GR 6307
Public Economics and Development

2. Taxation:
Raising Revenues with Tax Evasion and Informality

Michael Carlos Best

Spring 2024

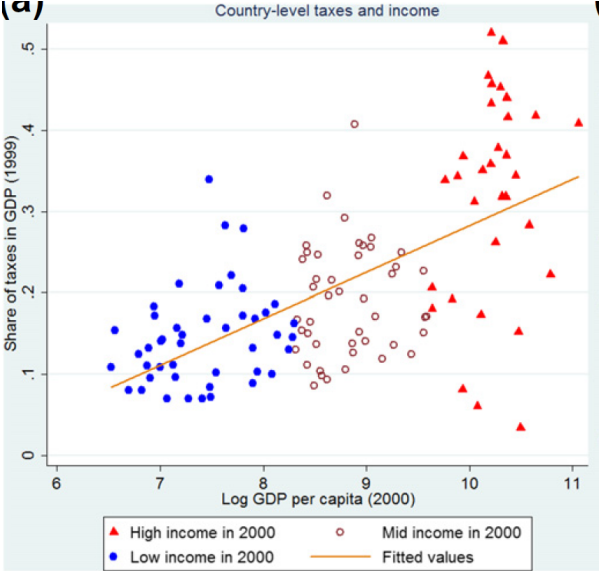
Outline

Taxation is Key to Achieving Development

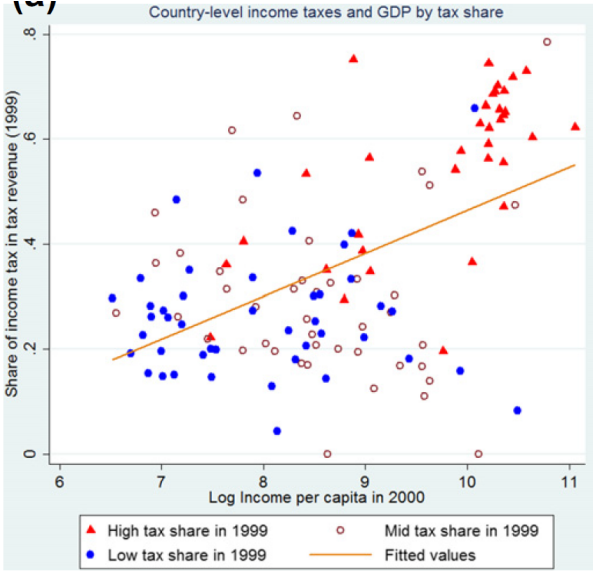
It is shortage of resources, and not inadequate incentives, which limits the pace of economic development. Indeed the importance of public revenue from the point of view of accelerated economic development could hardly be exaggerated.

Nicholas Kaldor, *"Taxation for Economic Development,"* Journal of Modern African Studies, 1963, p. 7.

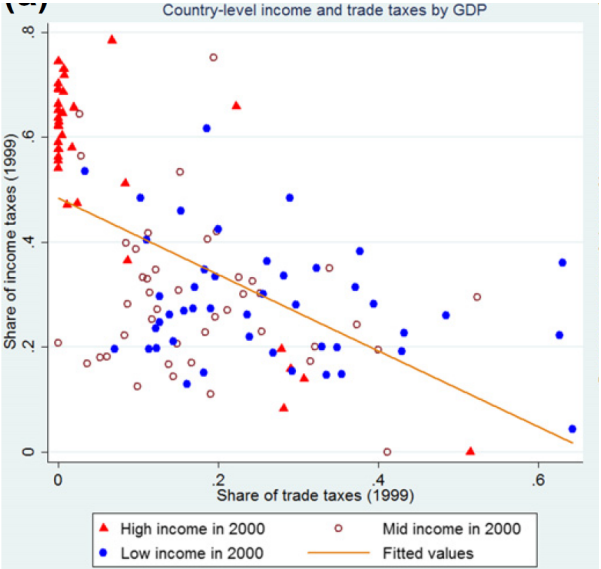
Motivating Facts: Besley & Persson (2013)



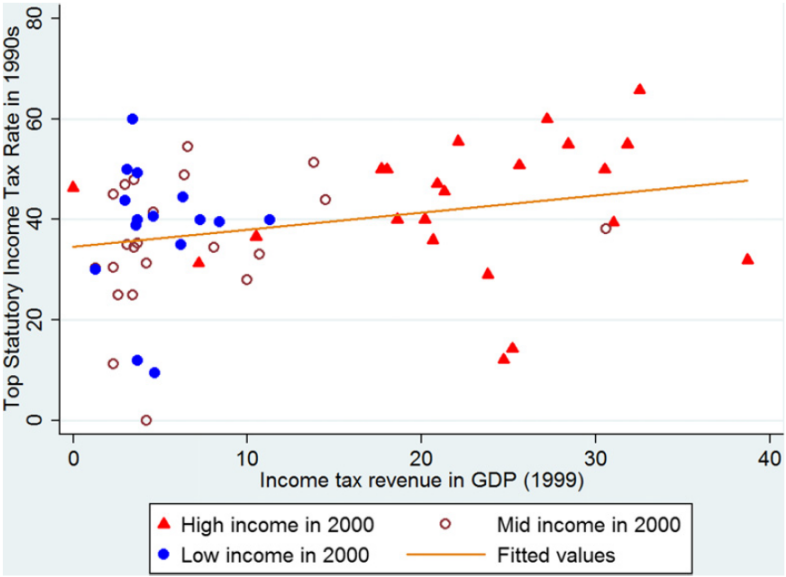
Motivating Facts: Besley & Persson (2013)



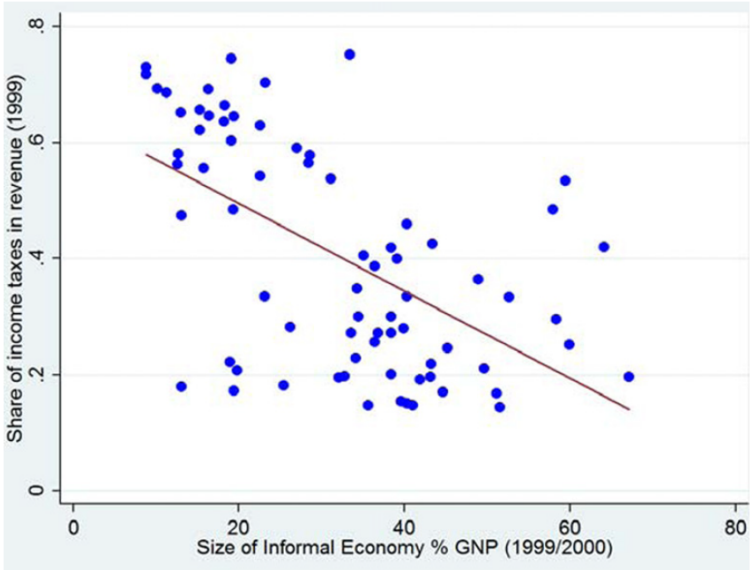
Motivating Facts: Besley & Persson (2013)



Motivating Facts: Besley & Persson (2013)



Motivating Facts: Besley & Persson (2013)



Gordon & Li (2009): Motivating Facts

- Traditional optimal tax theory makes some stark predictions for the tax mix
  - Diamond-Mirrlees (1971): Preserve production efficiency
  - Atkinson-Stiglitz (1976): Uniform commodity taxation
  - $\Rightarrow$ no tariffs, no taxes on intermediate goods, no differentiated sales taxes, no seignorage

Sources of government revenue (1996–2001).

GDP per capita	Tax revenue (% of GDP)	Income taxes (% of revenue)	Corporate income tax (% of income taxes)	Consumption and production taxes (% of revenue)	Border taxes (% of revenue)	Inflation rate	Seignorage income (% of revenue)	Informal economy (% of GDP)
<$745	14.1	35.9	53.7	43.5	16.4	10.6	21.8	26.4
$746–2975	16.7	31.5	49.1	51.8	9.3	15.7	24.9	29.5
$2976–9205	20.2	29.4	30.3	53.1	5.4	7.4	6.0	32.5
All developing	17.6	31.2	42.3	51.2	8.6	11.8	16.3	30.1
>$9,206	25.0	54.3	17.8	32.9	0.7	2.2	1.7	14.0

Notes: Authors' calculations based on available data between 1996 and 2001 from Government Finance Statistics (IMF, 2004a), International Finance Statistics (IMF, 2004b), and World Development Indicators (World Bank, 2003). The ranges for GDP per capita follow the World Bank 2003 classification of low income, lower middle income, middle income and

Outline

Outline

Besley & Persson (2013): Motivation

- Looking through history of how rich countries built tax systems, the political motivations of governments feature heavily.
  - Tilly (1985) argues war fueled need for revenue
- Suggests tax compliance is something governments deliberately build. Treat it as a form of capital they invest in for political motives.
- Creates feedback loop: More capacity for taxation $\rightarrow$ government has more incentive to create growth $\rightarrow$ more taxes

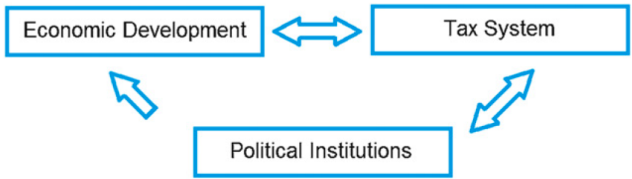


Figure 3 Extended approach.

