makes up for most of total income.

The losers are the young that are not poor enough and not rich enough: those whose net worth is above half a million dollar, but below ten or twenty (depending on their entrepreneurial ability level). This is because capital income makes up for a large share of their total income, and the interest rate drops as a result of this reform.

Similarly, the old with low entrepreneurial ability and assets above 1 million dollar, but below 7 million dollar, are hurt by the decrease in the interest rate. They also do not benefit from the estate tax break, given that they were below the exemption level, or close to it, before the reform took place.

The average welfare gain from this reform is of the order of 0.2% of yearly consumption.

6.2 Abolishing estate taxation while adjusting the consumption tax

The consumption tax hike needed to make up from the shortfall in revenues in the final steady state is small: this tax increases from 11% to 11.3%.

Tables 7 and 8 show that the long-run effects of this reform are very similar

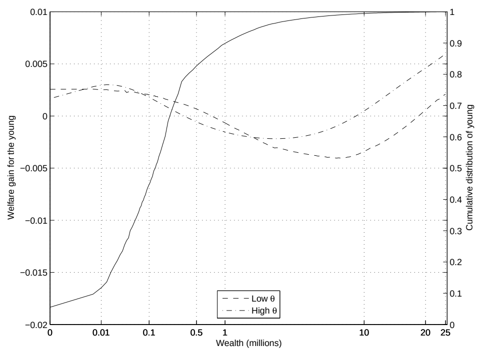

Figure 5: Welfare gains of eliminating estate taxes and reducing government spending for the initial young.

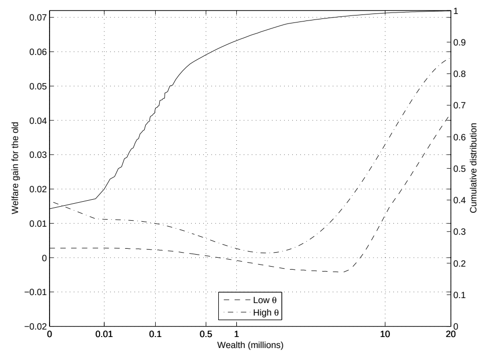

Figure 6: Welfare gains of eliminating estate taxes and reducing government spending for the initial old.

to the ones in the reform in which government spending is cut. Capital and output increase by similar amounts and wealth and consumption inequality change little. The fraction of entrepreneurs also remains unchanged.

Figure 7 plots the implied path of the tax rate on consumption over time. During the transition period the consumption tax peaks at 11.5% before declining to its final steady state level of 11.3%. Figure 3 highlights that capital overshoots its final steady state level a little bit during the transition, but that 50 years after the policy reform has taken place the majority of the transition in capital accumulation has occurred. Aggregate output behaves similarly to aggregate capital.

Figures 9 and 10 report the consumption compensations for this reform. Even the largest losses are smaller than 1% of yearly consumption. Nonetheless, most people lose from switching to this tax system: they are not rich enough to benefit from the estate tax break, and they have to pay higher consumption taxes. A young person has to own at least fifteen to twenty million dollars (depending on their entrepreneurial ability) to benefit from the tax re-

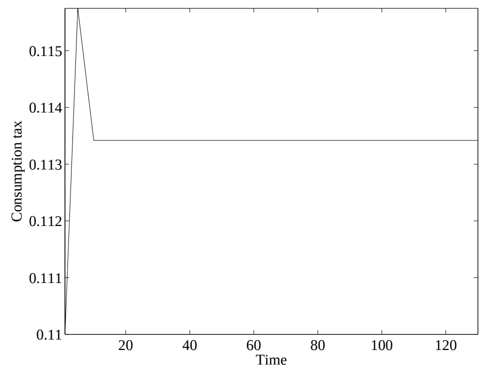

Figure 7: Consumption tax over time when eliminating estate taxes and increasing consumption taxes.

