Flat Tax Reform in an Economy with Occupational Choice and Financial Frictions

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Abstract

The article discusses flat tax reform in an economy with occupational choice and borrowing constraints. Previous models mostly deal with the question of how the tax system influences consumption-savings and labor-leisure decisions of households, with the production sector modelled as one representative firm. Here I also model endogenous entry and exit in the market, where not only firm size, but also the number of firms is influenced by the taxation regime. Another important aspect is that unlike previous models I also account for frictions in the capital market in the context of a collateralized capital market. In this economy, I find that in equilibrium, tax neutral flat tax reform reduces total welfare of agents by 0.8%. It increases welfare of entrepreneurs by 6.8% but decreases welfare of workers by 1.2%.

1 Introduction

The question of optimal personal income taxation, that is taxation of incomes of households and entrepreneurs, is widely discussed in the literature. Most papers, however, deal only with the changes in the economic decisions of households, leaving the question of how tax reform influences entrepreneurial activity unanswered. Yet

recent papers by Quadrini and Rios-Rull (1997) and Quadrini (1999) show that entrepreneurship is an important determinant of investment and wealth distribution. Gentry and Hubbard (2000) report that active businesses account for 40% of total wealth and receive 22% of total income. Optimizing the taxation system such that it increases entrepreneurial activity and efficiency may therefore have significant consequences on welfare and wealth equality.

Recently, a discussion of flat-tax system have emerged in the literature. While Hall and Rabushka (1995) build a tax system that comprises progressive tax on wage income and flat-tax on capital income to motivate investment, Ventura (1999) argues that a system with flat tax on both wage and capital is even more efficient. He also proposes a tax exemption for low income groups of households and a tax subsidy on investment. Engen and Gale (1996) form a stochastic model, in which they compare both types of taxes. The authors argue that flat tax can better eliminate the distortions that arise from the stochastic process of production shock. This would have a positive effect on consumption smoothing and lead to greater amount of funds spent on investment. Other references on flat tax reform include Aaron and Gale (1996), Altig et. al. (1999) and Stokey and Rebelo (1995).

In previous quantitative dynamic models dealing with optimal taxation, authors usually consider an exogenous number of firms (typically one representative firm) and a given number of households that work for a competitive wage (mostly measure one of heterogenous agents). The taxation system in those models only influences the size of the representative firm via consumption-saving and labor-leisure decisions of households. I will call it the intensive margin of business activity or "size effect". In my model I add one more choice to the households. Agents not only allocate funds for consumption and savings, but depending on the tax system, choose whether to work for a competitive wage or run a business. Those who choose to be entrepreneurs then hire workers and rent capital. In this setup, the tax system influences the economy also on the extensive margin, as it determines entry and entrepreneurial activity. I

will call this "entry effect".

Early occupational choice models include Evans and Jovanovic (1989) and Greenwood and Jovanovic (1990), later followed by Erosa (2001), Bohacek and Mendizabal (2003) and Gine and Townsend (2004). Models dealing with taxation in occupational choice include Chari et al. (2002). They build a partial equilibrium model with heterogenous agents and an occupational choice decision between working and running a business. Successful entrepreneurs are then bought by corporations, and households that ran those firms receive capital income from the corporation. Chari et al. (2002) find optimal rule for taxation of such capital income. Cagetti and De Nardi (2004) build a deterministic occupational choice, overlapping generations model and look at the issue of optimal estate and income tax. They find that abolishing estate tax and raising income tax to balance the government budget constraint has a negative effect on output and increases wealth inequality.

In my model, the choice of becoming an entrepreneur is given by the present discounted value of expected income received. This is influenced by the managerial ability of the entrepreneur, prices on the markets and the taxation system. However, to run a business households need a sufficient amount of capital otherwise the production may not be efficient. Then the opportunity cost of working for a competitive wage may be larger than the entrepreneurial profits. If a household lacks capital it may ask a competitive intermediary for the funds. Since the outcome of a business project is risky, the bank requires collateral for the credit. Households and small businesses vouch for their liabilities by their own personal assets. Thus those households and entrepreneurs who lack personal assets are financially constrained since they are not able to borrow the needed funds. Evans and Leighton (1989) investigate the financial constraints of small businesses. They estimate that entrepreneurs can borrow up to 50% of their current assets. Small firms pay fewer dividends, take on more debt, and invest more. Evans and Leighton (1989) also provide evidence that almost half of the entrepreneurs use their own family's savings to start up their business.

Thus households with a potentially productive entrepreneurial idea may not be able to run business, if they don't have enough assets to serve as collateral. This is inefficient, since the goal of the social planner is to let the most productive households run a business irrespective of their assets. Bohacek and Mendizabal (2003) deal with the issue of how monetary policy shocks can reduce the number of unconstrained firms and thus increase efficiency. In my model I look at how fiscal rather than monetary policy influences financial frictions and entrepreneurial activity.

In the model with occupational choice and financial frictions, taxation rules may influence allocation in equilibrium in two opposing ways. A progressive taxation regime lowers taxes to low income households and leaves them more funds. This makes it easier for productive, but low income households to accumulate collateral and run their own business, which results in higher entry, thus increasing entrepreneurial activity on the extensive margin. Since entrepreneurship is more profitable than working for a competitive wage, then if a household has enough assets and profitable entrepreneurial idea, it enters and runs a business. Progressive tax also increases entrepreneurial activity on the intensive margin, since low income entrepreneurs are left with more funds to invest and increase their business' size.

To make the system tax neutral, however, the government needs to increase the tax rates for high income agents. This also influences the allocation on both intensive and extensive margin. There may be situation, for instance, when without taxation an agent would receive more as a worker in the current period, but would be better off as an entrepreneur if we account for future periods so she chooses to be entrepreneur. When we introduce progressive tax, this increases the worker's current income but reduces future entrepreneurs incomes and she decides to join the labor force instead. This means that running a business may no longer be as attractive as working, reducing the entrepreneurial activity on the extensive margin. A progressive taxation regime also influences allocation on the intensive margin since it reduces the firm size of high income businesses by taking away funds that could have been used as capital

for investment and for hiring workers.

Flat tax influences the economy in the opposite direction. If households are financially constrained, a flat tax may reduce entry, since it takes relatively more funds from low income groups, as compared to progressive tax, making it more difficult for agents to accumulate collateral needed for running a firm. Flat tax thus will reduce entrepreneurial activity on the extensive margin. It may also reduce entrepreneurial activity on the intensive margin, since low income entrepreneurs may not have enough funds to increase their firms' size. On the other hand, it may increase the firm size of high income firms since it leaves them relatively more funds for investment, thus positively influencing entrepreneurial activity on the intensive margin. By taking relatively less funds from the high income groups, flat tax may make entrepreneurship more attractive thus increasing the entrepreneurial activity on the extensive margin.