Besley & Persson (2013): Setup

- Population consisting of $\mathcal{J}$ groups $J = 1, \ldots, \mathcal{J}$. Each group is a fraction ξ^J of the population.
- 2 time periods $s = 1, 2$
- $N + 1$ consumption goods $n = 0, 1, \ldots, N$. Consumption is $x^J_{n,s}$
- Non-rival and non-excludable public good g_s
- Labor supply L^J_s
- pre-tax prices $p_{n,s}$ and wage ω^J_s

Besley & Persson (2013): Setup

- Taxes:
  - each good's post-tax price is $p_{n,s}\left(1+t_{n,s}\right), \quad n=1,2,\ldots,N$
  - good 0 untaxed numeraire
  - net wage is $\omega_s^J\left(1-t_{L,s}\right)$
- Evasion.
  - tax raised from group J's consumption of good n are $t_{n,s}\left[p_{n,s}x_{n,s}^J-e_{n,s}\right]$
  - Evasion is subject to convex cost $c\left(e_{n,s},\tau_{n,s}\right)$
  - Labor taxes raise $t_{L,s}\left[\omega_s^J-e_{L,s}\right]$

Besley & Persson (2013): Fiscal Capacity

- Fiscal capacity $\boldsymbol{\tau}_s = \{\tau_{1,s}, \ldots, \tau_{N,s}, \tau_{L,s}\}$ makes evasion more difficult

$$\frac{\partial c\left(e_{k,s}, \tau_{k,s}\right)}{\partial \tau_{k,s}} > 0 \quad \frac{\partial^2 c\left(e_{k,s}, \tau_{k,s}\right)}{\partial e_{k,s} \partial \tau_{k,s}} \geq 0$$

- Investment in fiscal capacity.
  - period-1 fiscal capacity is given.
  - Cost of period-2 fiscal capacity is

$$\mathcal{F}^k\left(\tau_{k,2} - \tau_{k,1}\right) + f^k\left(\tau_{k,2}, \tau_{k,1}\right), \quad k = 1, \ldots, N, L$$

  - fixed cost is

$$f^k\left(\tau_{k,2}, \tau_{k,1}\right) = \begin{cases} f^k \geq 0 & \text{if } \tau_{k,1} = 0 \ \& \ \tau_{k,2} > 0 \\ 0 & \text{if } \tau_{k,1} > 0 \end{cases}$$

  - total cost is $\mathcal{F}\left(\boldsymbol{\tau}_2, \boldsymbol{\tau}_1\right) = \sum_{k=1}^{L} \mathcal{F}^k\left(\tau_{k,2} - \tau_{k,1}\right) + f^k\left(\tau_{k,2}, \tau_{k,1}\right)$

Besley & Persson (2013): Household Optimization

- Households have preference

$$x_{0,s}^J + u\left(x_{1,s}^J, \ldots, x_{N,s}^J\right) - \phi\left(L_s^J\right) + \alpha_s^J H\left(g_s\right)$$

subject to budget constraint

$$x_{0,s}^J + \sum_{n=1}^{N} p_{n,s}\left(1 + t_{n,s}\right) x_{n,s}^J \leq \omega_s^J\left(1 - t_{L,s}\right) L_s^J + r_s^J + \sum_{k=1}^{L}\left[t_{k,s} e_{k,s} - c\left(e_{k,s}, \tau_{k,s}\right)\right]$$

where r_s^J is a group-specific transfer

- Maximization yields commodity demands $x_{n,s}^J = x_{n,s}$
- Evasion decisions satisfy

$$t_{k,s} = c_e\left(e_{k,s}^*, \tau_{k,s}\right) \quad \text{for } k = 1, \ldots, N, L \text{ if } \tau_{k,s} > 0$$

Besley & Persson (2013): Household Optimization

- Household evasion yelds “profits”

$$q\left(t_{k,s},\tau_{k,s}\right)=t_k e_{k,s}-c\left(e_{k,s},\tau_{k,s}\right)$$

$$Q\left(\boldsymbol{t}_s,\boldsymbol{\tau}_s\right)=\sum_{k=1}^{L}q\left(t_{k,s},\tau_{k,s}\right)$$

- Group J’s indirect utility is then

$$\begin{aligned}V^J\left(\boldsymbol{t}_s,\boldsymbol{\tau}_s,g_s,\omega_s^J,r_s^J\right)&=v\left(p_{1,s}\left(1+t_{1,s}\right),\ldots,p_{N,s}\left(1+t_{N,s}\right)\right)\\&+v^L\left(\omega_s^J\left(1-t_{L,s}\right)\right)+Q\left(\boldsymbol{t}_s,\tau_s\right)\\&+\alpha_s^J H\left(g_s\right)+r_s^J\end{aligned}$$

- Government chooses the tax rates and spending. Tax revenue

$$B\left(\boldsymbol{t}_s,\boldsymbol{\tau}_s\right)=\sum_{n=1}^{N}t_{n,s}\left(p_{n,s}x_{n,s}-e_{n,s}\right)+\sum_{J=1}^{\mathcal{J}}\xi^J t_{L,s}\left(\omega_s^J L_s^J-e_{L,s}\right)$$

Besley & Persson (2013): Government's Problem

- Government's budget constraint is

$$B\left(\boldsymbol{t}_s, \boldsymbol{\tau}_s\right) + R_s \geq g_s + \sum_{J=1}^{\mathcal{J}} \xi^J r_s^J + m_s$$

$$m_s = \begin{cases} \mathcal{F}\left(\boldsymbol{\tau}_{2,}, \boldsymbol{\tau}_1\right) & \text{if } s = 1 \\ 0 & \text{if } s = 2 \end{cases}$$

  R_s is borrowing/aid/natural resource rents

- Government places weights μ^J on each group, normalized so that $\sum_{J=1}^{\mathcal{J}} \mu^J \xi^J = 1$ and maximizes

$$\sum_{J=1}^{\mathcal{J}} \mu^J \xi^J V^J\left(\boldsymbol{t}_s, \boldsymbol{\tau}_s, g_s, \omega_s^J, r_s^J\right)$$

Besley & Persson (2013): Optimal Taxes

- Commodity taxes satisfy Ramsey-style tax rule.
- Define the tax bases

$$Z_{n,s}\left(\boldsymbol{t}_s, \boldsymbol{\tau}_s\right) = p_{n,s}x_{n,s} - e_{n,s} \quad Z_{L,s}\left(t_{L,s}, \tau_{L,s}\right) = \sum_{J=1}^{\mathcal{J}} \xi^J \omega_s^J L_s^J - e_{L,s}$$

- Ramsey rule is

$$\left(\lambda_s - 1\right) Z_{n,s}\left(\boldsymbol{t}_s, \boldsymbol{\tau}_s\right) + \lambda_s \sum_{n=1}^{N} t_{n,s} \frac{\partial Z_{n,s}\left(\boldsymbol{t}_s, \boldsymbol{\tau}_s\right)}{\partial t_{n,s}} = 0 \text{ if } \tau_{n,s} > 0$$

$$t_{n,s} = 0 \text{ if } \tau_{n,s} = 0$$

- Optimal income tax satisfies

$$-\tilde{Z}_{L,s} + \lambda_s \left[Z_{L,s}\left(t_{L,s}, \tau_{L,s}\right) + t_{L,s} \frac{\partial Z_{L,s}\left(t_{L,s}, \tau_{L,s}\right)}{\partial t_{L,s}} \right] = 0 \quad \text{if } \tau_{L,s} > 0$$

$$t_{L,s} = 0 \quad \text{if } \tau_{L,s} = 0$$

Besley & Persson (2013): Optimal Taxes

- Consider the special case of no cross-price effects:

$$\frac{\partial Z_{m,s'}\left(\boldsymbol{t}_{s'},\boldsymbol{\tau}_{s'}\right)}{\partial t_{n,s}}=0 \text{ if } s'\neq s \text{ or } m\neq n;\ \&\ \frac{\partial Z_{L,s'}\left(t_{L,s'},\tau_{L,s'}\right)}{\partial t_{L,s}}=0 \text{ if } s'\neq s$$

- Then the Ramsey equations become

$$\left(\lambda_s-1\right)Z_{n,s}\left(\boldsymbol{t}_s,\boldsymbol{\tau}_s\right)+\lambda_s t_{n,s}\frac{\partial Z_{n,s}\left(\boldsymbol{t}_s,\boldsymbol{\tau}_s\right)}{\partial t_{n,s}}=0$$

$$\left(\lambda_s-1\right)Z_{n,s}\left(\boldsymbol{t}_s,\boldsymbol{\tau}_s\right)-\lambda_s t_{n,s}\frac{\partial Z_{n,s}\left(\boldsymbol{t}_s,\boldsymbol{\tau}_s\right)}{\partial 1-t_{n,s}}=0$$

$$\left(\lambda_s-1\right)Z_{n,s}\left(\boldsymbol{t}_s,\boldsymbol{\tau}_s\right)-\lambda_s\frac{t_{n,s}}{1-t_{n,s}}Z_{n,s}\left(\boldsymbol{t}_s,\boldsymbol{\tau}_s\right)\varepsilon_{n,s}=0$$

$$\frac{t_{n,s}}{1-t_{ns}}=\frac{\lambda_s-1}{\lambda_s}\frac{1}{\varepsilon_{n,s}}$$

"Standard" inverse-elasticity rule

Besley & Persson (2013): Investment in Fiscal Capacity

- Let maximized government welfare be

$$W\left(\boldsymbol{\tau}_s, R_s - m_2; \{\mu^J\}\right) = \max_{g_s, \boldsymbol{t}_s, t_s^1, \ldots, r_s^J} \left\{ \sum_{J=1}^{\mathcal{J}} \mu^J \xi^J V^J \left(\boldsymbol{t}_s, \boldsymbol{\tau}_s, g_s, \omega_s^J, r_s^J\right) \right\}$$

