The Aggregate Consequences of Tax Evasion

Alessandro Di Nola[1] Georgi Kocharkov[2]
Almuth Scholl[1] Anna Tkhir[1]

[1] University of Konstanz

[2] Goethe University Frankfurt

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Motivation

- Tax evasion is substantial in the U.S.
  - In 2001, $197 billion $\approx$ 18% of actual tax liability (Slemrod 2007)
- Tax evasion is concentrated among self-employed businesses
  - 57% of self-employed income versus 1% of wages and salaries
- Self-employed businesses are important
  - 39% of assets and 21% of income

▸ Tax Gap ▸ Tax Evasion Data ▸ Self-Employed Data

What We Do

- Research questions
  - How does tax evasion in the self-employment sector affect aggregate outcomes and welfare?
  - What are the implications for tax enforcement and tax policy?
- Dynamic general equilibrium model with
  - heterogeneous agents and incomplete markets
  - occupational choice: worker or self-employed business owner
  - tax evasion in self-employment sector
- Quantitative application to the U.S.

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Main Findings

- Tax evasion
  - $\uparrow$ size but $\downarrow$ productivity of the self-employment sector,
  - Induces self-employed businesses to stay small
  - $\uparrow$ aggregate savings and $\downarrow$ wealth inequality

- Welfare
  - Perfect enforcement $\Rightarrow$ welfare $\downarrow$ by 4% if no redistribution
  - Tax revenues $\uparrow$ by 1.6% of GDP
  - If redistributed back - average welfare gain of up to 0.9%

- Tax enforcement and tax policy
  - Tax revenues of self-employed follow a Laffer curve wrt the tax rate
  - Fine that maximizes tax revenues is 10 p.p. lower than existing penalty of 75% in U.S.

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Main Findings - Mechanism

- **Subsidy channel**
  - Tax evasion reduces the tax burden of self-employed business owners
- **Selection channel**
  - Tax evasion induces low-productive agents to become self-employed
- **Detection channel**
  - The probability of audit induces self-employed businesses to stay small

Literature

- Classic papers on tax evasion
  - Allingham and Sandmo (1972), Sandmo (2005), Slemrod (2007)
- Heterogenous agent models with entrepreneurship
  - Quadrini (2000), Cagetti and De Nardi (2006), Kitao (2008)
- Heterogenous agent models with informality/tax evasion
  - Maffezzoli (2011), Bobbio (2016), Bastidas (2018)
- Occupational choice models with informality
  - Amaral and Quintin (2006), Antunes and Cavalcanti (2007), Quintin (2008), Ordonez (2014)

Model

Model - Households

- Preferences

$$E\sum_{t=0}^{\infty}\beta^t u(c_t), \qquad u(c_t)=\frac{c_t^{1-\sigma}}{1-\sigma}$$

- Endowment
  - A unit of time
  - Working ability $\varepsilon \in \mathcal{E}$
  - Business ability $\theta \in \Theta$
- Occupation
  - Worker
  - Self-employment
- Tax evasion
  - Self-employed may evade part of their business profit

Model - Technology

- Corporate sector

$$Y_C = K_C^{\alpha} N_C^{1-\alpha}, \qquad 0 < \alpha < 1$$

- Sector of self-employment

$$y = \theta k^{\nu}, \qquad 0 < \nu < 1$$

- Capital depreciates at rate $\delta \in (0, 1)$

▸ Further

Model - Workers

- Receive wage w and interest r on their savings a
- Pay income taxes $T^W(\cdot)$
- Markets are incomplete and workers are borrowing-constrained
- Budget

$$
\begin{aligned}
y_w &= w\varepsilon + ra \\
c + a' &\leqslant y_w + a - T^W(y_w) \\
a' &\geqslant 0
\end{aligned}
$$

Model - Self-Employed

- Receive interest r on their savings a
- Invest in capital and may borrow at rate r subject to a collateral constraint
- Budget

$$\pi = \theta k^{\nu} - (\delta + r)k$$
$$y_E = \pi + ra$$
$$0 \leqslant k \leqslant \lambda a, \qquad \lambda \geqslant 1$$
$$a' \geqslant 0$$

Model - Tax Evasion

- Tax evasion takes place in the self-employment sector
- Self-employed agents pay income taxes $T^E(\cdot)$ but may evade a fraction ϕ of business income
- With probability $p(k)$, $p'(k) > 0$, an evader is detected and pays a proportional fine s
- Budget constraint if not detected

$$c + a' \leqslant y_E + a - T^E((1-\phi)\pi + ra)$$

- Budget constraint if detected

$$c + a' \leqslant y_E + a - T^E((1-\phi)\pi + ra) - s[T^E(\pi + ra) - T^E((1-\phi)\pi + ra)]$$

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Model - Government

- The government collects taxes on income, fines and provides transfers

- The tax function T (Gouveia and Strauss, 1994)

$$T^i(y) = a_0^i(y - (y^{-a_1^i} + a_2^i)^{-1/a_1^i})$$

with $i = \{Worker, Entrepreneur\}$

Model - Timing

1. At the beginning of each period ε and θ are realized
2. Agents choose an occupation $o \in \{W, E\}$
3. Self-employed decide how much to invest (k) and evade (ϕ)
4. Agents pay taxes (T^W, T^E)
5. Detection by tax authority takes place
6. Consumption and saving decisions are made

Household Problem - Occupational Choice

- At the start of each period, households decide whether to work in the corporate sector or to be self-employed

$$V(a, \epsilon, \theta) = \max_{o \in \{W,E\}} \left\{ V^W(a, \epsilon, \theta), V^E(a, \epsilon, \theta) \right\}$$

- $V^W(a, \epsilon, \theta)$: value function of a worker
- $V^E(a, \epsilon, \theta)$: value function of a self-employed

Household Problem - Value Function of Worker

$$V^W(a, \epsilon, \theta) = \max_{c, a'} \left\{ u(c) + \beta E\left[V\left(a', \epsilon', \theta'\right) | \epsilon, \theta \right] \right\}$$

subject to

$$y_W = w\epsilon + ra$$

$$c + a' \leqslant y_W + a - T^W(y_W)$$

$$a' \geqslant 0$$

Household Problem - Value Function of Self-Employed

$$V^E(a, \epsilon, \theta) = \max_{k,\phi} \left\{ p(k)\, V_d^E(a, \epsilon, \theta, k, \phi) + (1 - p(k))\, V_n^E(a, \epsilon, \theta, k, \phi) \right\}$$

subject to

$$0 \leqslant k \leqslant \lambda a, \qquad \lambda \geqslant 1$$

- $V_d^E(a, \epsilon, \theta)$: value function of a self-employed if detected
- $V_n^E(a, \epsilon, \theta)$: value function of a self-employed if not detected

Household Problem - Value Function Not Detected

$$V_n^E(a, \epsilon, \theta, k, \phi) = \max_{c, a'} \left\{ u(c) + \beta E\left[V\left(a', \epsilon', \theta'\right) | \epsilon, \theta \right] \right\}$$

subject to

$$\pi = \theta k^{\nu} - (\delta + r)k$$

$$y_E = \pi + ra$$

$$c + a' \leqslant y_E + a - T^E\left((1 - \phi)\pi + ra\right)$$

Household Problem - Value Function Detected

$$V_d^E(a, \epsilon, \theta, k, \phi) = \max_{c, a'} \left\{ u(c) + \beta E\left[V\left(a', \epsilon', \theta'\right) | \epsilon, \theta \right] \right\}$$

subject to

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▸ Stationary Equilibrium

Calibration

Calibration - External

- Panel Study of Income Dynamics (PSID) 1990-2003
- Income tax

$$T^i(y) = a_0^i(y - (y^{-a_1^i} + a_2^i)^{-1/a_1^i}), \qquad i = \{W, E\}$$

Details

- Working ability

$$\log \varepsilon_{t+1} = \rho_\varepsilon \log \varepsilon_t + \eta_{\varepsilon,t+1}$$

where $\eta_{\varepsilon,t+1} \sim N(0, \sigma_\varepsilon^2)$

Calibration - External

Parameter	Description	Value	Source
σ	Elasticity of substitution	2	standard value
α	Corp. capital share	0.38	Karabarbounis and Neiman (2014)
λ	Leverage ratio	1.2	Diaz-Gimenez et al. (1992)
s	Tax evasion fine	1.75	U.S. Department of the Treasury (2016)
Working ability			
ρ_ε	Persistence	0.89	micro data - PSID
σ_ε	Standard deviation	0.21	micro data - PSID
Tax functions			
a_0^W	workers	0.32	Cagetti and De Nardi (2009) - PSID
a_1^W	workers	0.76	Cagetti and De Nardi (2009) - PSID
a_2^W	workers	0.22	Cagetti and De Nardi (2009) - PSID
a_0^E	self-employed	0.26	Cagetti and De Nardi (2009) - PSID
a_1^E	self-employed	1.40	Cagetti and De Nardi (2009) - PSID
a_2^E	self-employed	0.44	Cagetti and De Nardi (2009) - PSID

▸ Tax

Calibration - Internal

- Business ability

$$\log \theta_{t+1} = \mu_\theta + \rho_\theta \log \theta_t + v_{\theta,t+1}, \qquad v_{\theta,t+1} \sim N(0, \sigma^2_\theta)$$

- Probability of detection

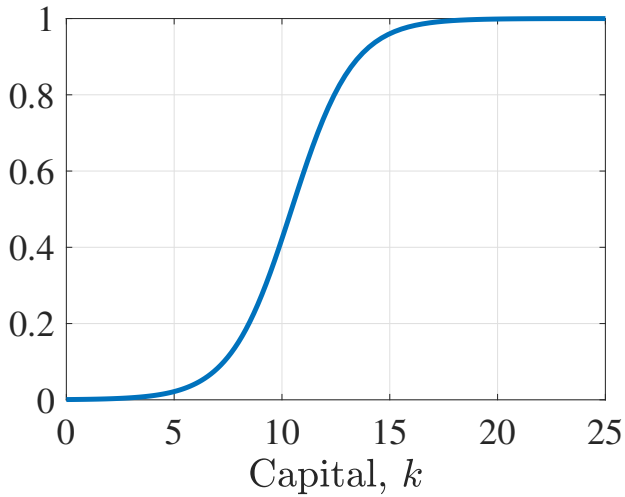
$$p(k) = \frac{1}{1 + p_1 \exp(-p_2 k)}, \qquad p_1 > 0,\ p_2 > 0$$

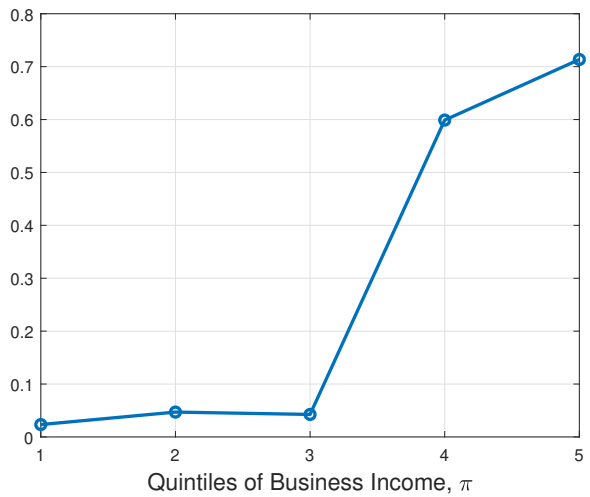
▸ Data on Auditing

Calibration - Internal

Parameter	Description	Value	Source/Target
Preferences			
β	Discount factor	0.935	4% interest rate
Production			
δ	Capital depreciation	0.11	Capital-output ratio
v	Span of control	0.62	Share of income, self-employed
Entrepreneurial ability			
ρ_θ	Persistence	0.935	Exit rate, self-employed
σ_θ	Standard deviation	0.77	Share of assets, self-employed
μ_θ	Unconditional mean	-1.29	Share, self-employed
Tax evasion detection			
p_1	Parameter of $p(k)$	1500	Tax evasion by income (quintiles)
p_2	Parameter of $p(k)$	0.7	Tax evasion by income (quintiles)
Tax functions rescale			
χ	Rescaling parameter	1.4	Tax revenue to GDP