More importantly, the allocation is not only influenced by "size effect" and the "entry effect" primarily but also secondarily via competitive prices such as wage and interest rate. Since households maximize their present discounted utility given prices, changes in prices will have a multiplicative effect of one or the other effect and the allocation in the economy. Since the total outcome is difficult to predict, a quantitative model is needed to find the optimal allocation in this economy.

I compare progressive tax regime currently in place in USA, with revenues neutral flat tax regimes, namely complete flat tax with no tax exemption, with 20% tax exemption and 40% tax exemption. I run a dynamic quantitative general equilibrium model with heterogenous agents, occupational choice and financial frictions. I also look at the changes of wealth distribution of agents, and analyze how the types of taxes in question influence wealth inequality, distribution of firms etc.

The paper is organized as follows. In section 2, I describe the basic model and discuss the main forces influencing the results. In section 3 I discuss the methodology, data and computational issues. After presenting the expected results in section 4 I conclude.

2 The Model

2.1 Setup and Timing

The economy is populated by a continuum of measure one infinitely lived heterogenous agents. There is one perfectly divisible good in the economy. Agent's preferences are such that they maximize the utility from consumption c given by the utility function

$$U(a_0, z_0) = E_0 \left[\sum_{t=0}^{\infty} \beta^t u(c) \right]$$

where $u(.)$ is a bounded, strictly increasing, strictly concave, and twice differentiable continuous function that satisfies the Inada conditions and $\beta \in (0, 1)$ is a discount factor.

Each agent is identified by the level of accumulated assets $a \in A = [0, \infty]$, ability shock $z \in Z = [\underline{z}, \overline{z}]$ and by her occupation. Here z can be interpreted as an idea or skill. After an agent makes her occupational choice she draws an effective ability shock z' which corresponds to the real productivity in the business project or job position. Effective ability shock z' is transferred to the idea shock z next period.

If an agent chooses to be an entrepreneur, she runs a privately owned company that produces a consumption good. The owner of the business rents capital k and hires n workers. The agent then draws an effective productivity shock z' and produces output

$$y = z' f(k, n)$$

where $f(.,.)$ is a decreasing returns to scale continuous, twice differentiable increasing and strictly concave production function. Entrepreneurs draw z' from a first-order Markov process $Q(z, z')$, satisfying Feller, Monotonicity and Mixing property. To model exit and entry I assume that $\underline{z} = 0$ and $Q(\underline{z}, \underline{z'}) = 1$. This implies that even the wealthiest agents with a signal z always prefer to work for a wage. To guarantee the exit of entrepreneurs, I assume $Q(z, \underline{z'}) > 0 \ \forall z \in Z$.

Capital k is provided by a competitive bank. All agents deposit their assets at the bank which lends capital k to the entrepreneurs at the competitive interest rate

r. The contract lasts for one period only and must be repaid at the end of the period. Capital depreciates at rate $\delta \in (0,1)$. To ensure that all the debts are repaid even if the business project fails, the bank requires entrepreneurs to hold sufficient assets (full collateral).

Labor n is provided by the households that choose not to be entrepreneurs. Each firm picks workers with average effective ability normalized to unity $\tilde{z} = 1$

If an agent chooses to be a worker, she works for a competitive wage rate w. She draws an effective ability shock z' from a fixed distribution $\psi(z')$ and receives wage income $z'w$. Note that workers' effective productivity shock z' is independent of ability shock z; This is assumed mainly for the purpose of computational tractability.

There is a government in the economy that needs to finance its services. It collects total amount of taxes G. I assume that the government requires fixed fraction $\sigma \in (0,1)$ of the total output in the economy for its expenditures.

The timing is as follows. In a stationary equilibrium, given prices (r, w)

1. Agent enters a period with (a, z);
2. Occupational choice is made, entrepreneurs must commit inputs (k, n);
3. Effective shock z' is drawn from ψ or Q depending on occupation;
4. Production, labor incomes, profits, consumption, investment take place, taxes are paid;
5. Savings and the effective shock become the next period state variables (a', z').

Because shocks are idiosyncratic, there is no uncertainty on the individual level between periods.

2.2 Recursive Description of the Economy

In this section I formulate the economy recursively. All the information in the economy is observable, and agents are rational with perfect foresight. The payments for

contracts are perfectly enforceable. There is no aggregate uncertainty in the model.

I define value function $v(a,z)$ to be the value of an agent having level of assets a and productivity shock z in the current period. Then it implies from the occupational choice that

$$v(a,z) = \max\left\{\int v^W(a,z')\psi(dz'), \max_{k,n}\int v^E(a,z')Q(z,dz')\right\} \tag{1}$$

where

$$v^W(a,z') = \max_{c,a'}\{u(c) + \beta v(a',z')\}$$
$$v^E(a,z') = \max_{c,a'}\{u(c) + \beta v(a',z')\}$$

is the value of being a worker and entrepreneur after realizing effective productivity shock z' respectively.

Workers' budget constraint is

$$c + a' \leq (1+r)a + z'wl - T^W, W \in \{FW, PW\} \tag{2}$$

where

$$\begin{aligned} T^{FW} &= \tau_f(z'w + ra) + \tau_k ra \\ T^{PW} &= \tau_1(I_1 - I_0) + \tau_2(I_2 - I_1) + \ldots \tau_m(I - I_{m-1}) + \tau_k ra \end{aligned} \tag{3}$$

are the taxes paid by the worker when there is flat or progressive tax system in place respectively, where τ_f is a flat tax rate on wages, τ_k is a flat tax rate on capital gains, $\tau_1, \tau_2, \ldots, \tau_m$ are progressive tax rates corresponding to the progressive tax income brackets $I_1, I_2, \ldots I_m$ and $I = z'w + ra$.

Similarly entrepreneurs' budget constraint is

$$c + a' \leq (1+r)a + z'f(k,n) - (r+\delta)k - wn\tilde{z} - T^E, E \in \{FE, PE\} \tag{4}$$

where if we denote entrepreneurial profit from production as $\Pi = \pi(k,n,z') = z'f(k,n) - (r+\delta)k - wn$

$$\begin{aligned} T^{FE} &= \tau_f(\Pi + ra) + \tau_k ra \\ T^{PE} &= \tau_1(I_1 - I_0) + \tau_2(I_2 - I_1) + \ldots \tau_m(I - I_{m-1}) + \tau_k ra \end{aligned} \tag{5}$$

where $I = \Pi + ra = z'f(k,n) - (r+\delta)k - wn + ra$

The financial liability constraint says that for all possible realizations of the shock, the entrepreneur must be able to repay her debt and pay workers.

$$(r+\delta)k + wn\tilde{z} \leq (1 + r - \tau_k)a + z'f(k,n), \forall z' \in Z$$

Note that since $Q(z, \underline{z}) > 0, \forall z \in Z$ this constraint must be satisfied for the lowest possible shock $\underline{z}$ which is set to $\underline{z} = 0$. Again since $\tilde{z} = 1$ we have

$$(r+\delta)k + wn \leq (1 + r(1 - \tau_k))a \tag{6}$$

Finally, I require

$$a \in A, \underline{a} = 0, k, n \geq 0, l = 1 \tag{7}$$

Each agent maximizes her present value discounted utility by solving (1) s.t. (2) or (4) depending on occupation, (6) and (7).