- Then fiscal capacity investment chooses $\boldsymbol{\tau}_2$ to maximize

$$W\left(\boldsymbol{\tau}_1, R_1 - \mathcal{F}\left(\boldsymbol{\tau}_2, \boldsymbol{\tau}_1\right); \{\mu^J\}\right) + W\left(\boldsymbol{\tau}_2, R_2; \{\mu^J\}\right)$$

- If $\tau_{k,1} > 0$ then optimum satisfies

$$\lambda_2 \frac{\partial B\left(\boldsymbol{t}_2^*, \boldsymbol{\tau}_2\right)}{\partial \tau_{k,2}} + \frac{\partial Q\left(\boldsymbol{t}_2^*, \boldsymbol{\tau}_2\right)}{\partial \tau_{k,2}} - \lambda_1 \frac{\partial \mathcal{F}\left(\boldsymbol{\tau}_1, \boldsymbol{\tau}_2\right)}{\partial \tau_{k,2}} \leqslant 0 \quad \text{for } k = 1, 2, \ldots, N, L$$
$$c.s.\ \tau_{k,2} \geq \tau_{k,1} > 0$$

Besley & Persson (2013): Politics

- Introduce politics into this model to see how it affects investments in fiscal capacity
- Citizen-candidate style model (Besley & Coate 1997). Whichever group is in power only cares about its members.
- Group in power in period s is I_s
- Political institutions constrain transfers:

$$r_s^J \geq \theta r_s^I \; \forall J \neq I, \; \theta \in [0,1]$$

- Solving for optimal transfers:

$$r_s^I = \beta^I \left(\xi^I, \theta\right) \left[B\left(\boldsymbol{t}_s, \boldsymbol{\tau}_s\right) + R_s - g_s - m_s\right]$$
$$r_s^O = \beta^O \left(\xi^I, \theta\right) \left[B\left(\boldsymbol{t}_s, \boldsymbol{\tau}_s\right) + R_s - g_s - m_s\right]$$

where

$$\beta^I \left(\xi^I, \theta\right) = \frac{1}{\theta + (1-\theta)\,\xi^I} \quad \beta^O = \frac{\theta}{\theta + (1-\theta)\,\xi^I}$$

Besley & Persson (2013): Politics

- The incumbents choose between public goods and transfers by comparing $\beta^I\left(\xi^I, \theta\right)$ to α_s^I
- If $\alpha_s^I > \beta^I\left(\xi^I, \theta\right)$ then all money spent on g, and $\lambda_s^I = \alpha_s^I$
- If $\alpha_s^I \leq \beta^I\left(\xi^I, \theta\right)$, then money spent on transfers, and $\lambda_s^I = \beta^I\left(\xi^I, \theta\right)$
- Fiscal capacity investments satisfy

$$\lambda_2^I \frac{\partial B\left(\boldsymbol{t}_2^*, \boldsymbol{\tau}_2\right)}{\partial \tau_{k,2}} + \frac{\partial Q\left(\boldsymbol{t}_2^*, \boldsymbol{\tau}_2\right)}{\partial \tau_{k,2}} - \lambda_1^I \frac{\partial \mathcal{F}\left(\boldsymbol{\tau}_1, \boldsymbol{\tau}_2\right)}{\partial \tau_{k,2}} \leqslant 0 \quad \text{for } k = 1, 2, \ldots, N, L$$

$$c.s.\ \tau_{k,2} \geq \tau_{k,1} > 0$$

Besley & Persson (2013): Political Turnover

- Assume 2 groups and $\xi^J = 1/2$
- Let $\gamma \in [0,1]$ be the probability incumbent switches between periods
- Now, in period s the value of being incumbent I_s or opposition O_s is

$$W^J\left(\boldsymbol{\tau}_s, R_s - m_s\right) = V_s^J\left(\boldsymbol{t}_s^*\left(\lambda_s^{I_s}, \boldsymbol{\tau}_s\right), \boldsymbol{\tau}_s, g_s^*\left(\lambda_s^{I_s}, \boldsymbol{\tau}_s\right), \omega_s^J, \beta^J(\theta)\, b_s\left(\lambda_s^{I_s}, \boldsymbol{\tau}_s\right)\right) \;\; J = I_s, O_s$$
$$b_s\left(\lambda_s^{I_s}, \boldsymbol{\tau}_s\right) = \left[B\left(\boldsymbol{t}_s^*\left(\lambda_s^{I_s}, \boldsymbol{\tau}_s\right), \boldsymbol{\tau}_s\right) + R_s - m_s - g_s^*\left(\lambda_s^{I_s}, \boldsymbol{\tau}_s\right)\right]$$

Besley & Persson (2013): Political Turnover

- Now the incumbent chooses fiscal capacity to maximize

$$W^I\left(\boldsymbol{\tau}_1, R_1 - \mathcal{F}\left(\boldsymbol{\tau}_1, \boldsymbol{\tau}_2\right)\right) + \left(1-\gamma\right) W^I\left(\boldsymbol{\tau}_2, R_2\right) + \gamma W^O\left(\boldsymbol{\tau}_2, R_2\right)$$

- Optimal choice satisfies

$$\left(1-\gamma\right)\frac{\partial W^I\left(\boldsymbol{\tau}_2, R_2\right)}{\partial \tau_{k,2}} + \gamma\frac{\partial W^O\left(\boldsymbol{\tau}_2, R_2\right)}{\partial \tau_{k,2}} - \lambda_1^I\frac{\partial \mathcal{F}\left(\boldsymbol{\tau}_1, \boldsymbol{\tau}_2\right)}{\partial \tau_{k,2}} \leqslant 0$$

$$c.s.\ \tau_{k,2} \geq \tau_{k,1} > 0$$

- Can rewrite as

$$\left[\lambda_2^I - \gamma\left(\lambda_2^I - \lambda_2^O\right)\right]\frac{\partial B\left(\boldsymbol{t}_2^*, \boldsymbol{\tau}_2\right)}{\partial \tau_{k,2}} + \gamma\frac{\partial V_2^O}{\partial \boldsymbol{t}_2^*}\frac{\partial \boldsymbol{t}_2^*}{\partial \tau_{k,2}}$$
$$+\frac{\partial Q\left(\boldsymbol{t}_2^*, \boldsymbol{\tau}_2\right)}{\partial \tau_{k,2}} - \lambda_1^I\frac{\partial \mathcal{F}\left(\boldsymbol{\tau}_1, \boldsymbol{\tau}_2\right)}{\partial \tau_{k,2}} \leqslant 0$$

$$c.s.\ \tau_{k,2} \geq \tau_{k,1}$$

Besley & Persson (2013): Common Interest State

- Can characterize 3 types of states.

1. The *common-interest* state: α_2 is large enough to spend all on g

$$\lambda_2^I = \lambda_2^O = \lambda_2 = \alpha_2 > \beta^I(\theta)$$

- Could be θ very high, or α_2 very high (war?)

$$\lambda_2 \frac{\partial B(\boldsymbol{t}_2^*, \boldsymbol{\tau}_2)}{\partial \tau_{k,2}} + \frac{\partial Q(\boldsymbol{t}_2^*, \boldsymbol{\tau}_2)}{\partial \tau_{k,2}} - \lambda_1 \frac{\partial \mathcal{F}(\boldsymbol{\tau}_1, \boldsymbol{\tau}_2)}{\partial \tau_{k,2}} \leqslant 0$$

$$c.s.\ \tau_{k,2} \geq \tau_{k,1}$$

Besley & Persson (2013): Redistributive State

- Suppose transfers valued more than public goods, $\alpha_2 < \beta^I(\theta)$
- Then $\lambda_2^I = \beta^I(\theta)$. The 2 groups value public money differently.
- Probability of staying in power becomes important. Expected value of period-2 revenues to the period-1 incumbent is

$$\lambda_2^{I_1} = (1-\gamma)\beta^I(\theta) + \gamma\beta^O(\theta)$$

- e.g. $\gamma = \theta = 0 \rightarrow \lambda_2^{I_1} = 2$. Completely redistributive state maximize capacity to redistribute to incumbents

$$2\frac{\partial B(\boldsymbol{t}_2^*, \boldsymbol{\tau}_2)}{\partial \tau_{k,2}} + \frac{\partial Q(\boldsymbol{t}_2^*, \boldsymbol{\tau}_2)}{\partial \tau_{k,2}} - 2\frac{\partial \mathcal{F}(\boldsymbol{\tau}_1, \boldsymbol{\tau}_2)}{\partial \tau_{k,2}} \leqslant 0$$
$$c.s.\ \tau_{k,2} \geq \tau_{k,1}$$

Besley & Persson (2013): Weak State

- If transfers valued more than public goods, but there is also high political instability
- e.g. $\gamma = 1, \theta = 0$ then

$$\frac{\partial V_2^O}{\partial \boldsymbol{t}_2^*} \frac{\partial \boldsymbol{t}_2^* \left(\lambda_2^{I_2}, \boldsymbol{\tau}_2 \right)}{\tau_{k,2}} + \frac{\partial Q \left(\boldsymbol{t}_2^*, \boldsymbol{\tau}_2 \right)}{\partial \tau_{k,2}} - \lambda_1 \frac{\partial \mathcal{F} \left(\boldsymbol{\tau}_1, \boldsymbol{\tau}_2 \right)}{\partial \tau_{k,2}} \leqslant 0$$

$$c.s.\ \tau_{k,2} \geq \tau_{k,1}$$

- All three terms are negative. The incumbent invests nothing in fiscal capacity since it will only be used against them

Outline

Outline

The Canonical Model: Allingham & Sandmo (1972)