Probability of Auditing



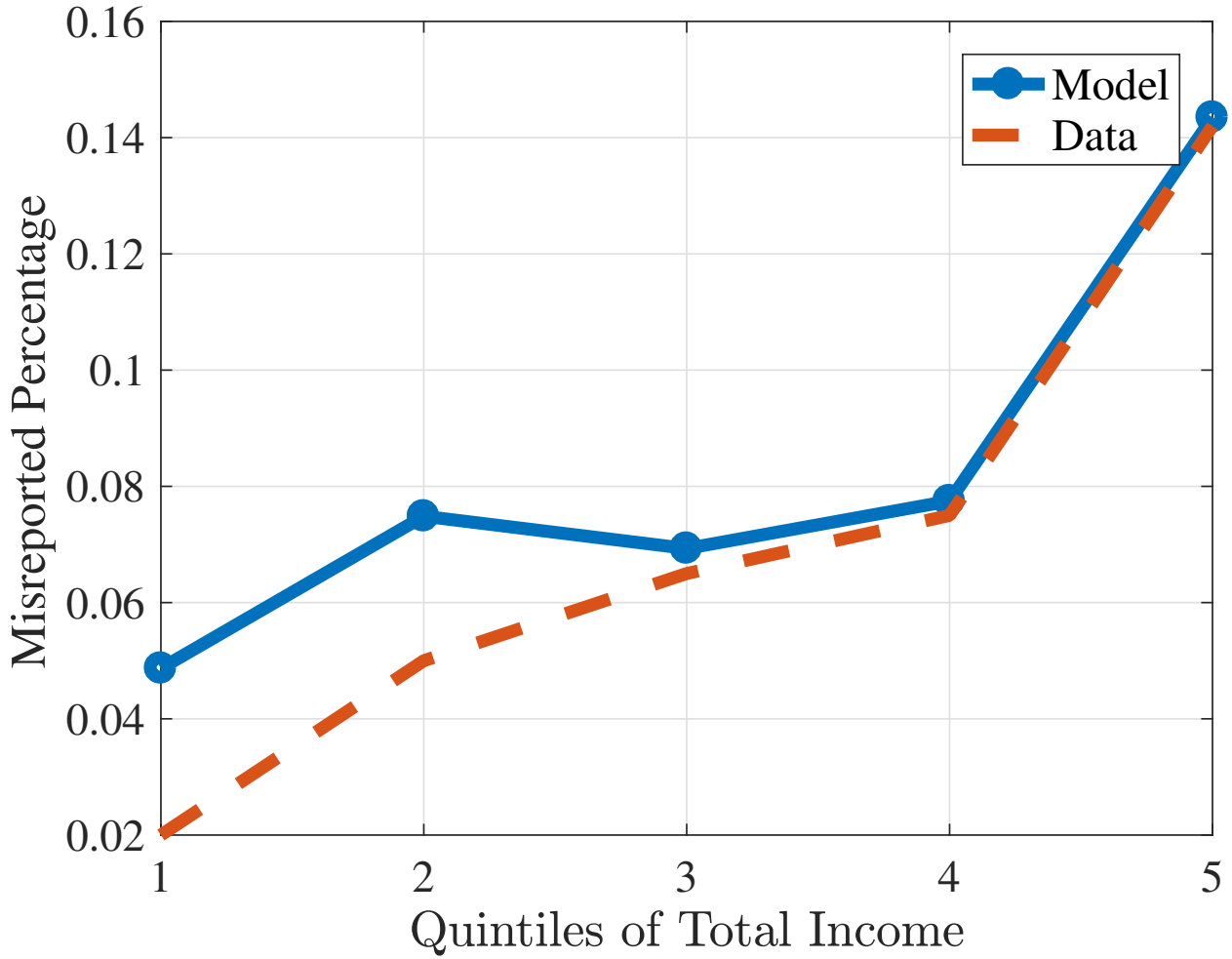


▶ More

Model Fit - Targets

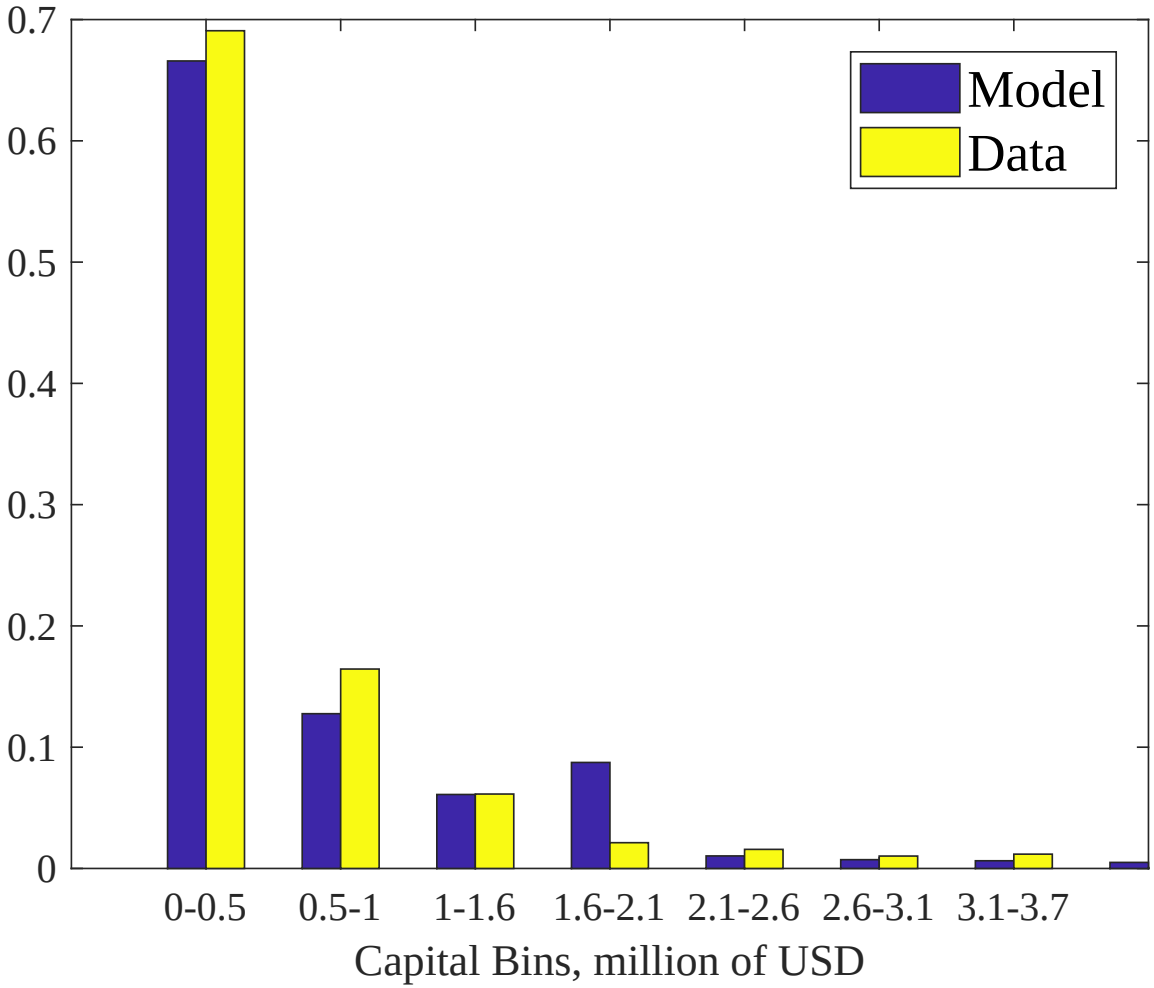
Moments	Data	Model
Interest rate (%)	4.00	3.97
Capital-output ratio	2.65	2.62
Share of self-employed (%)	14.70	14.65
Share of assets, self-employed (%)	39.11	42.72
Share of income, self-employed (%)	21.04	23.76
Exit rate, self-employed (%)	15.73	15.90
Misreporting rate (%)	11.00	10.33
Tax revenues/GDP (%)	15.20	14.96