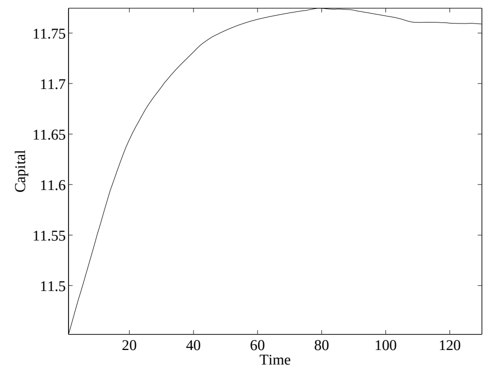

Figure 8: Total capital over time when of eliminating estate taxes and increasing consumption taxes.

form, and even for the very richest young people the benefits are small. Many of the elderly are also hurt by the reform, given that they must hold four to ten million dollar (depending on the ability level) to benefit from the tax reform. The benefits for the very rich, however, are significant: on the order of almost 7% of yearly consumption.

The average welfare cost from this reform is of the order of 0.3% of consumption.

6.3 Abolishing estate taxation while adjusting the proportional income tax

To balance the government budget constraint, the proportional part of the income tax increases from 3.6% to 4.0%. This change affects all of the households in the economy and, in particular, decreases the return (net of taxes) from investing in capital for the entrepreneurs. The entrepreneurs hit more harshly by this tax increase are most of the young ones (for which the expected

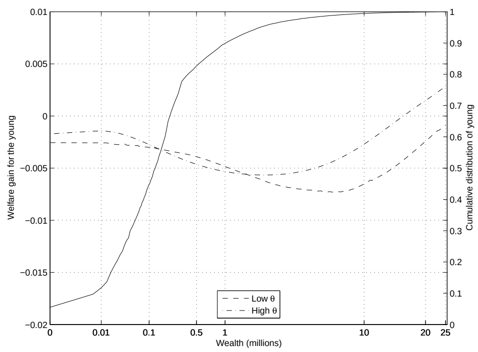

Figure 9: Welfare gains for the initial young of eliminating estate taxes and increasing consumption taxes.

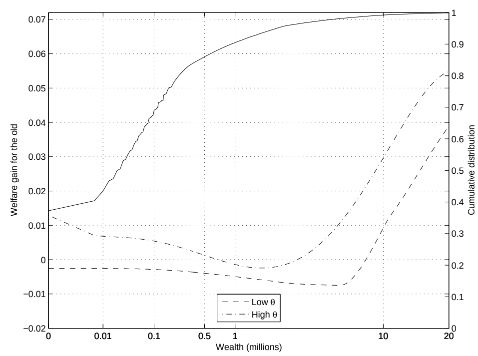

Figure 10: Welfare gains for the initial old of eliminating estate taxes and increasing consumption taxes.

time of death is still far in the future, and thus the benefits from the elimination of the estate tax are small) and the old ones who are not rich enough to really benefit from the abolition of the estate tax. As a result, there is only a very small increase in output with respect to the initial steady state, and the aggregate gains are much smaller compared to the ones in the previous two reforms.

The long-run effects of this policy on consumption and wealth inequality are very modest as in the other policies that we have considered.

Castañeda, Díaz-Giménez, and Ríos-Rull [13] analyze the effects of a similar reform in a model with no entrepreneurial choice, in which the key force driving wealth inequality is that the rich are subject to very large idiosyncratic earnings shocks (which are calibrated to match inequality in wealth holdings). As in our model, they find that the abolition of the estate tax generates only a small increase in wealth inequality. Compared to us, they obtain a long-run aggregate increase of 0.4% for output, which is four times larger than what we obtain, and a somewhat larger effect on total capital accumulation (0.87%

compared to 0.78%). The additional channel at work in our framework is the disincentive effect on entrepreneurial investment due to the higher income tax. Since in our framework the entrepreneurial technology is much more productive than the non-entrepreneurial one, smaller investment by the entrepreneurs results in much lower aggregate income than smaller investment by the workers.

Laitner [30] also studies the effects of a similar reform. He adopts a more stylized economy in which some household are altruistic while others do not care about their descendants. His main message is that, in his framework, abolishing the estate tax generates a significant increase in the share of total net worth held by the richest 1%, while the effects on the aggregates are relatively small for most parameterizations, but can be positive or negative depending on the fraction of altruistic households.

In our framework the consumption compensations required by this reform are similar to the ones that we reported when the consumption tax is raised. As in that policy, increasing the income tax to make up from lost revenues from the estate tax implies small welfare losses for most of the population. The average welfare cost for this reform is of the same order of magnitude than when the consumption tax is raised.