- Tax evasion: misreporting tax liability in an *illegal* way
- Tax avoidance: exploiting loopholes to minimize tax liability, *without* breaking the law
- A bit of a false taxonomy: Many tax avoidance schemes have never been tested in a court, and may well be illegal...
- Classical model is Allingham & Sandmo (JPubE 1972) extended by Yitzhaki (1974)
- Builds on Becker's (1968) theory of crime
- Takes true income as given, focus only on decision of what to report to the authorities

Allingham & Sandmo (1972): Setup

- Consider individual with true income W facing linear tax t on reported income.
- The individual chooses to evade an amount E
- If they are not caught, their net income is

$$Y = W - t\,(W - E)$$

- If they are caught, they pay a penalty rate $\theta > t$ on the evaded amount and have net income

$$Z = (1 - t)\,W - (\theta - t)\,E$$

- They are audited with probability p

Allingham & Sandmo (1972): Solution

- Individual maximizes expected utility

$$V = (1-p)\,U(Y) + pU(Z)$$

- FOCs yield

$$\frac{U'(Z)}{U'(Y)} = \frac{1-p}{p}\frac{t}{\theta - t}$$

- Comparative statics:

$$\frac{\partial E}{\partial \theta} < 0$$
$$\frac{\partial E}{\partial p} < 0$$

Allingham & Sandmo (1972) - Yitzhaki (1974)

- Effect of tax rate in A-S model:

$$\frac{\partial E}{\partial t} = \underbrace{-\frac{W-E}{1-t}\frac{\partial E}{\partial W}}_{\text{Income Effect}<0} + \underbrace{S}_{\text{Substitution Effect}>0}$$

- Substitution effect (consumption cheaper in unaudited state) seems unintuitive, drives ambiguous prediction.
- Yitzhaki (1974): This is because penalty is on evaded income not evaded tax. If instead penalty is $\theta t E$, then

$$\frac{U'(Z)}{U'(Y)} = \frac{1-p}{p(\theta-1)}$$

- No more substitution effect, only income effect

Outline

Chetty (2009): Overview

- How does evasion change how we think about efficiency cost of income taxes?
- Feldstein (1999) argues that elasticity of taxable income is *sufficient statistic* for deadweight loss of income tax.
- Is this still true when there's evasion?
- Provide simple model to think this through.
- General answer: No, now there are 2 statistics that are jointly sufficient.

Chetty (2009): Benchmark: No Evasion

- Individuals work l hours at wage w to maximize

$$\max_{l} u(c,l) = c - \psi(l)$$
$$s.t.\ c = y + (1-t)\,wl$$

- Social Welfare

$$W(t) = \underbrace{\{y + (1-t)\,wl - \psi(l)\}}_{u(c^*,l^*)} = twl$$

- Envelope theorem: $\frac{du(c^*,l^*)}{dt} = \frac{\partial u(c^*,l^*)}{\partial t} = wl \equiv TI$ so

$$\frac{dW(t)}{dt} = -wl + wl + t\frac{d[wl]}{dt}$$
$$= t\frac{dTI}{dt}$$

Chetty (2009): Evasion With Real Cost

- Add to the previous model the ability to shelter e dollars at convex cost $g(e)$. NB $g(e)$ is a real, social cost of evasion
- Individuals choose l and e

$$\max_{l,e} u(c,l,e) = c - \psi(l) - g(e)$$
$$s.t.\ c = y + (1-t)(wl - e) + e$$

- Social welfare is now

$$W(t) = \{y + (1-t)(wl - e) + e - \psi(l) - g(e)\} + t(wl - e)$$

- Envelope theorem $\rightarrow$

$$\frac{dW(t)}{dt} = -(wl - e) + (wl - e) + t\frac{d[wl - e]}{dt} = t\frac{dTI}{dt}$$

- Feldstein result survives

Chetty (2009): Evasion With Transfer Cost

- Now add sheltering a la Allingham Sandmo. Audit probability $p(e)$, $p'(e) > 0$.
- If caught, pay fine $F(e,t)$
- $\rightarrow$ private cost $z(e,t) = p(e)[te + F(e,t)]$ assume strictly convex in e
- Individuals choose l and e

$$\max_{l,e} u(c,l,e) = c - \psi(l)$$
$$s.t.\ c = y + (1-t)(wl - e) + e - z(e,t)$$

- Social Welfare

$$W(t) = \{y + (1-t)(wl - e) + e - z(e,t) - \psi(l)\} + z(e,t) + t(wl - e)$$

Chetty (2009): Evasion With Transfer Cost

- Envelope theorem $\rightarrow$

$$\begin{aligned}\frac{dW(t)}{dt} &= -(wl-e) - \frac{\partial z}{\partial t} + (wl-e) + \frac{\partial z}{\partial t} + \frac{\partial z}{\partial e}\frac{\partial e}{\partial t} + t\frac{d[wl-e]}{dt} \\ &= t\frac{dwl}{dt} + \frac{de}{dt}\left(\frac{\partial z}{\partial e} - t\right)\end{aligned}$$

- Evasion choice FOC: $\frac{\partial z}{\partial e} = t \rightarrow dW(t)/dt = dLI/dt$ where $LI = wl$ is real income
- ETI no longer sufficient, need *real* income elasticity

Chetty (2009): Both Types of Evasion

$$\max_{l,e} u(c,l,e) = c - \psi(l) - g(e)$$
$$s.t.\ c = y + (1-t)(wl - e) + e - z(e,t)$$

- Social welfare is

$$W(t) = \{y + (1-t)(wl-e) + e - z(e,t) - \psi(l) - g(e)\} + z(e,t) + t(wl-e)$$

- Envelope theorem $\rightarrow$

$$\frac{dW(t)}{dt} = t\frac{dLI}{dt} + \frac{de}{dt}\left(\frac{\partial z}{\partial e} - t\right)$$

- Evasion choice FOC is $t = z'(e) + g'(e)$

$$\frac{dW(t)}{dt} = t\left(\mu\frac{dTI}{dt} + (1-\mu)\frac{dLI}{dt}\right) \quad \text{where } \mu = g'(e)/t$$

Allingham-Sandmo in the Field

- Allingham-Sandmo does not predict actual tax evasion rates very well:
- Alm, McClelland & Schulze calibrate A-S to the US data. With coeff of RRA $\gamma = 3$, they get 13% compliance (waaaaaay off)
- Slemrod (2007) estimates 43% compliance for self-reported income in the US
- Calibrations require $\gamma = 5$ to get 44% compliance, $\gamma = 10$ to get 71% compliance
- Suggests the theory is incomplete.

Outline

Kleven et al. (2011): Overview

- One possible reason Allingham-Sandmo predicts evasion poorly: Detection probabilities are endogenous, and vary by type of income
- Extend A-S model to include endogenous detection probabilities and third-party reported income
- Perform random audits and field experiment sending audit threat letters
- Takeaways:
  1. Very little evasion on third-party reported income
  2. Tax rates positively affect evasion of self-reported income
  3. prior audits and threat letters reduce self-reported income evasion

Kleven et al. (2011): Model

- Simple AS model: Risk-neutral taxpayer has true income $\bar{y}$, reports income y, evades $e \equiv \bar{y} - y$.
- Probability of detection $p(e)$ with $p'(e) > 0$
- If evasion is detected, taxpayer pays evaded tax plus penalty proportional to evaded tax $\theta\tau e$

$$u = (1 - p(e)) \cdot [\bar{y}(1 - \tau) + \tau e] + p(e)[\bar{y}(1 - \tau) - \theta\tau e]$$

- Interior optimum for e satisfies

$$p(e)(1 + \varepsilon)(1 + \theta) = 1$$

where $\varepsilon \equiv p'(e)\, e/p \geq 0$ is elasticity of detection probability

Kleven et al. (2011): Model

- Incorporate third-party reporting in a simple way. True income is

$$\bar{y} = \bar{y}_t + \bar{y}_s$$

where $\bar{y}_t$ is third-party reported income, and $\bar{y}_s$ is self-reported income.

- Assume very hard to evade third-party reported income, but easier for self-reported income. $\Rightarrow$
  1. $p(e)$ low for $e < \bar{y}_s$
  2. $p(e)$ high for $e > \bar{y}_s$
  3. $p(e)$ increases rapidly around $e = \bar{y}_s$

Kleven et al. (2011): Model

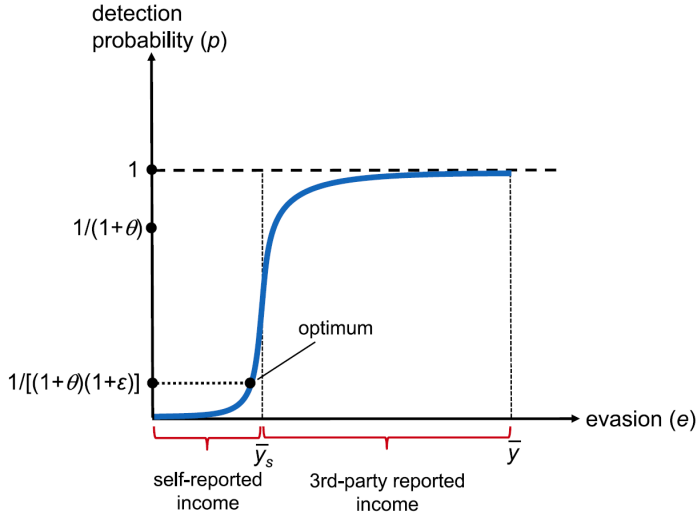


FIGURE 1.——Probability of detection under third-party reporting.