Model Fit - Targets



▸ Share of SE by Income

Model Fit - Size of Self-Employed Businesses



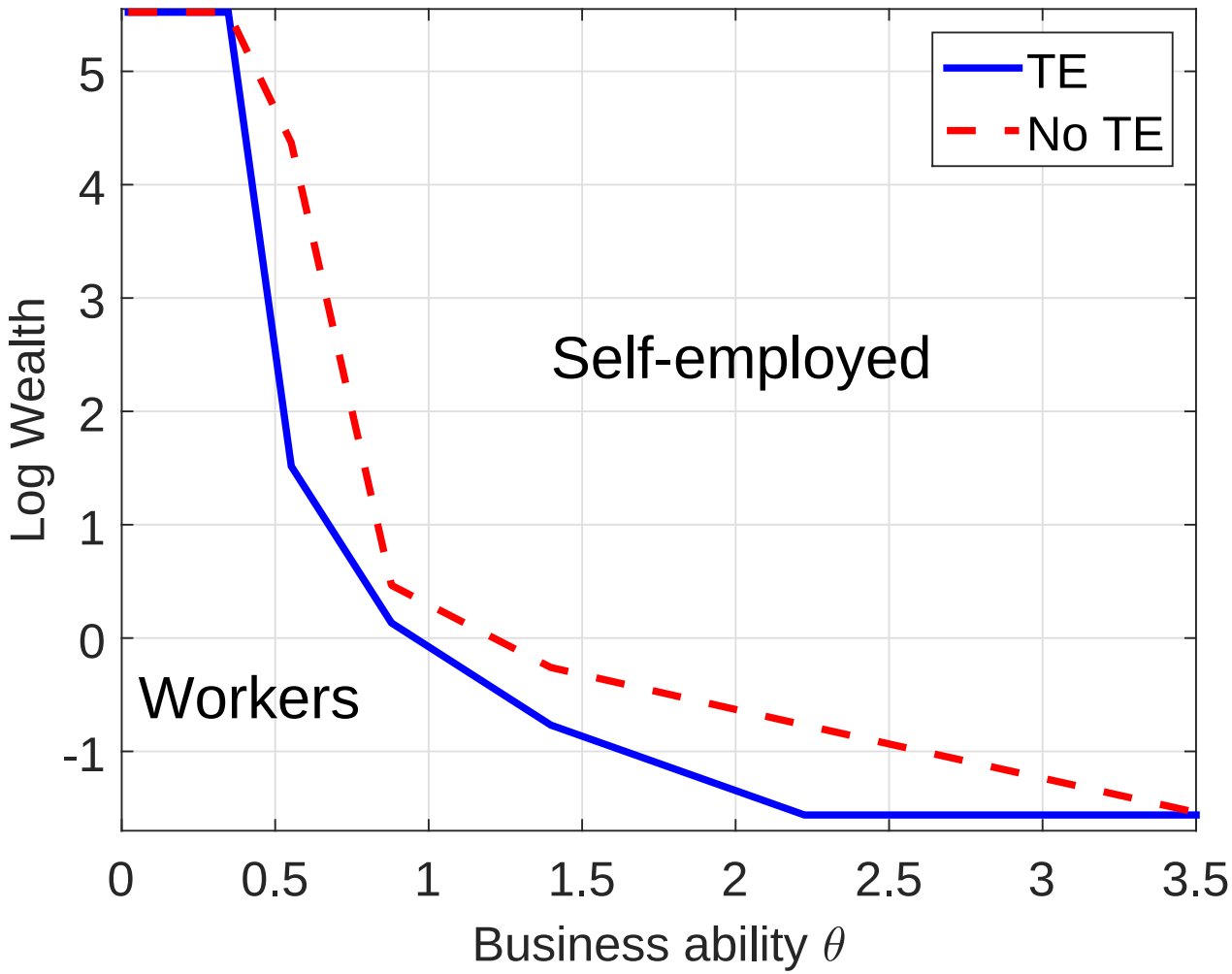
Net Worth

Model Fit - Wealth and Income Distribution

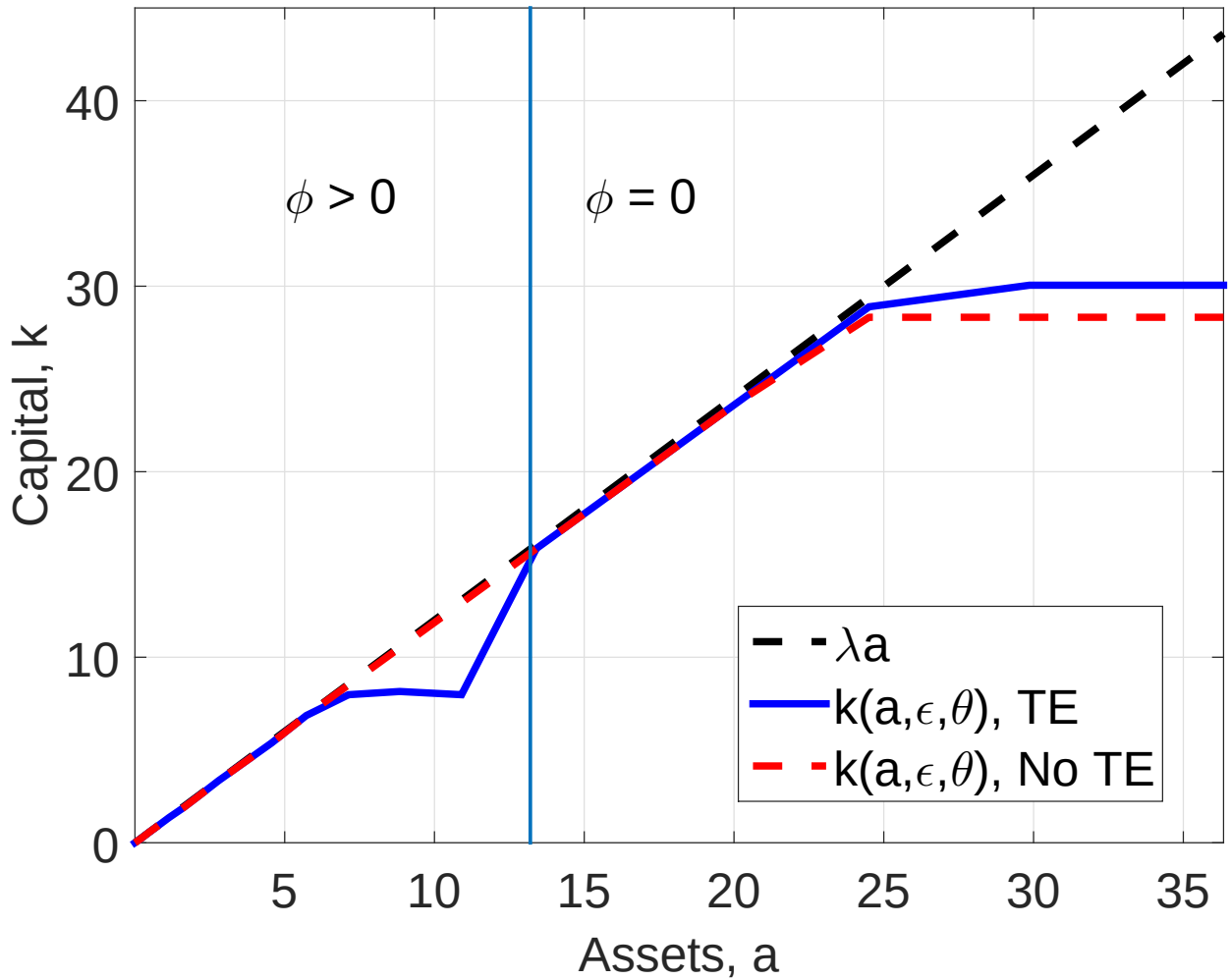
	Gini	Mean/Median	Bottom 40	Top 20	Top 10	Top 1
Wealth						
Model	73.5	2.90	3.26	76.38	63.32	21.53
US Data	71.1	3.10	2.71	75.64	60.56	26.53
Income						
Model	36.6	1.34	19.84	45.03	31.71	10.69
US Data	35.2	1.23	19.32	42.77	28.27	7.60

Results

The Impact of Tax Evasion - Occupational Choice



The Impact of Tax Evasion - Capital of Self-Employed



▸ Savings ▸ Audit and Tax Evasion

The Impact of Tax Evasion - Aggregates

	Tax Evasion	No Evasion	% Change
Sector of self-employment			
Share	0.147	0.105	+4.14
$E(\theta \mid E)$	0.93	1.02	-10.14
$E(k \mid E)$	12.86	14.65	-13.90
K^E	1.88	1.54	+18.30
Y^E	0.68	0.56	+17.90
Corporate sector			
K^C	3.84	3.82	+0.53
N^C	0.85	0.89	-4.34
Y^C	1.51	1.54	-2.46
Prices			
r (%)	3.97	4.34	-0.37
w	1.10	1.08	+1.48
Inequality and tax revenues			
Gini wealth	73.50	75.24	-1.74
T/Y(%)	14.96	16.61	-1.65

▸ Firm Size ▸ Inequality ▸ Decomposition

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Tax Evasion and Welfare

- Welfare effects of eliminating tax evasion measured in consumption equivalent variations in %
- Without *revenue neutrality*
  - Government keeps extra tax revenues
- With *revenue neutrality*
  - Lump-sum redistribution
  - Tax reduction for workers and self-employed
  - Tax reduction for self-employed only

Tax Evasion and Welfare

		Perfect Tax Enforcement			
	Tax Evasion Benchmark	No Redis-tribution	Redistribution		
			Lump-Sum All	Tax Cut All	Tax Cut Self-Employed
	(1)	(2)	(3)	(4)	(5)
Share of SE (%)	14.65	10.51	10.45	10.80	13.92
Y	2.18	2.10	2.10	2.13	2.21
r (%)	3.97	4.34	4.40	4.23	3.81
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Welfare (%)	N.A.	-4.09	-1.72	-1.25	-0.60

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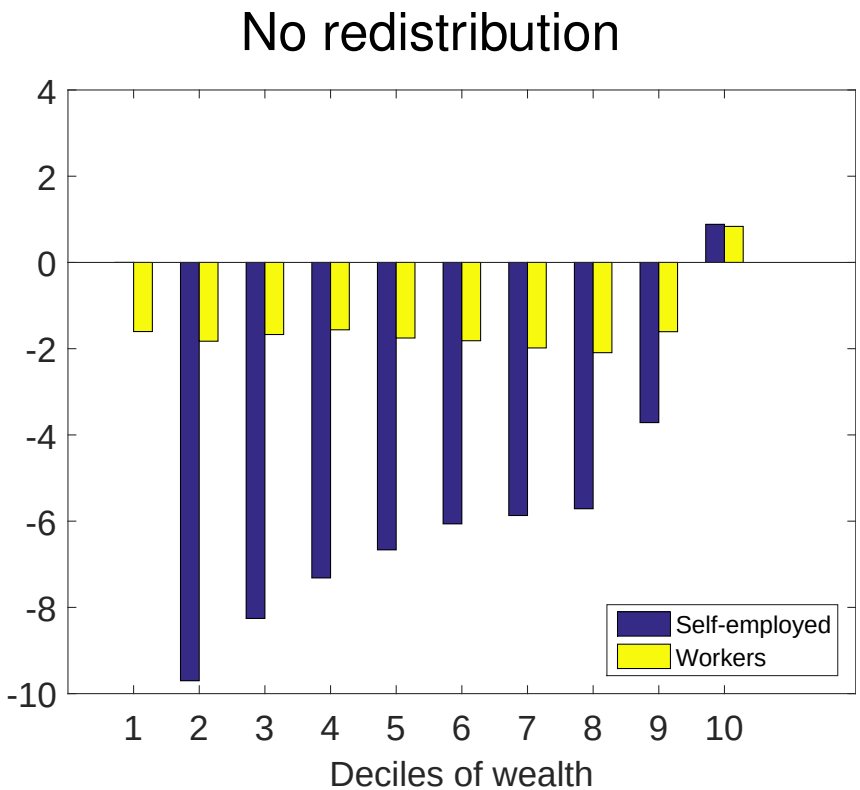
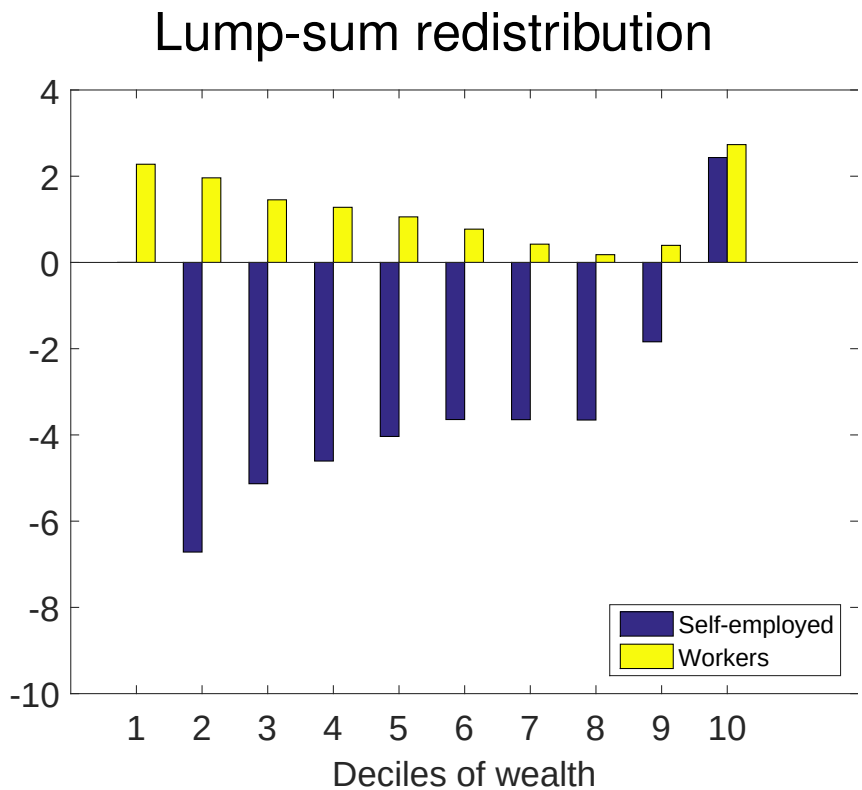
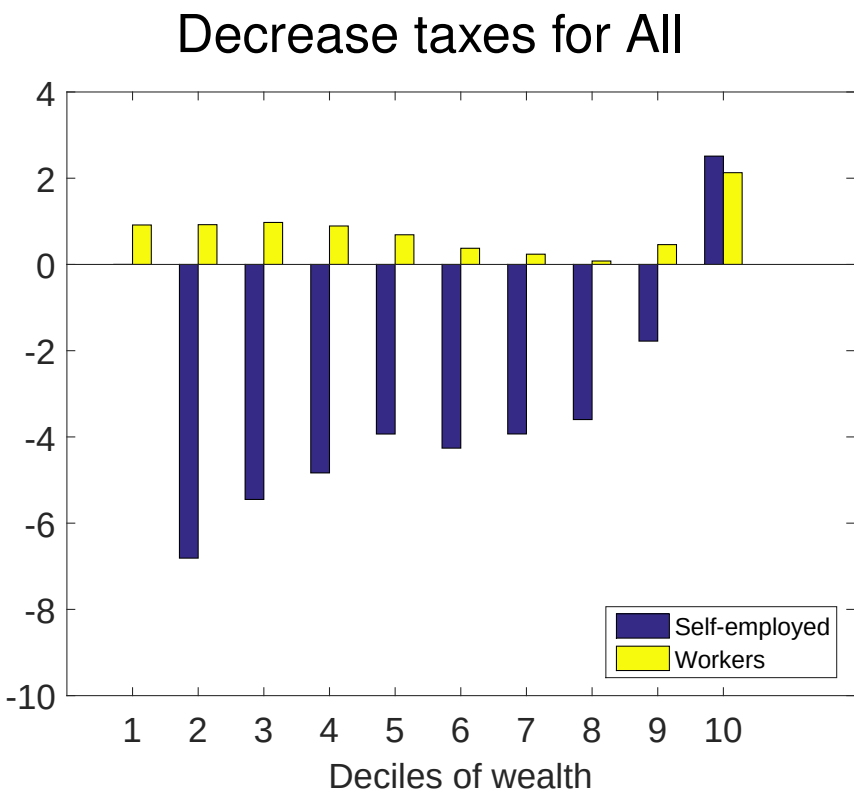
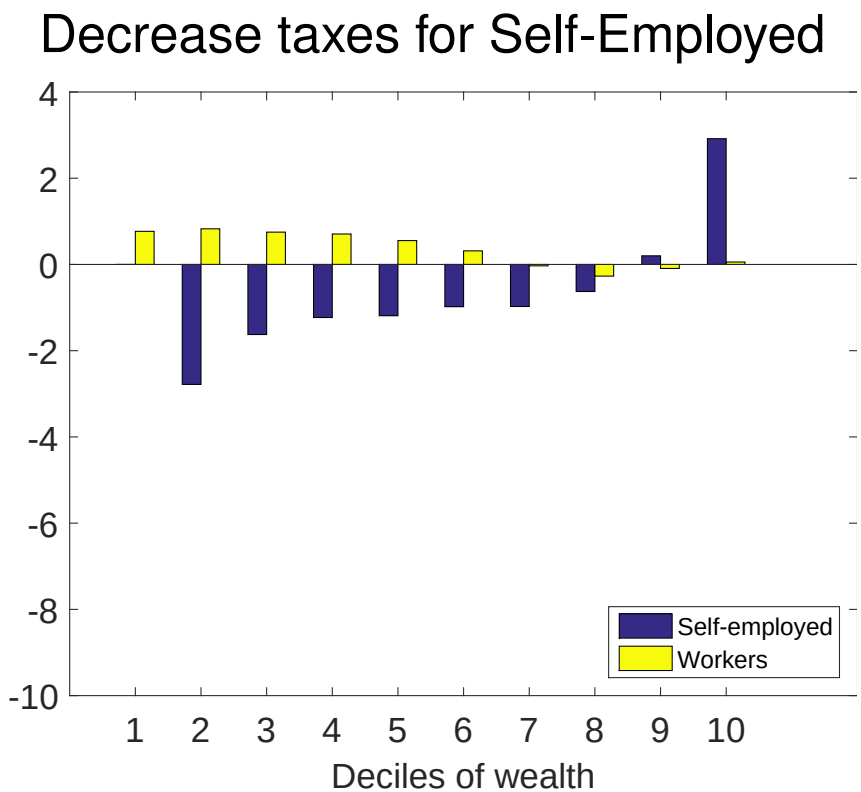