2.3 Definition of Equilibrium

A stationary recursive competitive equilibrium is constant prices (r, w), value functions $v(a,z)$,$v^E(a,z')$,$v^W(a,z')$, policy functions $k(a,z)$, $n(a,z)$, $c(a,z')$, $a'(a,z')$, taxes paid $T^W(a,z'), T^E(a,z')$,$W \in \{FW, PW\}$,$E \in \{FE, PE\}$ depending on occupation and taxation system, a probability measure $\lambda(A,Z)$ and aggregate levels (A,K,L,N,T) such that

1. at prices (r,w), the policy functions solve the optimization problem of each agent;

2. the probability measure λ is time invariant;

3. the capital and labor markets clear

$$A = \int a\lambda(da \times dz) = \int k(a,z)\lambda(da \times dz) = K \tag{8}$$

$$L = \int z'[Q(z,dz')_{|E} + \psi(dz')_{|W}]\lambda(da \times dz) = \int n(a,z)\lambda(da \times dz) = N \tag{9}$$

4. the government budget constraint holds with equality

$$\int [T^E(a,z')Q(z,dz')_{|E} + T^W(a,z')\psi(dz')_{|W}]\lambda(da \times dz) = G \tag{10}$$

5. the aggregate feasibility holds at equality

$$\begin{aligned} Y &= \int \{c(a,z') + a'(a,z')\}[Q(z,dz')_{|E} + \psi(dz')_{|W}]\lambda(da \times dz) + G = \\ &= \int \{z' f(k(a,z), n(a,z))Q(z,dz')\lambda(da \times dz)\} + (1-\delta)K \end{aligned} \tag{11}$$

2.4 Discussion

In order to have positive fractions of both occupations in equilibrium I first need to make two assumptions on the productivity shocks.

First, to guarantee a positive number of entrepreneurs, I require that there exists the level of assets a^s that agents with the highest possible shock $\overline{z}$ and assets $a \geq a^s$ choose to be entrepreneurs, that is

$$\int v^W(a,z')\psi(dz') \leq \int v^E(a,z')Q(\overline{z},dz')\forall a \geq a^s \tag{12}$$

Second, to have a positive fraction of workers, I assume that for the lowest possible realization of ability shock $\underline{z}$ agents choose to be workers. This can be written as

$$\int v^W(a,z')\psi(dz') \geq \int v^E(a,z')Q(\underline{z},dz')\forall a \in A \tag{13}$$

We can then divide the agents in the economy into workers, constrained entrepreneurs and unconstrained entrepreneurs. Figure 1 shows the occupational choice for each agent given (a,z).

A constrained entrepreneur is one who is running a business at suboptimal level of capital and labor, because of financial frictions. Due to decreasing returns to scale production function there is optimal k^* and n^* for each firm, with k/n being constant. However, not each firm can operate at this level due to financial constraints. Since the profit function Π is monotonously increasing for $k < k^*$ and monotonously decreasing

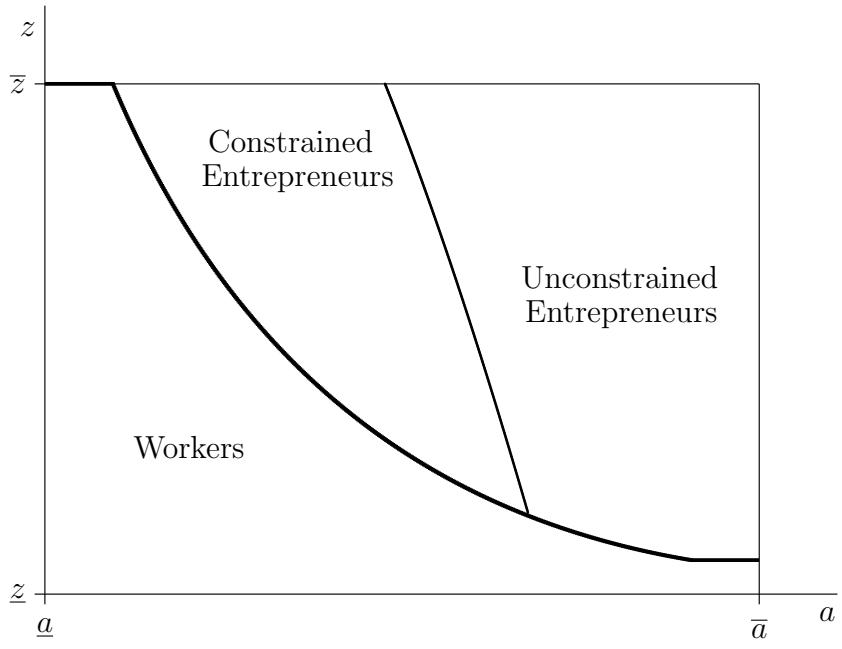

Figure 1: Occupational choice

for $k > k^*$, the closer to the optimal level of capital can firm operate, the more profitable it is.

It is optimal to have agents with productive z run a business independent of the level of her assets. On the other hand it's optimal to have as many unconstrained entrepreneurs as possible. The marginal agent is the agent who is indifferent between working or running a business, meaning that given shock z his present value discounted utility from both occupations is the same.

$$\int v^W(a^s, z')\psi(z') = \int v^E(a^s, z')Q(z, dz') \tag{14}$$

where a^s is the level of assets of marginal agent as described in (12) without taxation. Since $Q(z, z')$ is monotone for

$$\int z'\psi(z') < \int z'Q(z, dz') \tag{15}$$

due to the financial frictions, it may hold that

$$\int z'w\psi(dz') - T^W > \int z'f(k, n)Q(z, dz') - wn - (r + \delta)k - T^E \tag{16}$$

together with (14) being satisfied. The left hand side of (16) is the expected net wage in the current period and the right hand side is the current period expected net profit from entrepreneurship.

This would indicate that although in the current period wages are higher, the agent may be indifferent between working and running a business. It also means that marginal agent sacrifices current forgone wages in order to relax the borrowing constraint and run a business. For a given shock, a marginal agent is therefore the constrained entrepreneur with the lowest amount of assets. Because of a collateralized credit market, although constrained entrepreneurs are able to run a business, the business may not reach it's optimal size, since the constrained entrepreneurs can't invest high enough capital k and hire optimal amount of labor n.