Kleven et al. (2011): Experimental Design

- Conduct a field experiment in Denmark in 2007
- 88% of population liable to taxes, all required to file a return
- Tax administration (SKAT) receives tax returns, and separately receives third-party reports from employers, banks etc.
- Local, regional national taxes all administered by SKAT

Kleven et al. (2011): Tax System

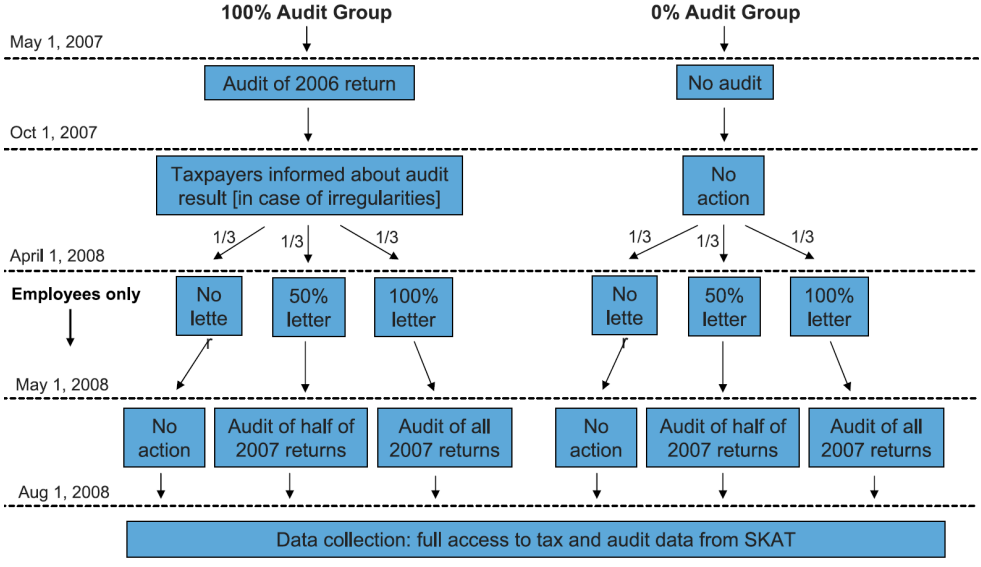
A. Income Concepts

Income Concept	Definition
1. Labor income	Salary, wages, honoraria, fees, bonuses, fringe benefits, business earnings
2. Personal income	Labor income (1) + social transfers, grants, awards, gifts, received alimony − payroll tax, and certain pension contributions
3. Capital income	Interest income, rental income, business capital income − interest on debt (mortgage, bank loans, credit cards, student loans)
4. Deductions	Commuting costs, union fees, unemployment contributions, other work related expenditures, charitable contributions, alimony paid
5. Taxable income	= Personal income (2) + capital income (3) − deductions (4)
6. Stock income	Dividends and realized capital gains from corporate stock

B. Tax Rates and Tax Bases

Tax Type[a]	Tax Base	Bracket (DKK)[b]	Tax Rate
Payroll tax	Labor income	All income	8.0%
		38,500–265,500	5.5%
National income tax	Personal income +	265,500–318,700	11.5%
	max(capital income, 0)	318,700–	26.5%[c]
Regional income tax	Taxable income	38,500–	32.6%[d]
Stock income tax	Stock income	0–44,400	28.0%
		44,400–	43.0%

Kleven et al. (2011): Experimental Design



Kleven et al. (2011): Audit Results (1)

AUDIT ADJUSTMENTS DECOMPOSITION[a]

		A. Total Income Reported				B. Third-Party vs. Self-Reported Income			
		Pre-Audit Income	Audit Adjustment	Under-reporting	Over-reporting	Third-Party Income	Third-Party Under-reporting	Self-Reported Income	Self-Reported Under-reporting
		1	2	3	4	5	6	7	8
I. Net Income and Total Tax									
Net income	Amounts	206,038	4532	4796	−264	195,969	612	10,069	4183
		(2159)	(494)	(493)	(31)	(1798)	(77)	(1380)	(486)
	% Nonzero	98.38	10.74	8.58	2.16	98.57	2.31	38.18	7.39
		(0.09)	(0.22)	(0.20)	(0.10)	(0.08)	(0.11)	(0.35)	(0.19)
Total tax	Amounts	69,940	1980	2071	−91				
		(1142)	(236)	(235)	(11)				
	% Nonzero	90.76	10.59	8.41	2.18				
		(0.21)	(0.22)	(0.20)	(0.10)				
II. Positive and Negative Income									
Positive income	Amounts	243,984	3776	3943	−167	223,882	516	20,102	3427
		(2511)	(485)	(485)	(27)	(1860)	(76)	(1693)	(478)
	% Nonzero	98.24	5.80	4.78	1.02	98.15	1.60	19.53	3.41
		(0.09)	(0.17)	(0.15)	(0.07)	(0.10)	(0.09)	(0.28)	(0.13)
Negative income	Amounts	−37,946	756	853	−97	−27,913	97	−10,033	756
		(1014)	(71)	(69)	(14)	(406)	(12)	(862)	(68)
	% Nonzero	79.09	6.45	5.13	1.32	78.21	0.75	29.49	4.99
		(0.29)	(0.18)	(0.16)	(0.08)	(0.29)	(0.06)	(0.33)	(0.16)

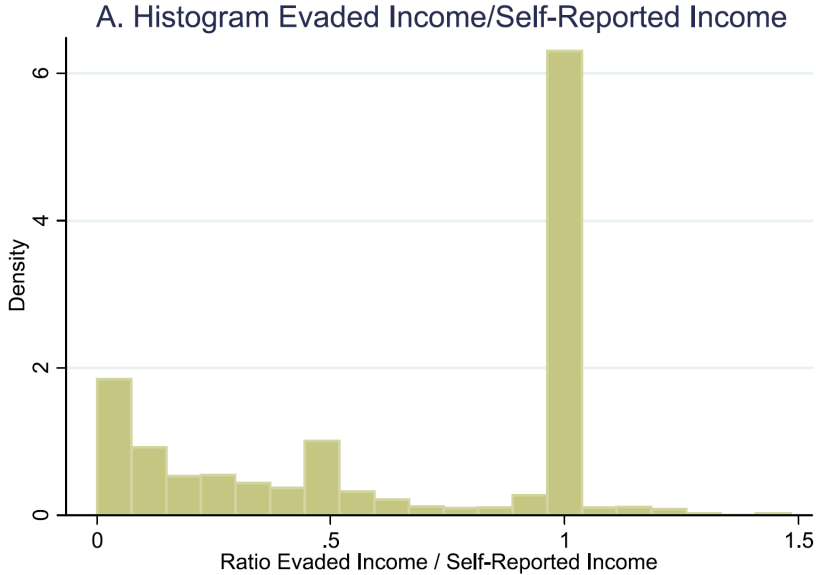
Kleven et al. (2011): Audit Results (2)

		A. Total Income Reported				B. Third-Party vs. Self-Reported Income			
		Pre-Audit Income	Audit Adjustment	Under-reporting	Over-reporting	Third-Party Income	Third-Party Under-reporting	Self-Reported Income	Self-Reported Under-reporting
		1	2	3	4	5	6	7	8
III. Income Components									
Personal income	Amounts	210,178	2327	2398	−71	211,244	463	−1066	1936
		(1481)	(399)	(399)	(11)	(1385)	(74)	(548)	(392)
	% Nonzero	95.22	2.49	1.99	0.50	95.20	1.30	11.95	0.82
		(0.15)	(0.11)	(0.10)	(0.05)	(0.15)	(0.08)	(0.23)	(0.06)
Capital income	Amounts	−11,075	254	286	−32	−14,556	98	3481	188
		(340)	(49)	(49)	(6)	(602)	(11)	(542)	(47)
	% Nonzero	93.93	2.10	1.69	0.41	94.91	0.79	12.29	1.28
		(0.17)	(0.10)	(0.09)	(0.05)	(0.16)	(0.06)	(0.23)	(0.08)
Deductions	Amounts	−9098	148	197	−49	−5666	18	−3432	179
		(104)	(17)	(15)	(7)	(48)	(3)	(85)	(15)
	% Nonzero	60.07	3.45	2.56	0.89	57.61	0.31	22.60	2.49
		(0.35)	(0.13)	(0.11)	(0.07)	(0.35)	(0.04)	(0.30)	(0.11)

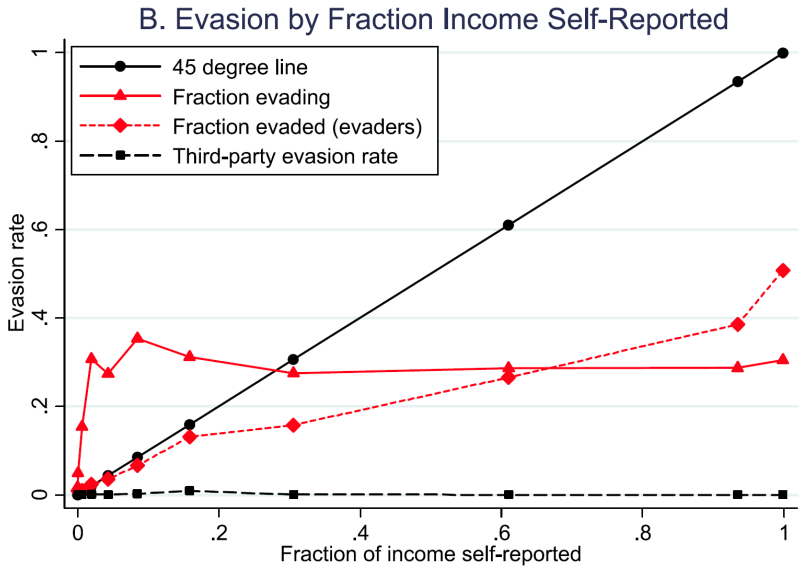
Kleven et al. (2011): Audit Results (3)