Tax Evasion and Welfare





Tax Evasion and Welfare

- Target a specific group of self-employed
- Only to wealth-poor self-employed, with $a < p`x`$ where $x = 10 - 90$

	Threshold as Percentage of the Wealth Distribution								
	p10	p20	p30	p40	p50	p60	p70	p80	p90
Share of SE (%)	15.25	14.71	14.52	14.45	14.54	14.83	14.38	14.41	14.15
Y	2.14	2.14	2.14	2.16	2.17	2.22	2.20	2.23	2.22
r (%)	4.13	4.14	4.14	4.12	4.05	3.92	3.96	3.85	3.84
w	1.09	1.09	1.09	1.09	1.09	1.10	1.10	1.10	1.10
Welfare (%)	-1.33	-1.09	-1.03	-0.82	-0.3	0.89	0.38	0.78	0.25

Tax Evasion and Laffer Curves

Additional results

- What is the impact of tax enforcement on tax revenues and aggregate outcomes? Fine and Tax Enforcement
- How do changes in tax rates affect tax revenues and aggregate outcomes? Tax Scheme

Conclusions

Conclusions

- Tax evasion by small self-employed businesses matters for aggregate outcomes and welfare

- Tax evasion
  - increases the size but reduces the productivity of the self-employment sector
  - reduces the size of self-employed businesses
  - increases aggregate savings and reduces wealth inequality

- Perfect tax enforcement: small average welfare gain with sizable gains for workers

Appendix

More on the Tax Gap

	Tax Gap ($billion)	Share of Total
Total Tax Gap	285	-
- Individual income tax	197	69.1%
- Employment tax	54	18.9%
- Corporate income tax	30	10.5%
- Estate and excise taxes	4	1.4%

Source: U.S. Department of the Treasury (2006), Slemrod (2010)

- Underreporting of individual income tax: most important component of tax gap

Back

Tax Gap by Income Sources

Table: Misreporting Percentages by Income Sources

	Tax Gap (% of True Amount)
Salaries and Wages	1%
Interest	4%
Dividends	4%
Business (Sch C)	57%
Part.,S Corp	18%
Capital Gains	12%

Source: U.S. Department of the Treasury (2006), Slemrod (2010)

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Tax Evasion Data

- Since 1979 IRS estimates “tax gap”
  - How much tax should be paid, but is not *voluntarily* paid in a *timely* manner
- Two programs of random audits
  1. Taxpayer Compliance Measurement Program (TCMP)
  2. National Research Program (NRP)
- For tax year 2001, NRP selected a random sample of 45000 tax returns
- A.Johns & Joel Slemrod “The Distribution of Income Tax Noncompliance”, National Tax Journal 2010 use IRS data to estimate distribution of tax evasion by income level

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Self-Employed - Data

Table: Summary Statistics for Alternative Definitions

Variable	Self-Employed	Business Owners
Fraction of entre.	14.70%	20.11%
Share of entre. income	21.04%	27.98%
Assets owned by entre.	39.11%	46.15%
Ratio of median assets (E to W)	4.02	3.65
Exit rate entre.	15.73%	24.43%
Obs	22647	22704

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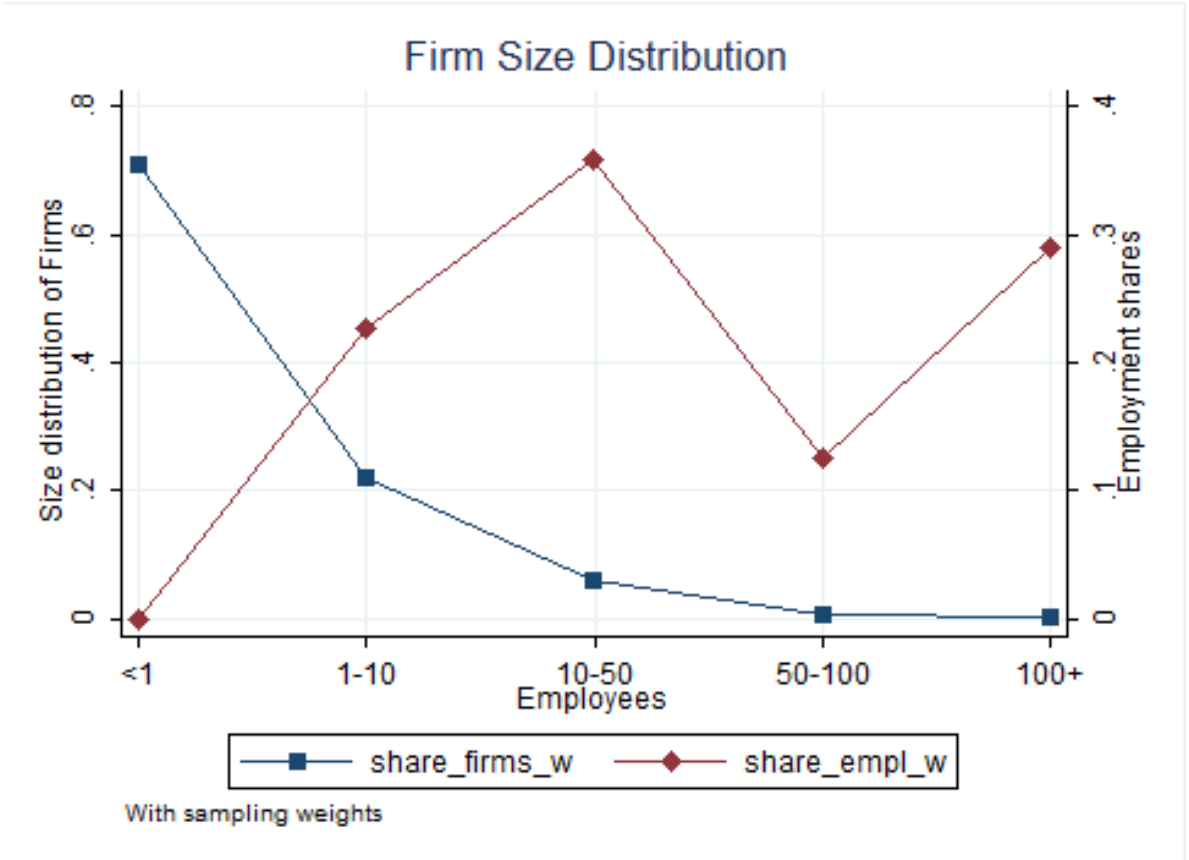
SBO Firm Size



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Stationary Equilibrium

Let $x = (a, \epsilon, \theta)$ be a state vector. A stationary equilibrium is given by

- prices r and w and taxes T^W, T^E
- a set of policy functions $c(x)$, $a'(x)$, $k(x)$, $\phi(x)$, $o(x)$
- a set of value functions $V(x)$, $V^W(x)$, $V^E(x)$, $V^E_d(x)$, $V^E_n(x)$
- an invariant distribution $\mu(x)$

such that

- Value and policy functions solve the household problem
- Prices are given by

$$r = F_K(K_C, N_C) - \delta, \qquad w = F_N(K_C, N_C)$$

Stationary Equilibrium

- Markets clear

$$K_C + \int o(x)k(x)\, d\mu(x) = \int_x a\, d\mu(x)$$

$$N_C = \int (1 - o(x))\epsilon\, d\mu(x)$$

- The government budget constraint is fulfilled

$$\begin{aligned} G = & \int [(1 - o(x))\, T^W(y_W(x)) + o(x)\, T^E((1 - \phi(x))\, \pi(x) + ra) \\ & + o(x)\, p(k(x))\, [T^E(\pi(x) + ra) - T^E((1 - \phi(x))\, \pi(x) + ra)]s]\, d\mu(x) \end{aligned}$$

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Tax Function Estimation I

- Combine PSID (survey years 1990-2003) with NBER's TAXSIM program (Feenberg and Coutts 1993)
- Tax function estimation: regress average tax rate on pre-government income
- pre-government income: labor earnings + self-employment income + income from financial assets
- Taxes include only federal taxes (obtained from TAXSIM)