A progressive taxation regime takes away relatively less funds from low income groups such as workers. This may allow them to accumulate collateral, relax the financial constraint and run the business more easily, thus increasing the entrepreneurial activity on the extensive margin as can be seen from the binding budget constraint (2). With fixed prices, it holds that $T^{FW} > T^{PW}$ for the low income groups such as workers. Then for the agent with the same shock z and consumption c and progressive tax it holds that $a'^{FW} < a'^{PW}$, where

$$a'^{W} = (1+r)a + z'wl - T^{W} - c, W \in \{FW, PW\} \tag{17}$$

allowing faster accumulation of assets (collateral) than a flat tax regime.

For further discussion, let's denote a^s the level of assets of before tax marginal agent and a^t the level of assets of after tax marginal agent.

A progressive taxation may also allow some constrained entrepreneurs to increase the size of the firm, thereby increasing the entrepreneurial activity on the intensive margin. A progressive taxation system, however, takes relatively more funds from high income groups such as unconstrained entrepreneurs and some constrained entrepreneurs, such that with higher taxes needed to pay, the more of them may become constrained. It also means that by because agent pays relatively more in the future

when her income increases, the before tax marginal agent with assets a^s faces now a different choice. With (16) holding, the gains for paying less taxes as a worker may be such that

$$\int v^W(a^s, z')\psi(z') > \int v^E(a^s, z')Q(z, dz') \tag{18}$$

$$\int v^W(a^t, z')\psi(z') = \int v^E(a^t, z')Q(z, dz') \tag{19}$$

and the before tax marginal agent decides not to run a business, but to work for a competitive wage. Since $a^t > a^s$ the marginal agent moved to a higher asset group reducing the number of entrepreneurs. Thus progressive taxation may also reduce entrepreneurial activity on the extensive margin.

Flat tax on the other hand influences allocation in the economy in the opposite way. By taking away relatively more funds from low income groups it makes it more difficult for workers to collect the collateral, since $a'^{FW} < a'^{PW}$, and for some constrained entrepreneurs to increase firm size. Thus flat tax makes (16) hold for more periods, decreasing entrepreneurship activity on extensive and intensive margins. Decreasing taxes for high income groups may, however, lead to higher possible investments for high income entrepreneurs, and it makes entrepreneurship more attractive, since with (16) holding we have

$$\int v^W(a^s, z')\psi(z') < \int v^E(a^s, z')Q(z, dz') \tag{20}$$

$$\int v^W(a^t, z')\psi(z') = \int v^E(a^t, z')Q(z, dz') \tag{21}$$

moving the after tax marginal agent to a lower asset group, because $a^t < a^s$, thus increasing the number of entrepreneurs.

Thus both taxation system may influence extensive margin and intensive margins in both directions. What prevails depends on the parametrization of the model. Here I simulate US economy and calibrated the model to match the stylized fact of the US economy.

3 Methodology

3.1 Taxation System in the USA

Taxation in the United States is a complex system that consist of four basic forms of taxes: Corporate Income Tax, Individual Income Tax, Social Security Tax and Other Taxes like VAT, estate tax, other customs and tariffs. Taxation involve payments to at least three different levels of government: Local government, possibly including one or more of municipal, township, district and county governments; State government and Federal government. The local and state taxation differs in all states by system (flat tax-progressive tax), deductions, tax brackets and tax rates. Income tax paid to the local and state government is deductable from federal income tax. State and local taxes consisted of 32.8% of total tax revenues in 2004. However concerning income taxes, it was only 19.1% of individual income taxes and 16% of corporate income taxes.

In the paper I concentrate on individual income taxation. I abstract from all but federal government income taxation. Individual income taxes paid to federal government was 34.8% of all tax revenues or 5.6% of GDP in USA. This seems to be relatively large amount, and the tax reform may have significant welfare consequences.

Personal income tax is paid by employees and small businesses or so called self-employers. The Federal income tax uses a system of direct withholding. Employers pay part of a taxpayer's income tax directly from their payrolls. The amount of withholding is calculated based on the employee's expected annual salary and the employee's living situation (married or unmarried, number of dependents, other factors). Withholding does not perfectly calculate the employee's tax each year. The difference between the amount withheld and actual tax is either paid to a government by the end of a year, or refunded by the government.

Except Federal income taxes, both employers and employees pay in Social Security and Medicare Taxes. Employees cannot deduct Social Security and Medicare taxes in

figuring their adjusted gross income. In addition Self-employers pay Social Security and Medicare Taxes themselves. It is known as Self-Employment Tax. Self Employers can deduct half of their Self-Employment taxes in figuring their adjusted gross income. There is also a ceiling for a maximum amount of Self-Employment taxes for entrepreneurs. I abstract from this type of taxation.

Personal Income Tax Rates depend on status of a taxpayer. Rates vary depending on whether taxpayer is single, married individual filing jointly, married individuals filing separately, head of household. For single taxpayers the tax rates are summarized in the Table 1.

Taxable income		**Tax**		
Over	**But not over**	**Tax**	**+%**	**On amount over**
\$0	\$ 7,300	\$0.00	10	\$ 0
\$7,300	\$29,700	\$730.00	15	\$7,300
\$29,700	\$71,950	\$4,090.00	25	\$29,700
\$71,950	\$150,150	\$14,652.50	28	\$71,950
\$150,150	\$326,450	\$36,548.50	33	\$150,150
\$326,450	...	\$94,727.50	35	\$326,450

Table 1: US Tax system marginal tax rates

The personal income tax is calculated as percentage of an individual's gross income, which is subject to deductions and exemptions. Total tax is calculated from the amount that is gross profit minus the deductions. This is called taxable income.

Besides standard deduction for single taxpayer (this deduction depends on whether taxpayer is single, married individual filing jointly, married individuals filing separately, head of household.), there is also a personal exemption. The personal exemption is phased out for individuals with high incomes. There are also other types of deductions such as mortgage exemption, etc. that I abstract from.

3.2 Data and Calibration

Since there is no closed form analytical solution to the problem, I used numerical methods to compute the allocations.

- To model technology, I use the decreasing returns to scale production function in a form $y = z'(k^{\alpha}n^{1-\alpha})^{\theta}$. Preferences were modelled using the logarithmic utility function in a form $u(c) = \log(c)$. Modelling period was 2 years. Parameter values are depicted in Table 2.