		A. Total Income Reported				B. Third-Party vs. Self-Reported Income			
		Pre-Audit Income	Audit Adjustment	Under-reporting	Over-reporting	Third-Party Income	Third-Party Under-reporting	Self-Reported Income	Self-Reported Under-reporting
		1	2	3	4	5	6	7	8
III. Income Components (Continued)									
Stock income	Amounts	5635	259	281	−22	3783	30	1852	251
		(1405)	(45)	(45)	(8)	(976)	(12)	(943)	(43)
	% Nonzero	22.47	0.95	0.80	0.15	22.44	0.07	2.45	0.75
		(0.30)	(0.07)	(0.06)	(0.03)	(0.30)	(0.02)	(0.11)	(0.06)
Self-employment	Amounts	10,398	1544	1633	−89	1164	4	9234	1630
		(812)	(280)	(279)	(26)	(177)	(2)	(816)	(279)
	% Nonzero	7.63	3.43	3.02	0.41	1.40	0.04	7.66	3.00
		(0.19)	(0.13)	(0.12)	(0.05)	(0.08)	(0.01)	(0.19)	(0.12)

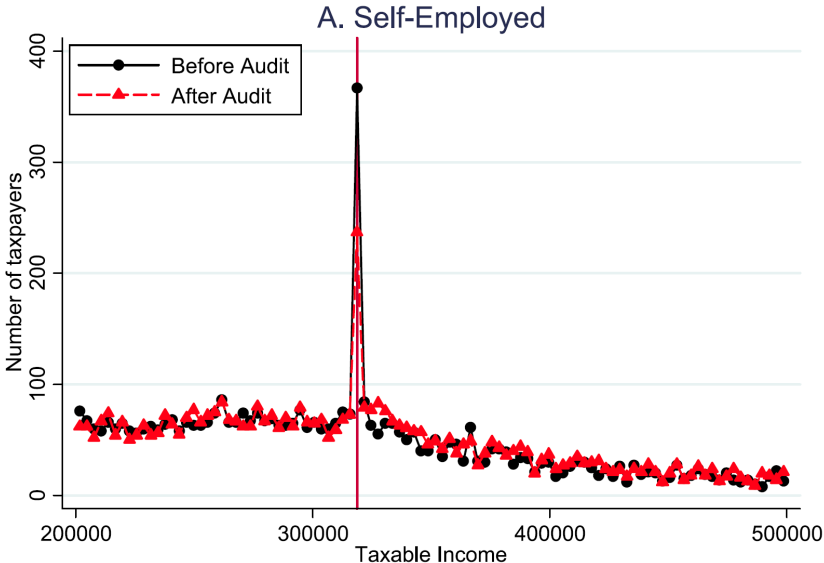
Kleven et al. (2011): Audit Results (4)



Kleven et al. (2011): Audit Results (5)



Kleven et al. (2011): Audit Results (6)



Kleven et al. (2011): Prior Audit Effects (1)

	Baseline Audit Adjustment	Change in Reported Income (Panels A1 and B1) and Probability of Income Increase (Panels A2 and B2) from 2006 to 2007			IV Effect of Audit Adjustment on Income Change
		Total Income	Self-Reported Income	Third-Party Reported Income	
	1	2	3	4	5
A. Full Sample					
A1. Amounts [difference between the 100% and the 0% audit groups]					
Net income	8491	2557	2331	225	0.301
	(827)	(787)	(658)	(691)	(0.098)
Total tax	3295	1375			0.417
	(257)	(464)			(0.144)
A2. Probability of audit adjustment and income increase [difference between the 100% and the 0% audit groups]					
Net income	19.09	0.89	2.11	0.24	0.047
	(0.28)	(0.48)	(0.48)	(0.48)	(0.025)
Total tax	19.17	0.99			0.052
	(0.28)	(0.49)			(0.025)
Number of observations	41,571	41,571	41,571	41,571	41,571
B. Sample Limited to Those Receiving No Threat-of-Audit Letter					
B1. Amounts [difference between the 100% and the 0% audit groups]					
Net income	12,835	2904	3086	−182	0.226
	(1310)	(1117)	(1008)	(962)	(0.091)
Total tax	5019	1732			0.345
	(406)	(677)			(0.137)

Kleven et al. (2011): Prior Audit Effects (2)

	Baseline Audit Adjustment	Change in Reported Income (Panels A1 and B1) and Probability of Income Increase (Panels A2 and B2) from 2006 to 2007			IV Effect of Audit Adjustment on Income Change
		Total Income	Self-Reported Income	Third-Party Reported Income	
	1	2	3	4	5
B. Sample Limited to Those Receiving No Threat-of-Audit Letter (Continued)					
B2. Probability of audit adjustment and income increase [difference between the 100% and the 0% audit groups]					
Net income	25.75	0.73	2.12	−0.52	0.028
	(0.39)	(0.61)	(0.61)	(0.61)	(0.024)
Total tax	25.93	0.98			0.038
	(0.39)	(0.61)			(0.024)
Number of observations	26,180	26,180	26,180	26,180	26,180

Kleven et al. (2011): Threat of Audit Effects

THREAT-OF-AUDIT LETTER EFFECTS ON INDIVIDUAL UPWARD ADJUSTMENTS TO REPORTED INCOME[a]

	No Letter Group	Differences Letter Group vs. No-Letter Group									50% Letter – No Letter	100% Letter – 50% Letter
	Both 0% and 100% Audit Groups	Both 0% and 100% Audit Groups			0% Audit Group Only			100% Audit Group Only			Both 0% and 100% Audit Groups	
	Baseline	Any Adjustment	Upward Adjustment	Downward Adjustment	Any Adjustment	Upward Adjustment	Downward Adjustment	Any Adjustment	Upward Adjustment	Downward Adjustment	Upward Adjustment	Upward Adjustment
	1	2	3	4	5	6	7	8	9	10	11	12
A. Average Amounts of Individual Upward Adjustments												
Net income	−497	94	84	10	74	77	−3	115	92	23	58	52
	(31)	(42)	(22)	(34)	(55)	(29)	(45)	(64)	(35)	(52)	(26)	(26)
Total tax	−322	67	50	17	57	46	11	77	54	23	32	36
	(24)	(32)	(18)	(26)	(43)	(24)	(34)	(49)	(28)	(39)	(21)	(21)
Number of obs.	9397	24,788	24,788	24,788	14,145	14,145	14,145	10,643	10,643	10,643	24,788	24,788
B. Probability of Upward Adjustments (in percent)												
Net income	13.37	1.63	1.56	0.07	2.29	1.52	0.76	0.98	1.60	−0.62	1.10	0.93
	(0.35)	(0.47)	(0.28)	(0.40)	(0.62)	(0.37)	(0.53)	(0.73)	(0.44)	(0.61)	(0.33)	(0.33)
Total tax	13.69	1.52	1.57	−0.05	2.03	1.65	0.37	1.02	1.49	−0.47	1.03	1.07
	(0.35)	(0.48)	(0.29)	(0.40)	(0.63)	(0.37)	(0.54)	(0.73)	(0.44)	(0.61)	(0.33)	(0.33)
Number of obs.	9397	24,788	24,788	24,788	14,145	14,145	14,145	10,643	10,643	10,643	24,788	24,788