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Tax Function Estimation II

- Total tax liabilities for $i = W, E$:

$$T^i(y) = a_0^i(y - (y^{-a_1^i} + a_2^i)^{-1/a_1^i})$$

- Average tax rate:

$$t(y)^i \equiv \frac{T^i(y)}{y} = a_0^i(1 - (a_2^i y^{a_1^i} + 1)^{-1/a_1^i})$$

- Marginal tax rate:

$$m(y^i) = a_0^i(1 - (a_2^i y^{a_1^i} + 1)^{-1/(a_1^i - 1)})$$

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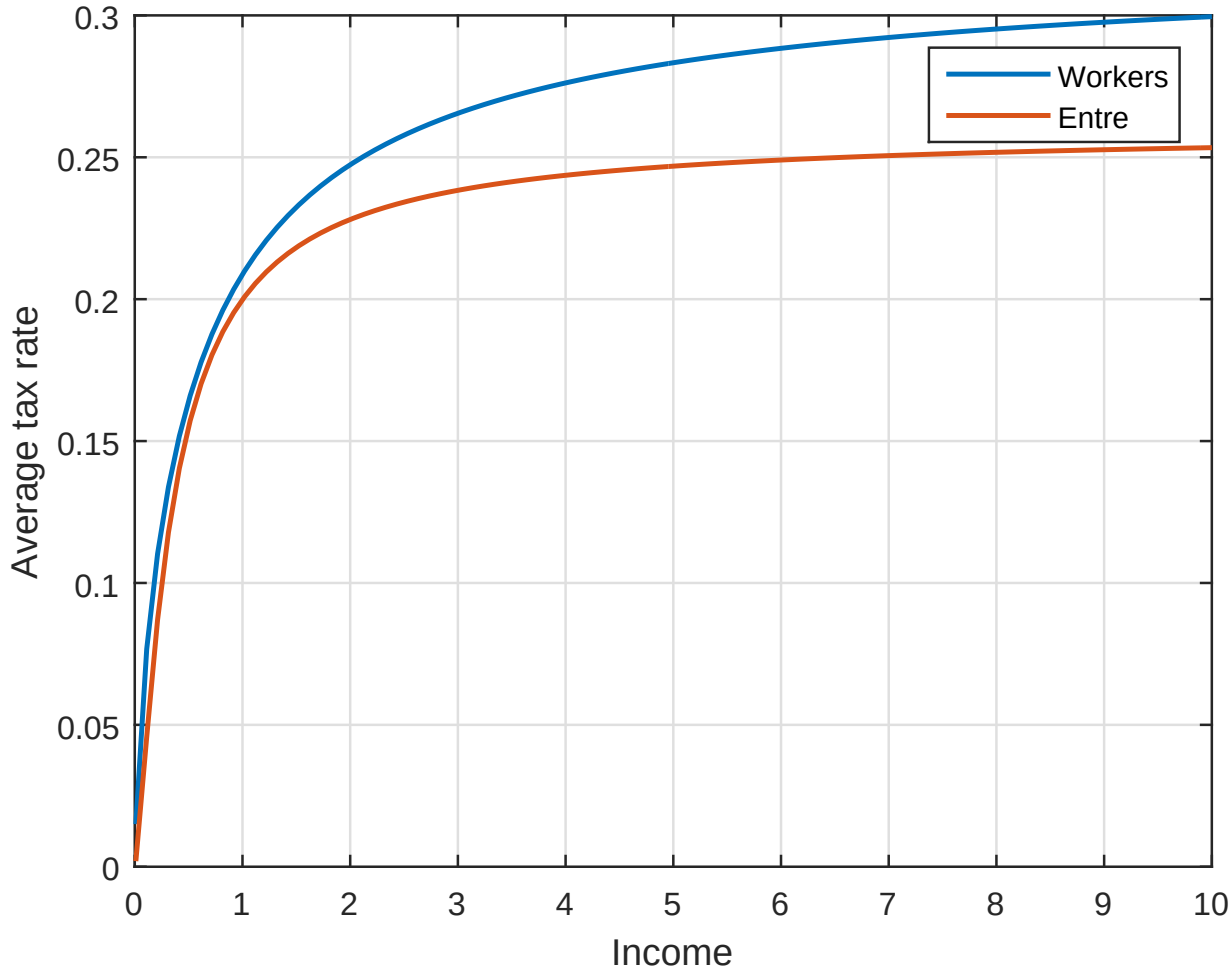
Tax Functions



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Data on Auditing I

Type of return	*Percent covered*
Individual Income Tax	1.11
No adjusted gross income	3.42
[1, 25000]	1.22
[25000, 50000]	0.73
[50000, 75000]	0.83
[75000, 100000]	0.82
[100000, 200000]	1.00
[200000, 500000]	2.66
[500000, 1m]	5.38
[1m, 5m]	11.80
[5m, 10m]	20.75
$>$ 10m	29.93
Corporate income tax	1.5
Small firms ($<$\$10m in assets)	1.0
Large firms ($>$\$10m in assets)	17.6

- **Individuals**: the probability of audit is generally rising in reported income
- **Corporations**: the share of returns audited rises dramatically with the amount of total assets

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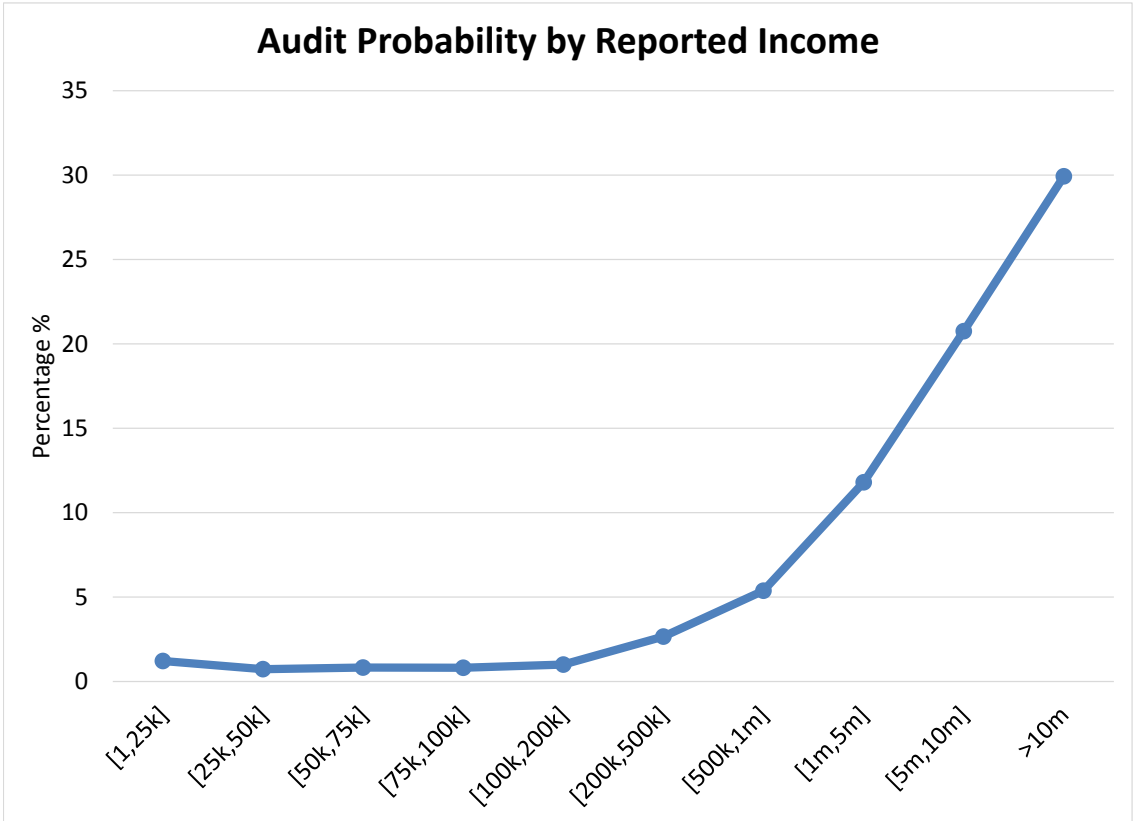
Data on Auditing II



Source: IRS, Data Book 2011

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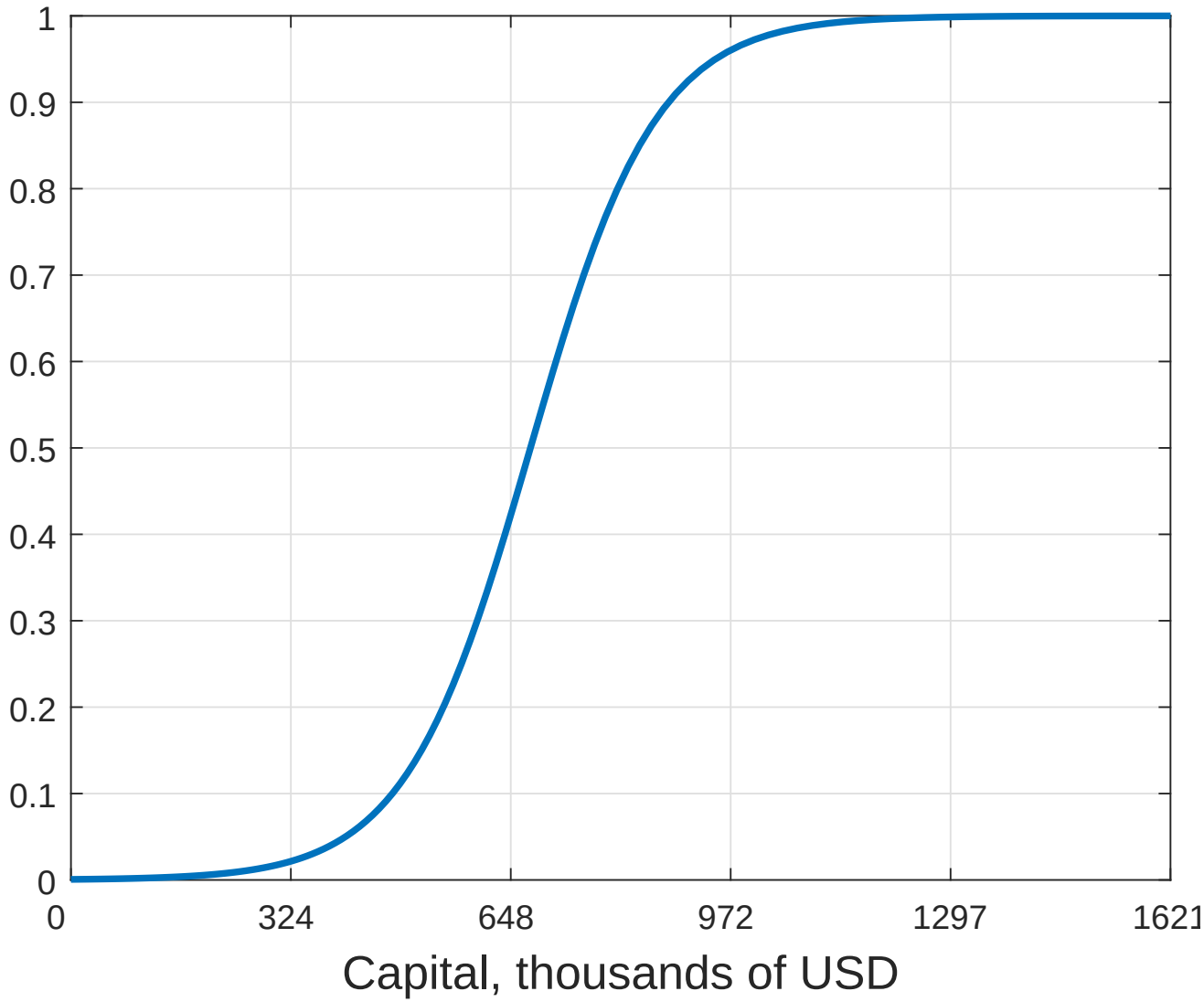
Probability of Auditing