Parameter	Value	Parameter	Value
α	0.36	β	0.9565
δ	0.0861	θ	0.95

Table 2: Technology Parameters

- Transition of shocks $Q(z, z')$ was calibrated using estimates of firm growth by Evans (1987). It's summarized in Table 3.

	z'_0	z'_1	z'_2	z'_3	z'_4	z'_5	z'_6	z'_7
z_0	1.000	0	0	0	0	0	0	0
z_1	0.109	0.698	0.192	0.001	0	0	0	0
z_2	0.059	0.095	0.713	0.131	0.002	0	0	0
z_3	0.053	0.001	0.111	0.736	0.098	0.001	0	0
z_4	0.044	0.004	0.015	0.107	0.755	0.074	0.001	0
z_5	0.039	0	0	0.001	0.162	0.756	0.041	0.001
z_6	0.025	0	0	0	0.008	0.172	0.758	0.037
z_7	0.018	0	0	0	0	0.001	0.339	0.642

Table 3: Transition matrix

- Values of shock z has been chosen such as to represent stylized facts on a distribution of firms, share of wealth held by entrepreneurs etc. The stylized facts

are described in section 4.1.

- The base for modelling the taxation system is current US federal income tax schedule. Ventura (1999) estimated the income tax brackets I_m as the ratios of total income to average income $\hat{I_m} = I_m/\hat{I}$. These estimates, together with current marginal tax rates are summarized in Table 3. The capital tax rate

Tax Bracket	Marginal Tax Rate
$(I_0, I_1) = (0, 0.3I^*)$	$\tau_1 = 0.10$
$(I_1, I_2) = (0.3I^*, 1.35I^*)$	$\tau_2 = 0.15$
$(I_2, I_3) = (1.35I^*, 2.56I^*)$	$\tau_3 = 0.25$
$(I_3, I_4) = (2.56I^*, 3.74I^*)$	$\tau_4 = 0.28$
$(I_4, I_5) = (3.74I^*, 6.29I^*)$	$\tau_5 = 0.33$
$(I_5, I_6) = (6.29I^*, \infty)$	$\tau_6 = 0.35$

Table 4: Tax Parameters

$I_0, I_1, \ldots$ are fractions of average income. $I_1 = d_1 I^*, I_2 = d_2 I^*, \ldots$

$\tau_k = 0.36$ is taken from Cross-Country Estimates of Effective Tax Rates on Factor Incomes and Consumption for 2005[1]

- The government finances the public good, taking the funds from the households and the entrepreneurs. I assume that for this the government receives a fixed amount of $\sigma = 0.19$ of the total output of the economy.

- The stylized facts are represented by Evans (1987) estimates, Characteristics of Business Owners, Economic Census 1992 and Chari et al. (2002) estimates from PSID 1993 statistics.

[1]Methodology described in Mendoza, Razein and Tesar (1994)

4 Results

In this section I compare the basic economy with three types of income tax reforms. Reform 1 is a flat tax reform with no tax exemption. Reform 2 is a flat tax reform with tax exemption as large as 20% of average income, and Reform 3 is a flat tax reform with tax exemption of 40% of average income. If we denote d the percentage of average income that is tax exempted then for Reform 1, $d = 0$, for Reform 2 $d = 0.20$ and Reform 3 $d = 0.40$. Taxation rules for those types of reform are therefore as follows

$$\begin{aligned} T^{R1} &= \tau_{f1} I + \tau_k r a \\ T^{R2} &= \max\{0, \tau_{f2}(I - 0.2I^*)\} + \tau_k r a \\ T^{R3} &= \max\{0, \tau_{f3}(I - 0.4I^*)\} + \tau_k r a \end{aligned} \tag{22}$$

All reforms are revenues neutral, so the marginal tax rate for each reform is determined endogenously by the model.

4.1 Stylized Facts

In this part I describe how the basic model was able to meet stylized facts from the data. Table 5 shows the comparisons.

The model was parameterized in a way as to have good fit with the data. Table 5 shows that the model seems to fit the facts. Share of assets and share of income possessed and earned by the entrepreneurs is higher in the model, although the difference is relatively low. The interest rate is also lower in the model. Gini coefficients saw good fit to the data, as well as output/capital ratio and the exit rates.

Figure 2 shows how the model was able to fit the data in terms of characteristics of small businesses. I compare how the model was able to fit the data with respect to distribution of firms and how I was able to model the exit of firms depending on the size of the firm.

Indicator	Data	Model
r (2 years)	3.75%	2.91%
Output/Capital	42.2%	40.4%
Profit/Income (Entrepreneurs)	64.9%	66.9%
Share of Assets (Entrepreneurs)	40.5%	45.8%
Share of Income (Entrepreneurs)	22.7%	29.8%
Average Spell (Entrepreneurs)	9.1 years	8.0 years
Average Employment per firm	9.1	9.4
Exit Rate (2 years)	12.4%	12.5%
Gini (Income)	0.42	0.38
Gini (Wealth)	0.82	0.79

Table 5: Stylized Facts

4.2 Marginal and Average Tax Rates

Although I call all reforms flat tax reform, it's clear that due to tax deductions both reform 2 and reform 3 are progressive systems, since the average tax rate increases with income. As can be seen in Figure 3, reform 3 is even more progressive than the current system. I introduced this reforms to compare the results not only when one moves towards flat tax, but also towards more progressive tax. Reform 2 seems to have similar progressiveness as the current system, with the difference that it taxes the very low income groups less and taxes households with the highest incomes more. Figure 3 presents marginal tax rates as well as average tax rates for all four systems.

As all tax reforms are tax neutral, the marginal tax rates for all reforms were determined by the model.

$$\tau_{f1} = 0.20, \tau_{f2} = 0.28, \tau_{f3} = 0.36$$

are the marginal tax rates for Reform 1, Reform 2 and Reform 3 respectively.

The model predicted that with the governmental revenues unchanged, the tax

	PT (current)	R1 (d=0.0)	R2 ($d = 0.2$)	R3 ($d = 0.4$)
Average Welfare All	100%	99.2%	99.0%	99.1%
- workers	100%	98.8%	99.0%	99.4%
- entrepreneurs	100%	106.8%	100.7%	95.9%
Average Taxes All	-	-	-	-
-workers	100%	114.6%	105.6%	93.4%
-entrepreneurs	100%	91.6%	99.3%	107.1%
Average Wage	100%	106.6%	102.1%	96.6%
Interest Rate	0.0291	0.0232	0.0265	0.0316

Table 6: Welfare consequences

deduction of 20% of average income leads to about a 8% increase in the marginal flat tax rate.

4.3 Welfare consequences

In this section I summarize the basic welfare consequences of the three reforms. The main results are depicted in Table 7.

All three reforms decreased welfare in the modelled economy. Also all three saw a decrease in welfare for workers in equilibrium. On the other hand entrepreneurs were better off in reform 1, due to lower taxation of high income groups.

In reform 1 entrepreneurs paid less taxes by 9.4%, while workers' taxes paid increased by 14.6%. On the other hand wages increased in equilibrium, and workers were worse off only by 1.2%.

In case of reform 2, welfare decreased by the highest margin. Although average wage increased by 2.1%, the taxes paid by workers also increased by 5.6% in equilibrium. Entrepreneurs were still better off, although only by a small margin.

In reform 3 workers lost welfare by the smallest margin among all reforms. It's mainly due to high tax deduction, which resulted in a 6.6% decrease in taxes paid.