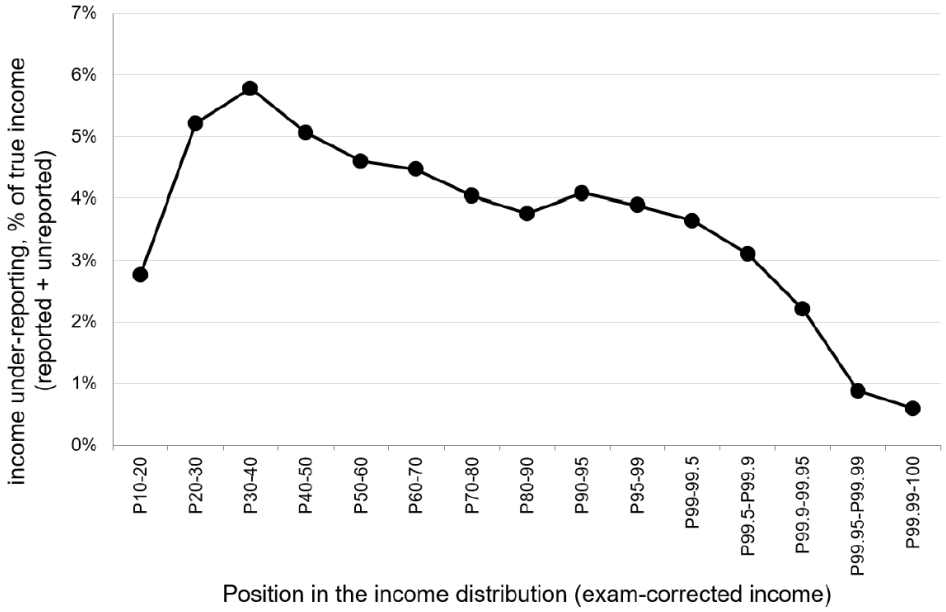
Outline

Guyton *et al.* (2021): Motivation

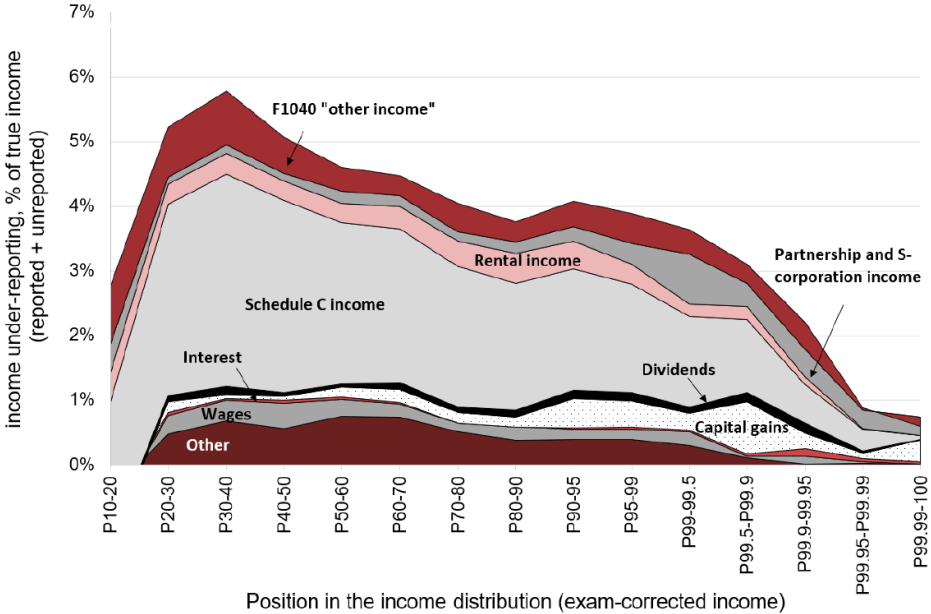
- How much (personal income) tax evasion is there in the US?
- How is it distributed? Do the rich evade more or less than lower-income households?
- **This paper:** Combine multiple data sources to estimate the extent of evasion through the income distribution.
- Find that audits do not detect all evasion, especially at the very top.
- At the very top, evasion through pass-through businesses and offshore sheltering more common
- Theory to explain this; methodology to measure tax gap correctly.

Guytan *et al.* (2021): Noncompliance in Random Audits

- IRS runs the *National Research Program* (NRP) that conducts *random* audits of individual tax returns (form 1040).
- NRP does stratified random sampling, oversampling top earners.
- Auditors go through the 1040 using its schedules, 3rd-party reports, taxpayer's own records, risk measures comparing the return to other filers.
- Audits known not to be able to detect all evasion. IRS has a methodology, *detection-controlled estimation* (DCE), to estimate *undetected* evasion. used to estimate aggregate tax gap.
- Pool data from NRP audits 2006–2013: 105,167 audited taxpayers; of whom 12,003 are in top 1%
- On aggregate, NRP finds 4.0% of true income is under-reported; 7.7% of taxes owed are not paid (before DCE correction)


(a) Unreported Income (% of True Income)
income under-reporting, % of true income
(reported + unreported)
7%
6%
5%
4%
3%
2%
1%
0%
P10-20
P20-30
P30-40
P40-50
P50-60
P60-70
P70-80
P80-90
P90-95
P95-99
P99-99.5
P99.5-P99.9
P99.9-99.95
P99.95-P99.99
P99.99-100
Position in the income distribution (exam-corrected income)

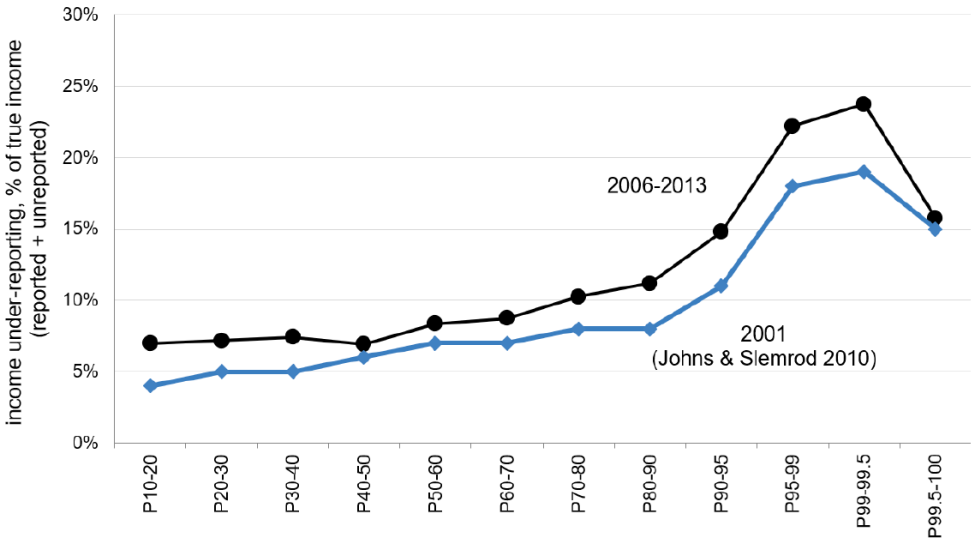
(b) Decomposition by Type of Income



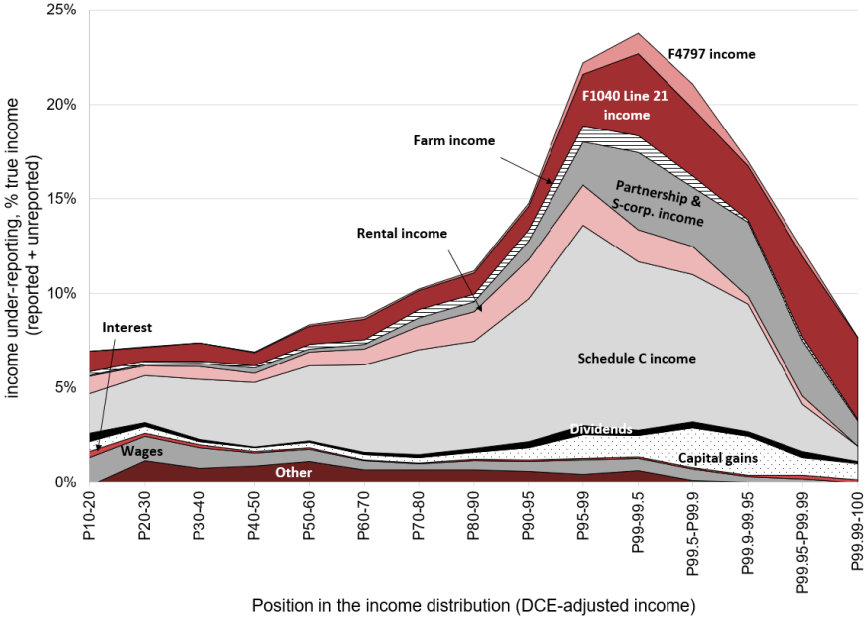
Guyton *et al.* (2021):Applying DCE Correction

- *Detection-Controlled Estimation* (DCE) correction is used to scale up evasion detected in NRP.
- Based on Feinstein (1991) model fraction of evasion detected depending on return characteristics (types of income, presence of schedules) and examiner (experience, age etc).
- After DCE correction, estimated total evasion is 14.0% of true income is under-reported; 20.0% of owed taxes are not paid.

(a) Unreported Income (% of True Income)



(b) Decomposition by Type of Income (2006–2013)

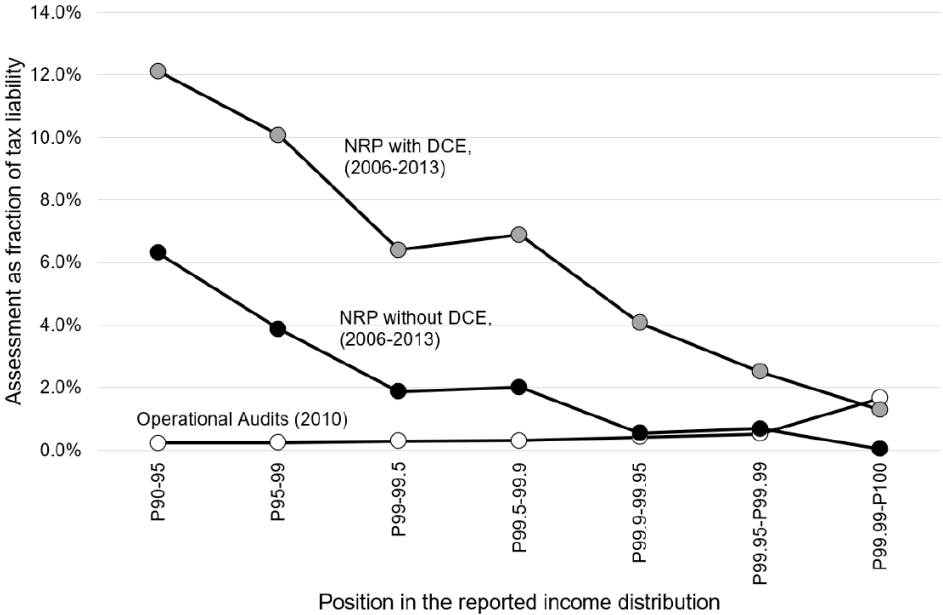


Guyton *et al.* (2021): Can DCE Fully Correct for Undetected Evasion?

- Undetected evasion may well rise with income:

1. interest, dividends, capital gains accruing to offshore accounts not extensively reported pre 2014 FATCA
2. Owners of business networks raise challenges: Need to dig one by one into each of the businesses' returns. Not always extensively examined.