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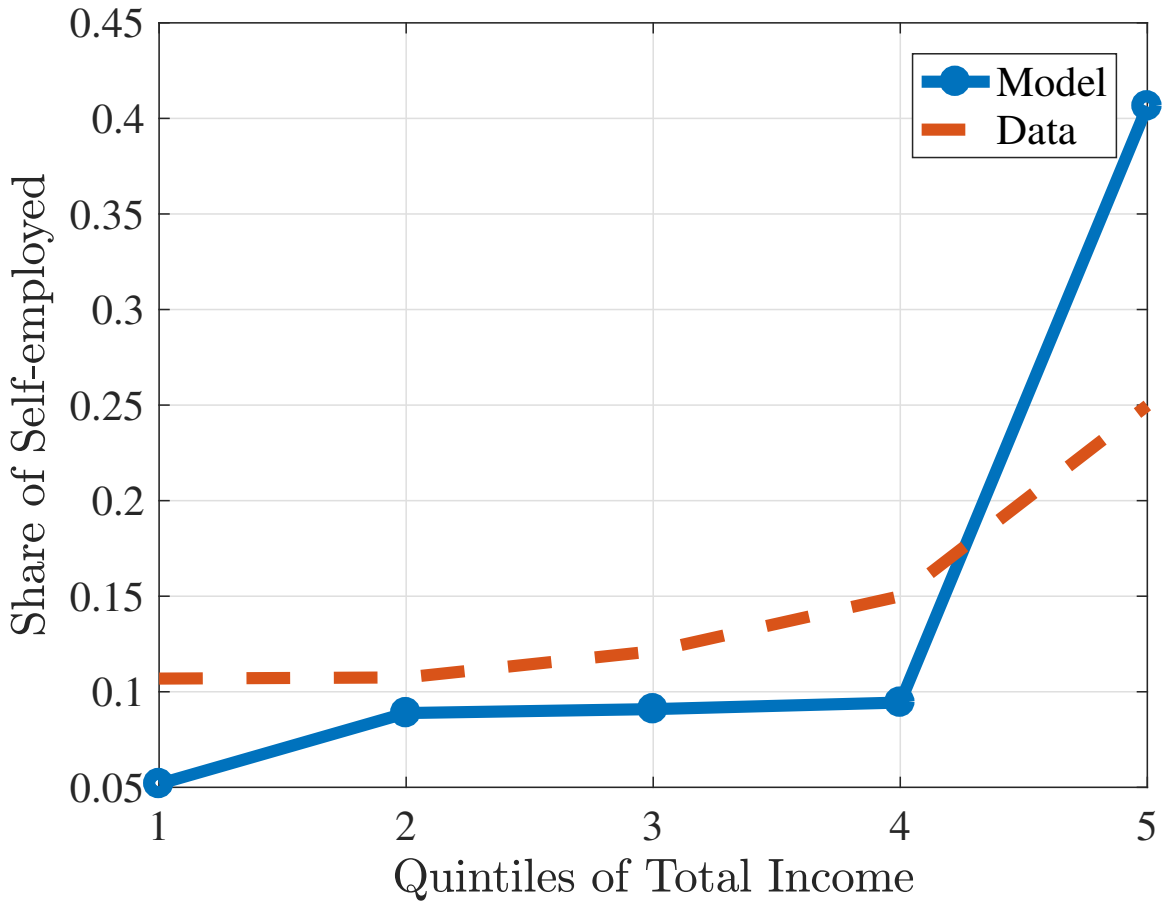
Share of Self-Employed by Income



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Misreporting of Self-Employed by Income

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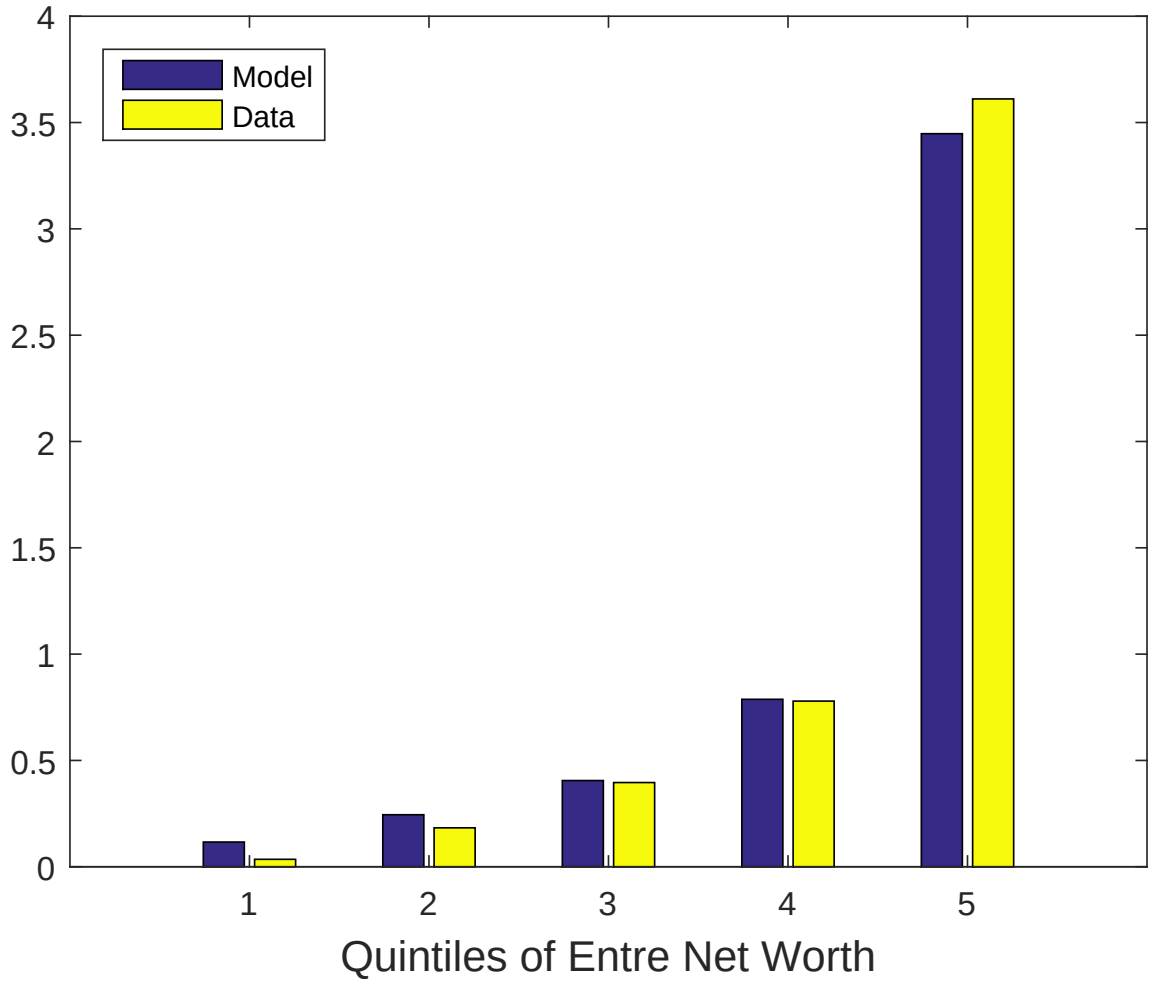
Average Net Worth Normalized by Mean



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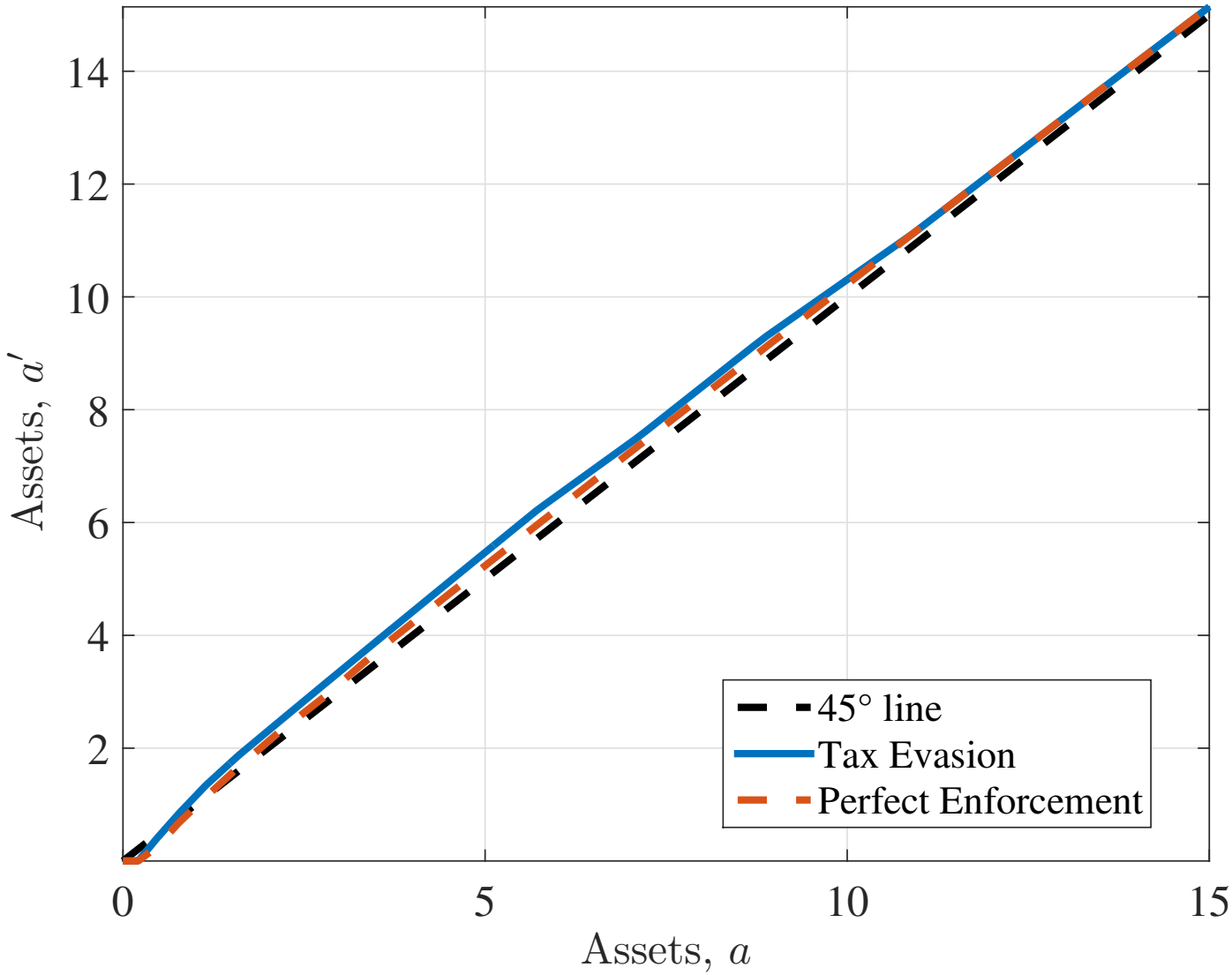
Policy Function for Savings