	PT (current)	R1 (d=0.0)	R2 ($d = 0.2$)	R3 ($d = 0.4$)
Median Welfare All	100%	99.3%	99.8%	99.1%
- workers	100%	98.8%	98.6%	97.6%
- entrepreneurs	100%	107.1%	104.7%	95.4%
Median Taxes All	100%	118.6%	106.2%	90.2%
-workers	100%	118.5%	106.4%	89.8%
-entrepreneurs	100%	95.5%	98.9%	102.1%
Gini (Net Income) All	0.377	0.369	0.383	0.393
-workers	0.176	0.171	0.181	0.185
-entrepreneurs	0.537	0.547	0.558	0.561

Table 7: Median Agent welfare and Gini

However entrepreneurs paid more taxes due to the increased marginal tax rate for high income agents. Equilibrium wage decreases, which made workers worse off in also in reform 3.

4.4 Inequality Consequences

In the previous section I described the changes to the welfare with the different taxation systems in the model economy. Here I describe the consequences on inequality of agents. Table 8 summarizes the results. I compare welfare of median agent as well as Gini inequity coefficients.

In all reforms, a median agent is worse of then in the current system. In the case of reform 1, the welfare of the median agent as well as a median worker decreases. On the other hand welfare of a median entrepreneur is higher in equilibrium.

The results in case of reform 2 are similar to the previous case, with the exception of smaller decrease of welfare for the median agent. Hover the median worker is worse off than in reform 1, although he pays fewer taxes. The median agent is worse off also in reform 3.

	PT (current)	R1 (d=0.0)	R2 ($d = 0.2$)	R3 ($d = 0.4$)
Number of Entrepreneurs	9.6%	8.7%	8.9%	9.8%
Average Exit Rate (2 years)	12.49%	12.77%	12.72%	12.27%
Average Spell (Entrepreneurs)	8.0 years	7.4 years	7.5 years	8.1 years
Average Firm Size	9.5 work.	10.5 work.	10.4 work.	9.1 work.
Assets to Enter (a^t/a^s)		+9.9%	+4.6%	-3.9%
Capital/Optimal Capital (k/k^*)		+10.1%	+0.5%	-7.0%

Table 8: Entrepreneurship and Financial Frictions

Gini coefficients measuring inequality in net income of workers decreased in the first reform, making workers more equal, and increased in the reform 2 and reform 3. All three reforms increases inequality in entrepreneurial sector.

Considering workers and entrepreneurs together, inequality measured by Gini increased in the reform 3. First reform made the economy more equal in equilibrium.

4.5 Entrepreneurship and Financial Frictions

In this section I give background to the previous results as well as discussion in section 4.1., by looking on how taxation system in place influences entrepreneurship. The results are summarized in Table 9. In the first two reforms, the number of entrepreneurs decreased in equilibrium. In the third reform the number of entrepreneurs increased slightly.

In the first two cases this is influenced by the fact that due to financial frictions, agents need to accumulate on average more assets in order to be profitable by running a business taking into consideration opportunity cost of working for a wage. The marginal agent needs to have more assets than before, meaning that $a^t > a^s$ For instance in reform 1, an agent need to have on average 9.9% assets more to be more profitable as entrepreneur than as worker. Or $a^t/a^s = 0.099$. It takes also more time to start a business as shown by average spell of being a worker. In case of reform 1

the average worker's spell increased by 5.2%.

In the third reform, it is easier to run a business, since on average, an agent needs to accumulate less assets on order to start a business. In this case $a^t < a^s$. The assets are also accumulated easier, since length of a spell before becoming entrepreneur is lower in reform 3. Assets needed to enter market decreased by 3.9%. Or $a^t/a^s = 0.039$. The average time of working as a worker decreased by 2.6%.

Regarding constraints imposed on entrepreneurs, the ratio of capital/optimal capital increased on average in reform 1. This means that tax system enabled firms to run at a more efficient size. We see firms size increased in equilibrium also in reform 2.

In reform 3, the firms operate at less efficient levels. Average employment decreased by 1.0% and the capital/optimal capital k/k^* ratio decreases by 7.0%.

Figure 4 shows the development in employment and capital/optimal capital ratio with the age of firm. In reform 1 and reform 2 the size of firm increased faster, while in the current system and reform 3 firms grow slower. Capital/Optimal capital ratio is highest for all firms in reform 1 and it increases with the age of firm. On the other hand this ratio is lowest in reform 3. In reform 2, younger firms are on average more constrained then in the current system. However as the spell increases capital/optimal capital ratio moves above the one of the current system.

4.6 Intensive and Extensive Margins

Summarizing the basic results from the previous section we see that on average, the higher progressiveness of tax increases the number of firms and the firms on average smaller in the modelled economy. Thus progressive tax reduces the intensive margin and increases the extensive margin. Figure 5 depicts the loan/capital ratios and the number of firms by size. From this we may infer some conclusions concerning intensive and extensive margins discussed in section 2.4.

In reform 3 it's easier for firm to enter the market because it is less constrained.

Here progressive tax increases the extensive margin. Smaller firms up to 4 employees, which are constrained, are able to loan more compared to current system. Larger firms however still face significant financial constraints. They pay higher taxes and are constrained more, and cannot borrow as many funds as in the current system. This results in the increase in the number of smaller firms and the drop in the number of larger firms. Thus progressive tax reduces the intensive margin.

In reform 1 it's more difficult to enter the market because it faces higher financial constraints. Thus flat tax decreases the extensive margin. Smaller firms up, which are constrained, can loan less compared to current system in equilibrium. Larger firms however pay less taxes compared to current system, are therefore less constrained and may grow faster. Figure 5 shows that flat tax increases the number of larger firm and decreases the number of small firms. Thus progressive tax increases the intensive margin.

Reform 2 with the similar rate of progressiveness yields similar results as the current system.

5 Conclusion

The general equilibrium model comparing income tax systems in the economy with financial frictions shows, that if we account for financial frictions, flat tax reform may not be efficient in terms of welfare. I compared four systems, with the different rate of progressives. Revenuers neutral flat tax reform with no tax exemption saw a 0.8% decrease in welfare. Reform 2, which is flat tax reform with tax exemption as large as 20% of average income saw a 1.0% decrease in welfare, and Reform 3 which is flat tax reform with tax exemption of 40% of average income saw a decrease in welfare in the total amount of 0.9%.

Without social benefits in place, flat tax reduces net income inequality compared to flat tax. "Progressive" reform 3 increased Gini coefficient for net income by 1.7%. On the other hand, "flat" reform 1 decreased the coefficient by 2.5%, making the

economy less equal.