In sum, we find that eliminating the estate tax while increasing the tax on total income would generate a small increase on aggregate capital but would have negligible effects on aggregate output. This reform would slightly increase wealth inequality, and would redistribute from the young to the old and from most people to a tiny fraction of rich people, thus generating welfare losses for the most of the population.

7 Conclusions

Our model suggests that eliminating the estate tax would not generate large increases in wealth and consumption inequality, and increases in aggregate output and capital accumulation.

Unfortunately, these reforms would also imply welfare losses to the vast majority of the population, and benefit only the very rich and, in particular, the old among the very rich.

This happens despite the fact that our framework models explicitly entrepreneurial activity and borrowing constraints, which seem to be the key features that the proponent of abolishing estate taxation are most concerned about.

There are features of reality that could provide additional reasons to abolish estate taxation. For example, our model does not consider tax avoidance costs. Significant amounts of resources might be spent to decrease the tax burden, through the use of lawyers and accountants. The cost of tax avoidance might generate a deadweight loss that should be considered in the overall evaluation of any change in the estate tax. (See Aaron and Munnell [2] and Schmalbeck [40] for a discussion of the avoidance costs.) This is an important and to a large extent unexplored issue that we leave for future research.

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A Income and entrepreneurial ability

We assume that the income process is AR(1) and approximate it with a five-point discrete Markov chain, using the method described in Tauchen and Hussey [45]. The gridpoints y for the income process (normalized to 1) that we use are

$$\begin{bmatrix} 0.2468 & 0.4473 & 0.7654 & 1.3097 & 2.3742 \end{bmatrix}$$

and the transition matrix P_y is

$$\begin{bmatrix} 0.7376 & 0.2473 & 0.0150 & 0.0002 & 0.0000 \\ 0.1947 & 0.5555 & 0.2328 & 0.0169 & 0.0001 \\ 0.0113 & 0.2221 & 0.5333 & 0.2221 & 0.0113 \\ 0.0001 & 0.0169 & 0.2328 & 0.5555 & 0.1947 \\ 0.0000 & 0.0002 & 0.0150 & 0.2473 & 0.7376 \end{bmatrix}.$$

The transition matrix P_θ is given by

$$\begin{bmatrix} .97 & .03 \\ .2 & .8 \end{bmatrix}.$$

B Federal tax schedules

We estimate equation (1) using nonlinear least squares. The data are for 1989 and are taken from the Panel Study of Income Dynamics (PSID). We use the PSID dataset for this part of our analysis because it asks questions that allow us to classify households as entrepreneurs and non-entrepreneurs, and, until 1989, it also provides computed data on total taxes paid by the respondents.

Parameter	Point estimate	95% Confidence interval
Whole sample		
b	.30	.27-.34
p	.82	.74-.90
s	.24	.18-.30
Workers only		
b_w	.32	.26-.38
p_w	.76	.68-.85
s_w	.22	.14-.29
Entrepreneurs only		
b_e	.26	.23-.28
p_e	1.40	1.1-1.7
s_e	.42	.30-.54

Table 9: Estimates for the federal average tax rates.

Our measure of total monetary income includes all forms of labor income, capital income, transfers, and income from entrepreneurial activities. Total federal taxes paid is the variable computed in the PSID (in our case, V18862 in the 1990 file). The dependent variable in the regression, average tax rate, is the ratio of federal taxes paid to total monetary income.

To obtain a representative sample, we exclude the poverty and Latino samples. To obtain the appropriate tax rate for our model (in which the lowest income level is positive), we also drop all observations with income smaller than $1,000 or negative taxes paid.

To make the data on entrepreneurs consistent with those that we use from the SCF data set and the model we employ, we define as *entrepreneurs* those who declare to be self-employed and own or have a financial interest in a business activity and had an income of at least $1,000 from running the business during the period. The resulting sample of entrepreneurs has very similar characteristics to those from the SCF. Our estimates would be very similar if we were to assume a somewhat smaller or larger cutoff for the amount of business income received during the period.

We perform the estimation on three samples: the whole population of households, including workers and entrepreneurs, the subpopulation of workers only, and the subpopulation of entrepreneurs only. The estimated values for the three groups are shown in Table 9 and plotted in Figure 1.