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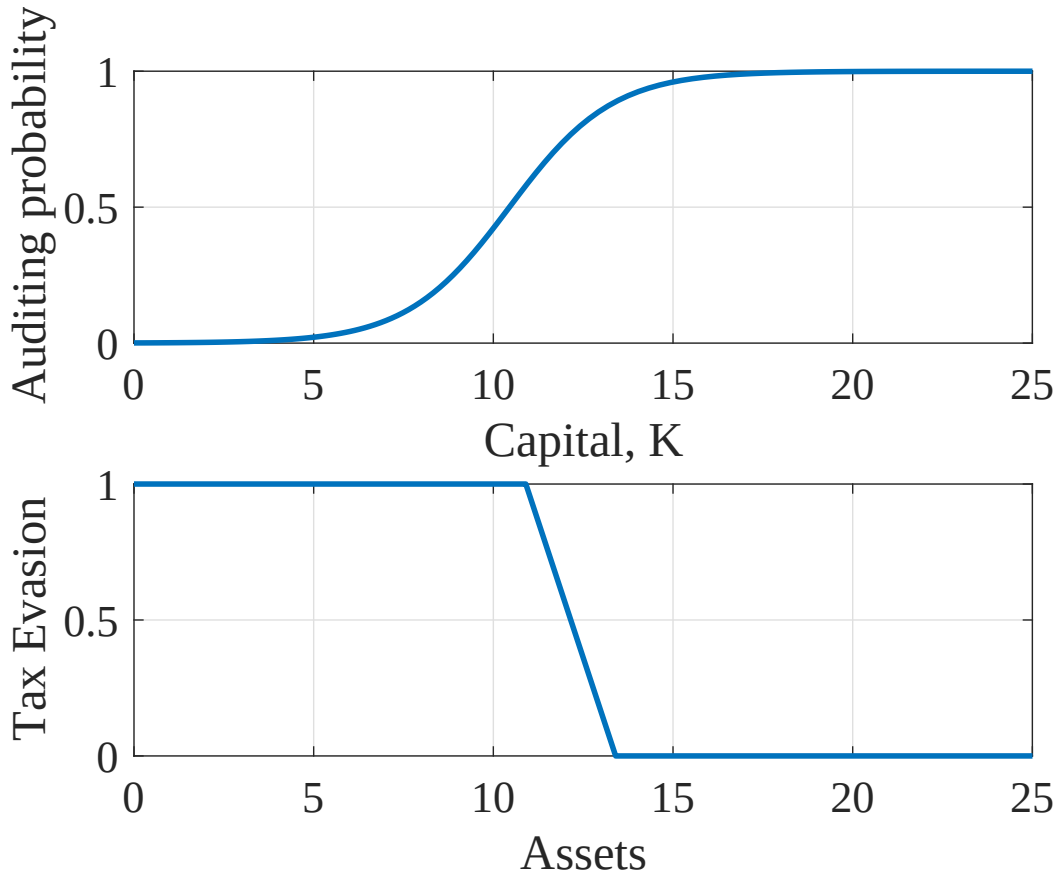
Auditing Probability and Tax Evasion



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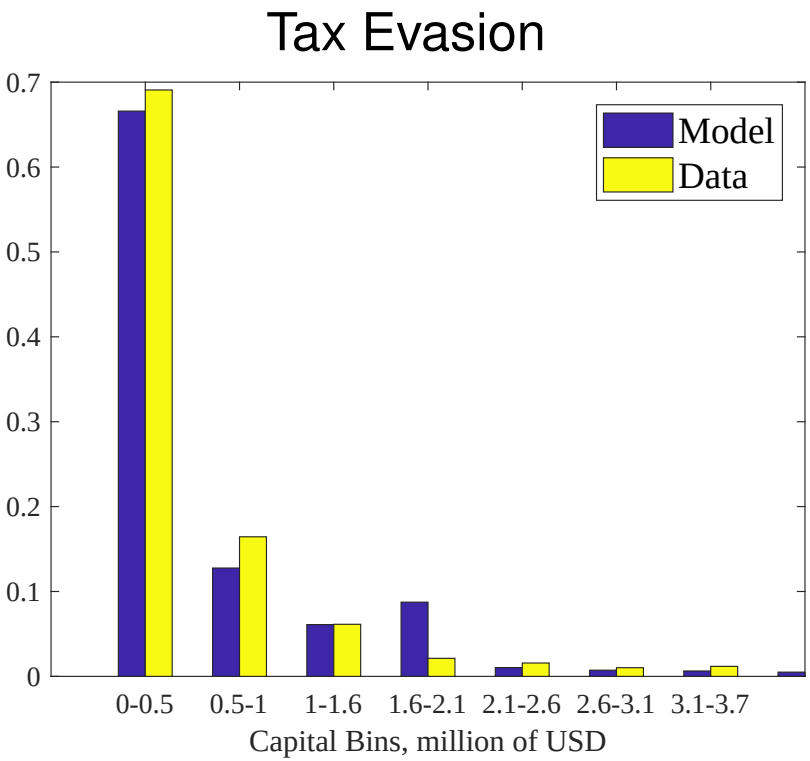
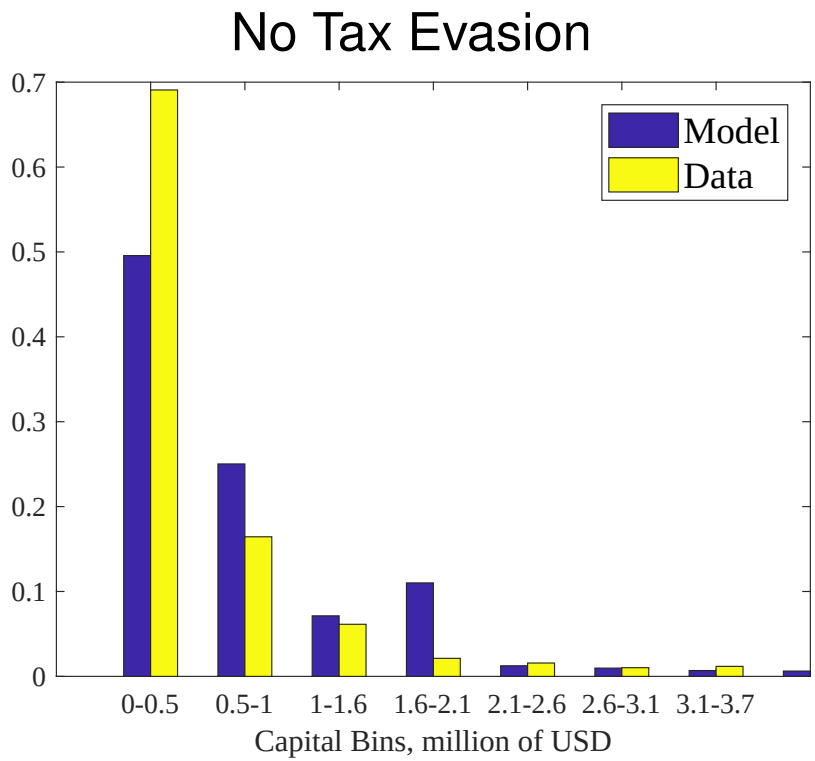
The Impact of Tax Evasion - Size of Businesses





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Wealth and Income Inequality

	Gini	Mean/Median	Bottom 40	Top 20	Top 10	Top 1
Wealth						
Tax Evasion	73.5	2.90	3.26	76.38	63.32	21.53
No Tax Evasion	75.2	3.12	2.76	77.93	65.66	23.11
Income						
Tax Evasion	36.6	1.34	19.84	45.03	31.71	10.69
No Tax Evasion	36.3	1.32	19.91	44.71	31.38	10.47

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Decomposition - Three Channels

- Start from the economy with perfect tax enforcement
- Then move to tax evasion economy keeping prices fixed
- By fixing some of the choices we isolate three channels

  - Fix $o(x)$ and $k(x)$ to eliminate the selection + detection effect
    $\Rightarrow \Delta_{\text{subsidy}}$
  - Fix $o(x)$ to eliminate the selection effect
    $\Rightarrow \Delta_{\text{subsidy}} + \Delta_{\text{detection}}$
  - Fix $k(x)$ to eliminate the detection effect
    $\Rightarrow \Delta_{\text{subsidy}} + \Delta_{\text{selection}}$

Decomposition - Three Channels

		Tax Evasion Economies			
	Perfect Enforcement	Experiments			Benchmark
	(1)	(2)	(3)	(4)	(5)
Fixed decisions from (1)	-	o, k	o	k	-
Endogenous decisions	all	*assets*, ϕ	*assets*, k, ϕ	o, *assets*, ϕ	all
Operational channels	-	Subsidy	Subsidy+Detection	Subsidy+Selection	Subsidy+Detection +Selection
Outcomes					
Share of self-employed	10.505	11.222	11.292	14.933	14.646
Average SE capital $E(\mathrm{k}\|E)$	14.646	15.687	15.040	13.233	12.859
Self-employed capital, K^E	1.538	1.760	1.698	1.976	1.883
Misreporting rate	0	7.771	8.631	9.83	10.331

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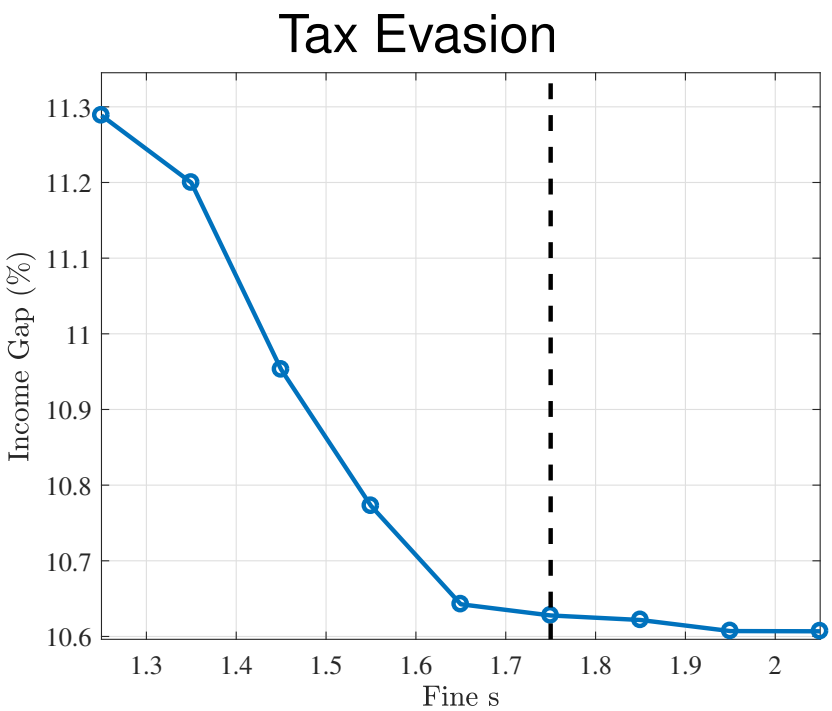
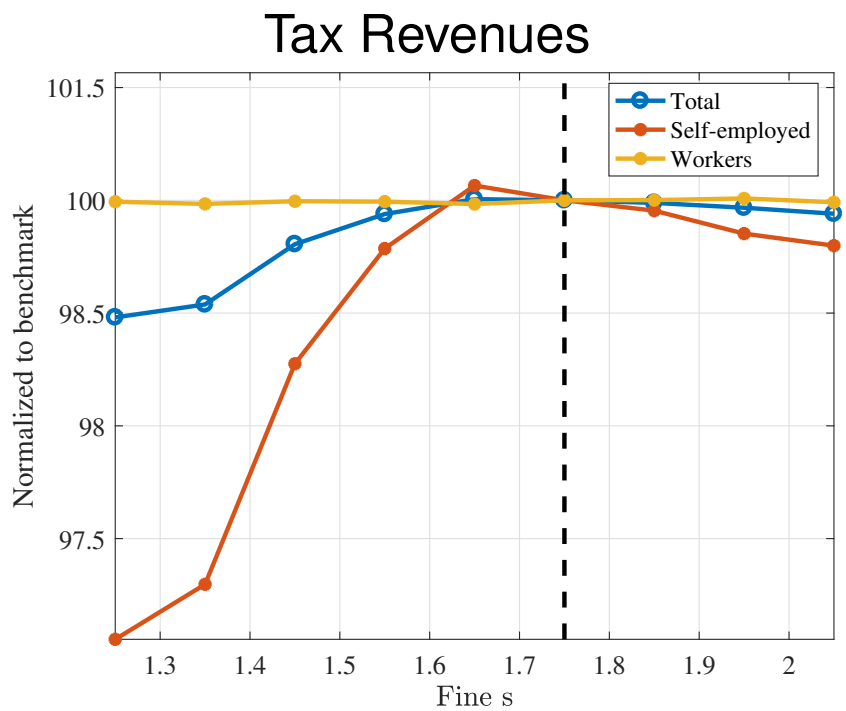
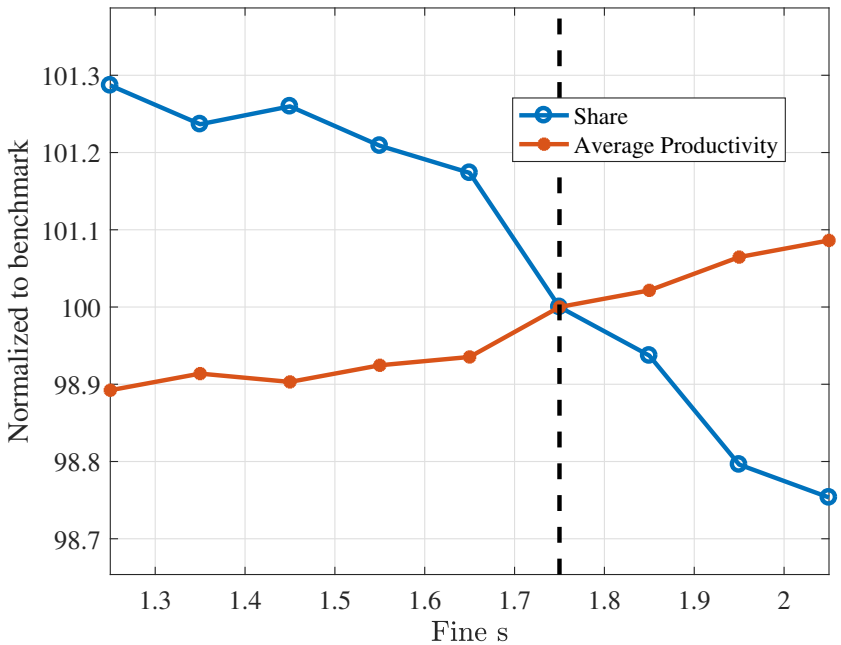
Tax Enforcement - Tax Evasion and Tax Revenues