On average, "flat" tax reform 1 decreases the number of entrepreneurs, while increases the average firm size. There is less small firms and the higher number of larger firms. It is more difficult to enter the market, however once entered it is easier for firm to grow. "Progressive" reform 3 increases the number of entrepreneurs and it's easier for firm to enter market. However it's more difficult for firm and the average size of firm decreased. There are more smaller firms and less larger firms in equilibrium of reform 3.

The model can be extended in several ways. In the model, I deal with income taxation of households and entrepreneurs, by abstracting from corporate taxes. However, the corporate sector owns a relatively high amount of capital and employs a high level of labor force. Hence, although not dealing with taxation of corporations, it would be appropriate to account also for this sector. This may be modelled as a fraction of the economy given exogenously, or it may be calculated endogenously, given the taxation system in place. With the same technology for both entrepreneurs and corporations, different taxing policies influence the size of the corporate sector and the number of entrepreneurs.

Second, in the model, I compare flat tax and several types of progressive tax. But there are also other forms of taxation policies, including tax deductions, tax supplements, social benefits, no taxation of investment etc. The model can also be extended to deal with the capital taxation. Relaxing capital taxation may have significant effects on allocations in equilibrium.

Third, I only compare four taxation systems. Thus the question which system is optimal in the setup of the model is still unanswered. Comparing system, such that we fix flat tax rate and then move tax deduction seems to be appropriate way to model progressiveness. Important question here would be, what size of tax deduction is optimal in the modelled economy.

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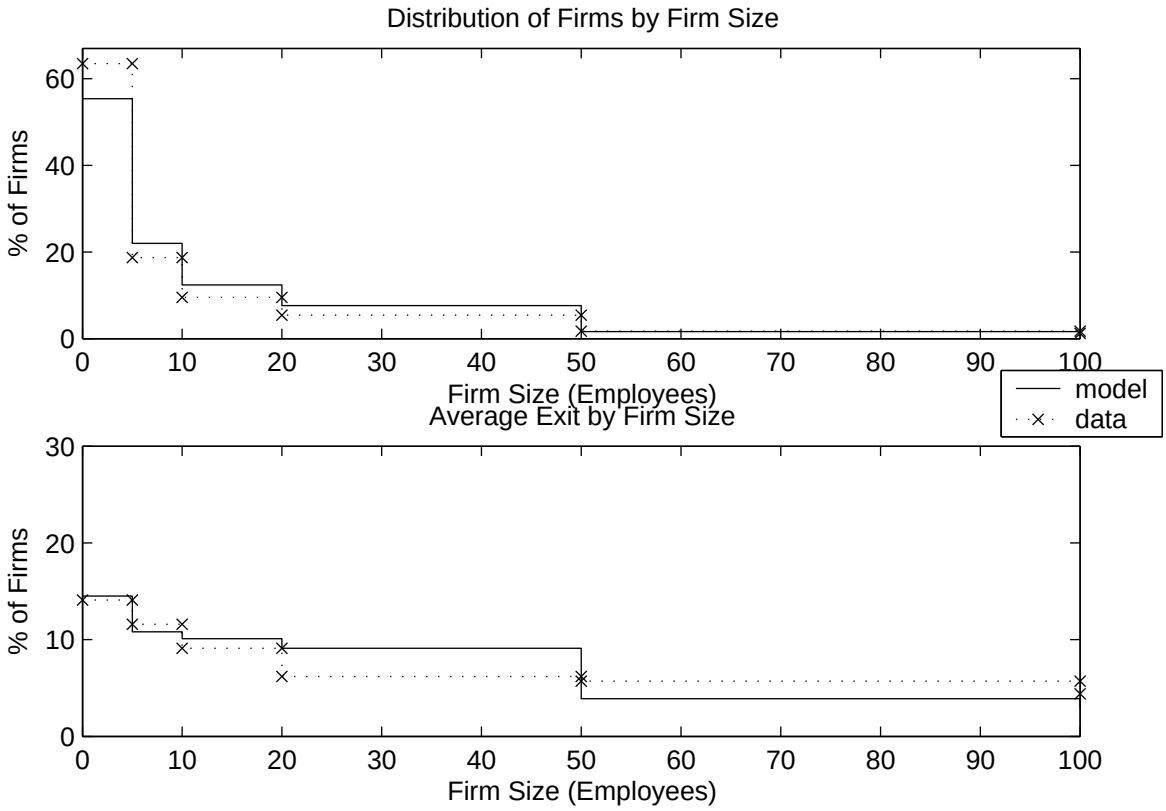

Figure 2: Firms' characteristics

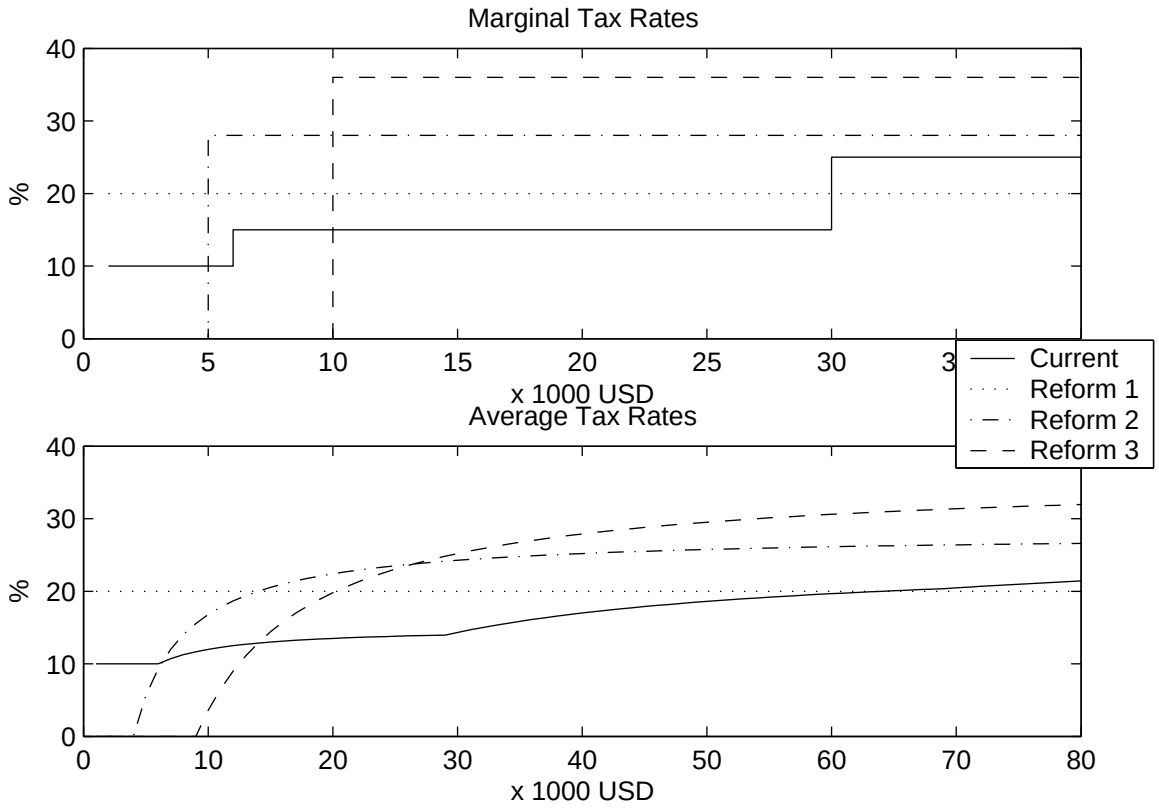

Figure 3: Marginal and Average Tax Rates

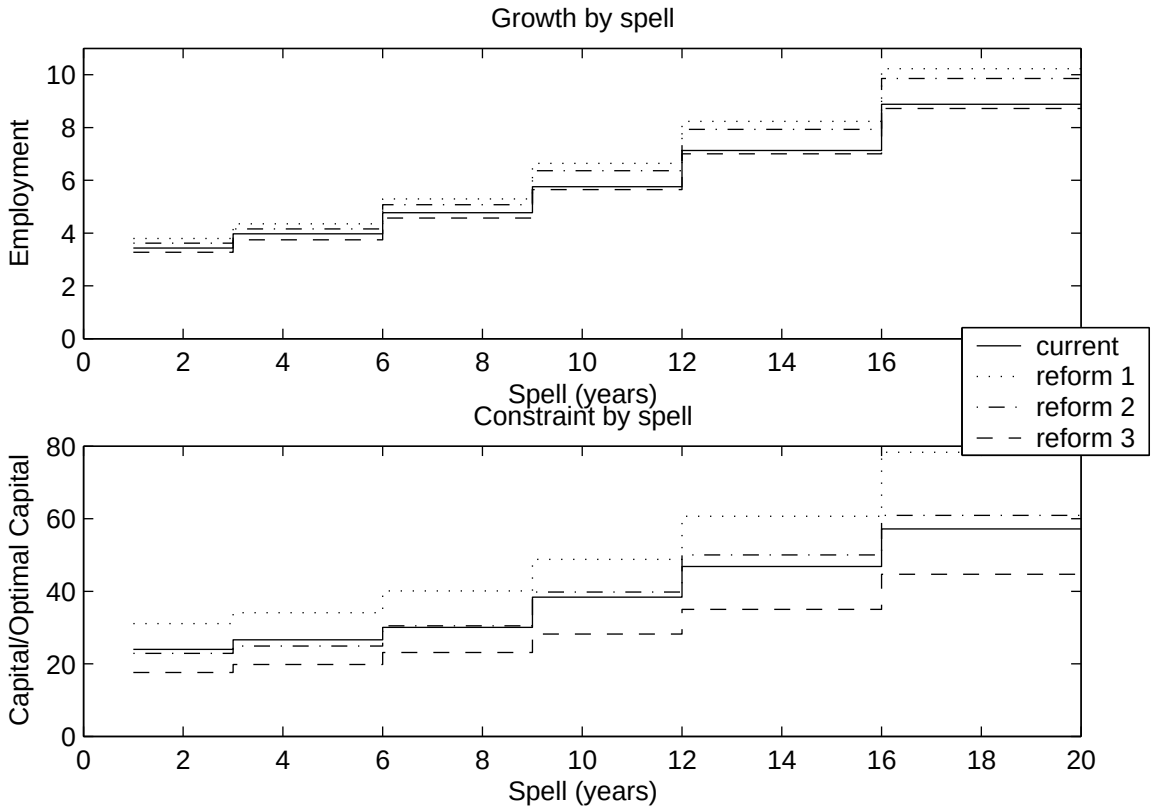

Figure 4: Firm growth by spell

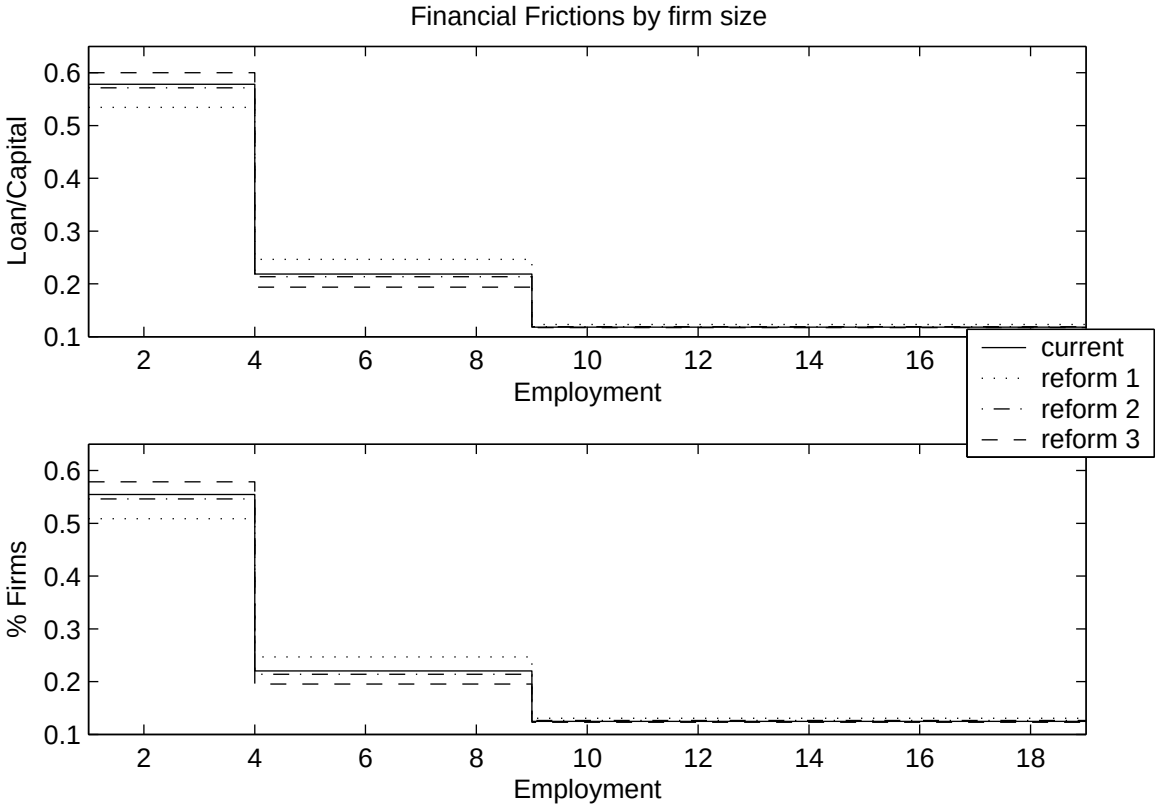

Figure 5: Financial Frictions by the size of firm