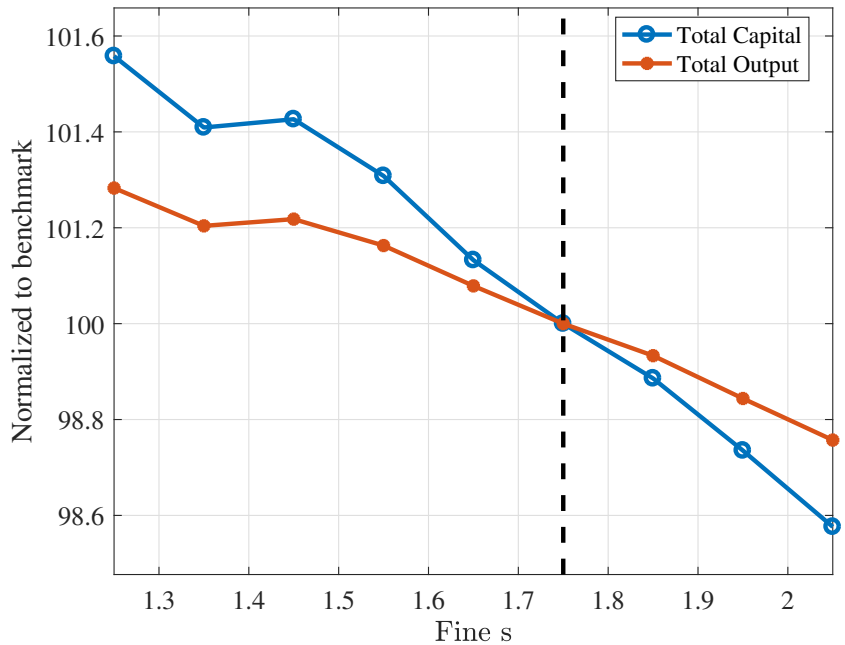


Tax Enforcement - Aggregates

Self-employed



Capital and Output



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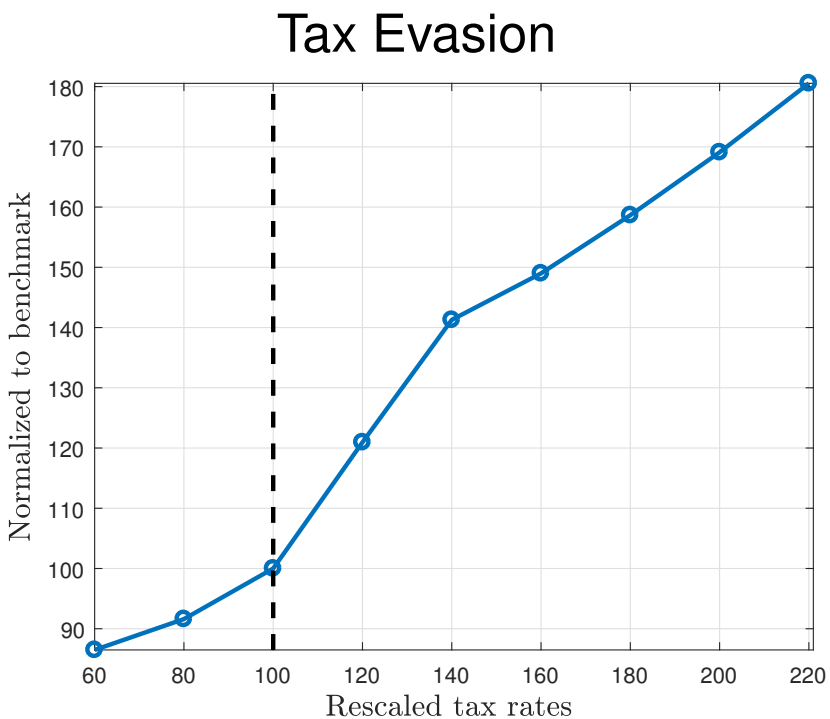
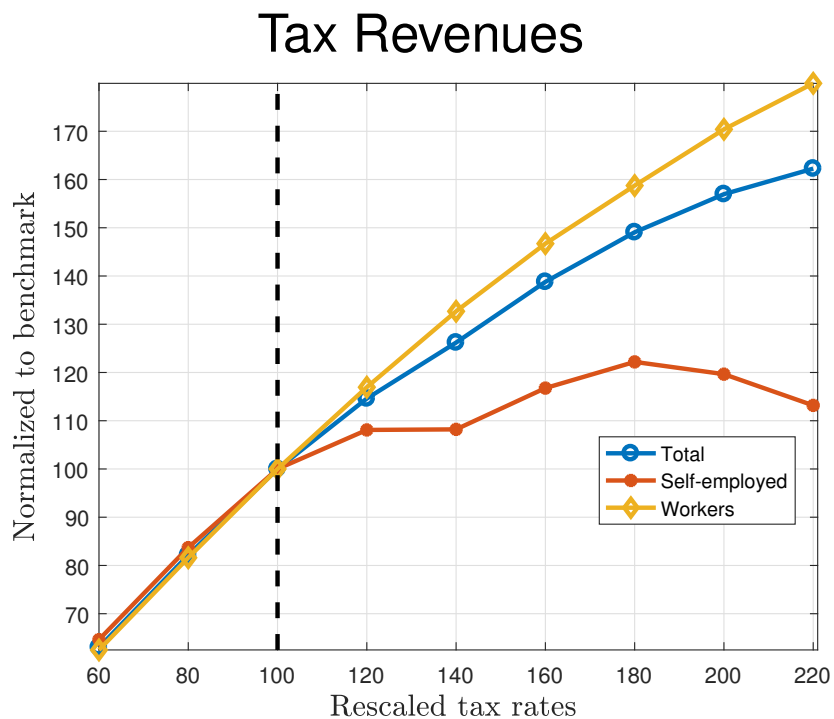
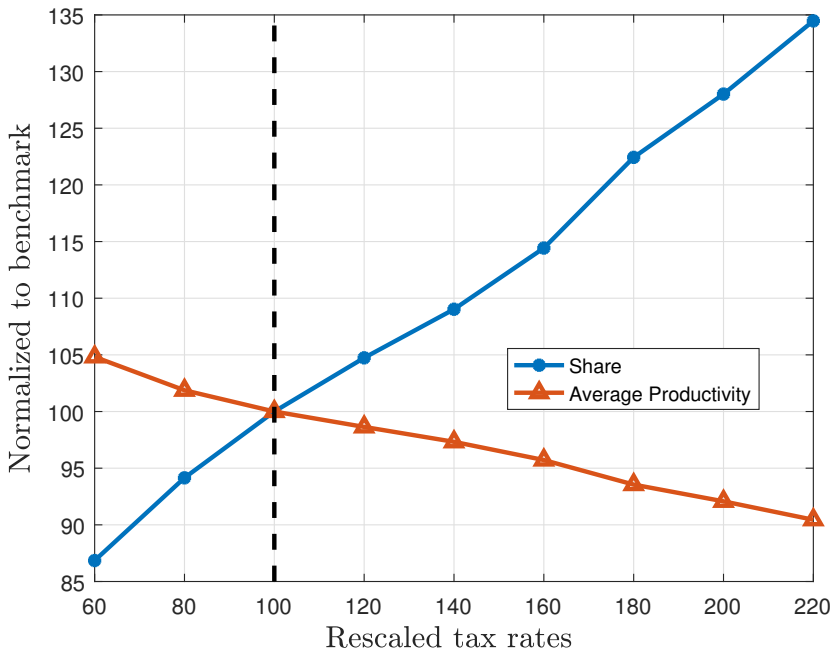
Tax Scheme - Tax Evasion and Tax Revenues



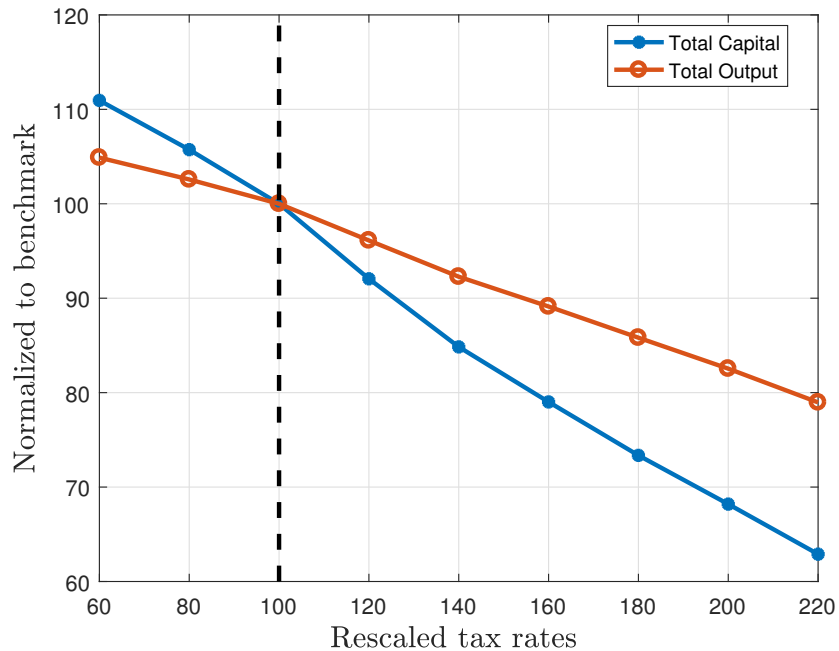


Tax Scheme - Aggregates

Self-employed



Capital and Output



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