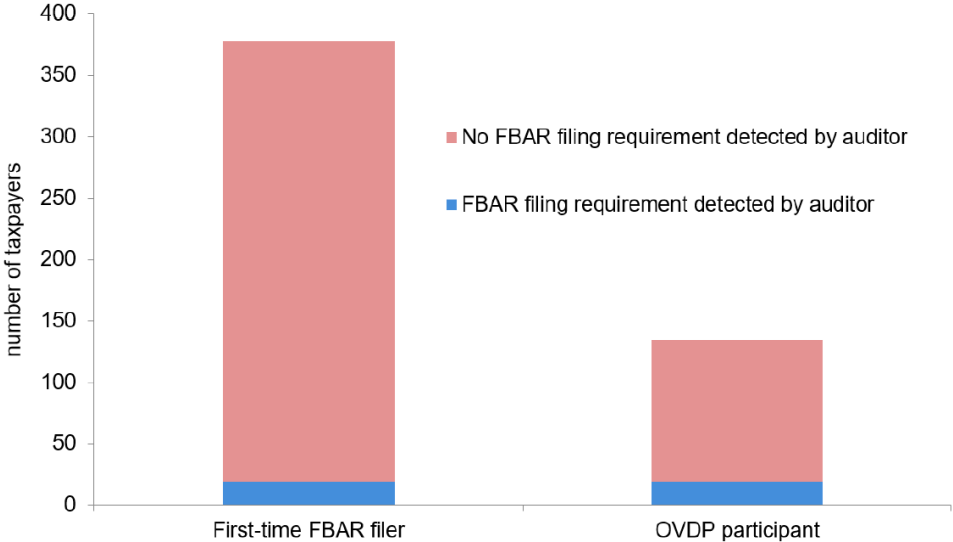
- Direct test: Compare weighted total noncompliance according to NRP, NRP with DCE, and detected in operational (targeted, more in-depth) audits.


Taxes assessed (% of taxes owed)
14.0%
12.0%
10.0%
8.0%
6.0%
4.0%
2.0%
0.0%
Assessment as fraction of tax liability
NRP with DCE, (2006-2013)
NRP without DCE, (2006-2013)
Operational Audits (2010)
P90-95
P95-99
P99-99.5
P99.5-99.9
P99.9-99.95
P99.95-P99.99
P99.99-P100
Position in the reported income distribution

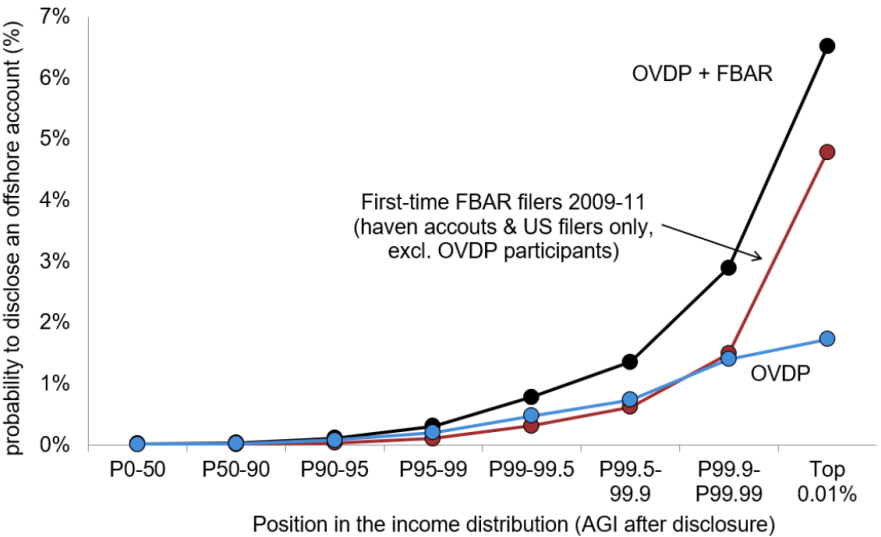
Guyton *et al.* (2021): Offshore Evasion

- After 2007 IRS pursued a series of initiatives to crack down on offshore tax evasion
- From 2008, *Offshore Voluntary Disclosure Program* (OVD), allowed people to pay penalties but avoid criminal prosecution
  - use data on 50,020 OVD participants matched to their returns
- 2010 passage of Foreign Accounts Tax Compliance Act (FATCA) requires 3rd-party reporting of offshore accounts from 2014
- Voluntarily file Foreign Bank Account Reports (FBAR) if more than $10K in offshore account
  - use data on 31,752 first-time FBAR filers linked to their returns

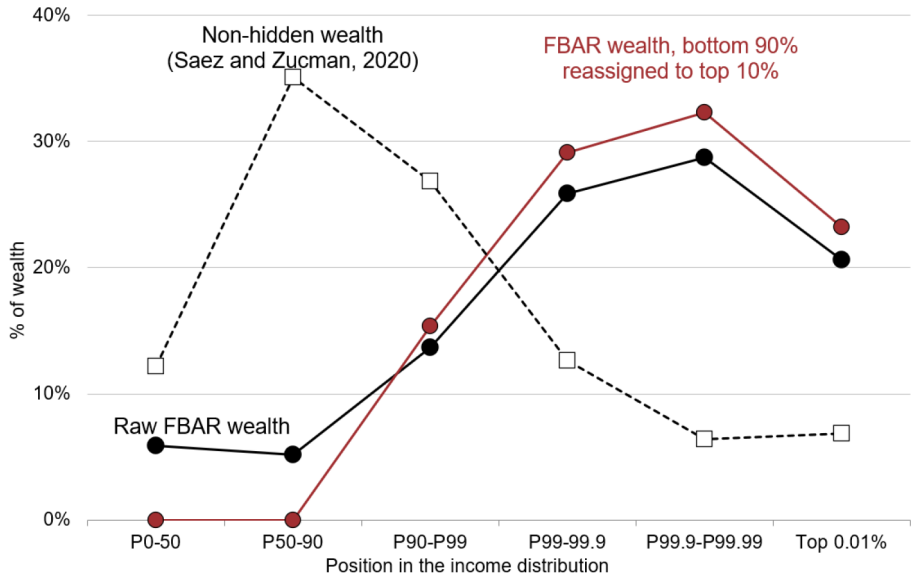
(a) Do NRP audits detect offshore evasion?



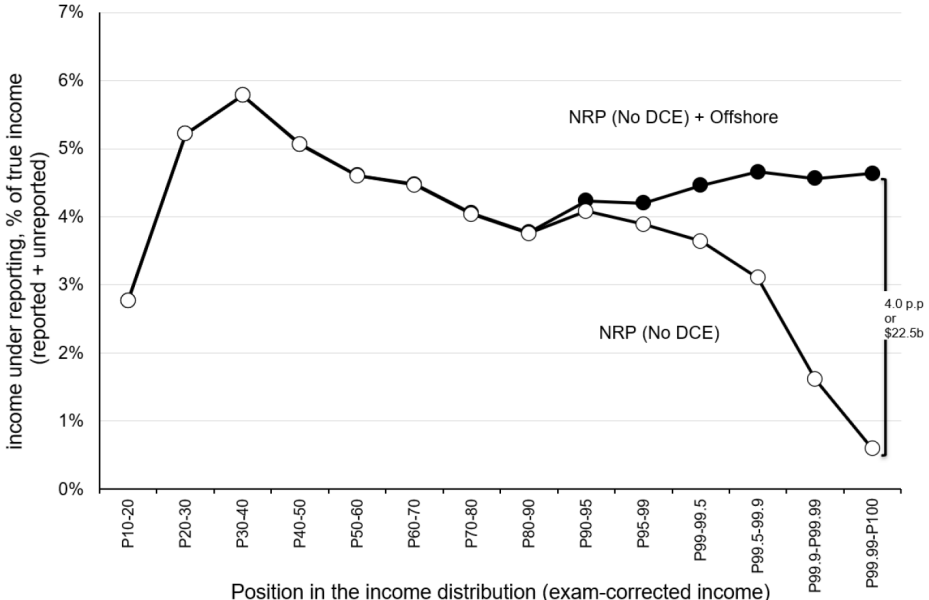
(b) Share Disclosing by Income Rank



(c) Distribution of Offshore Wealth



(a) Unreported Income (% True Income)

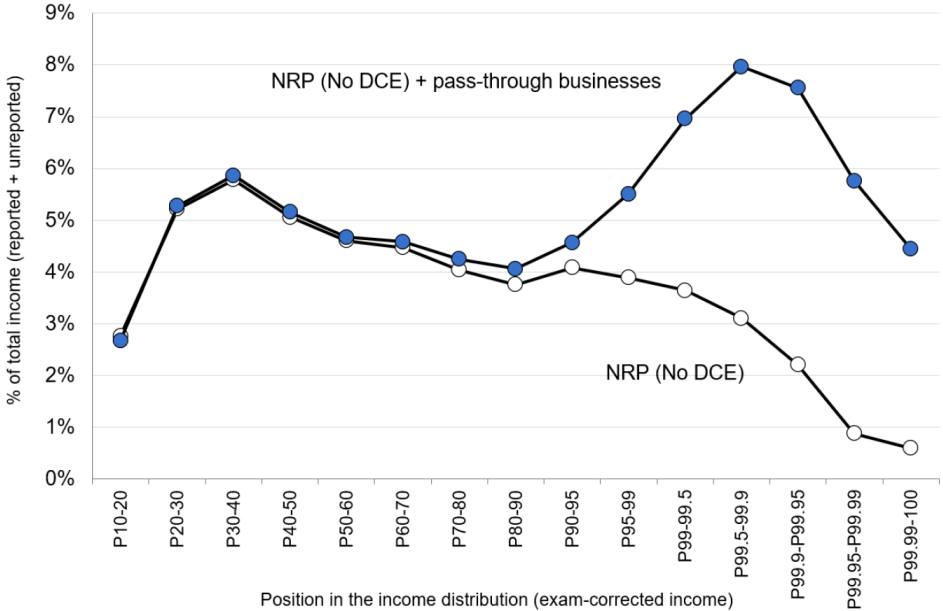


Guyton *et al.* (2021): Pass-through Business Income Evasion

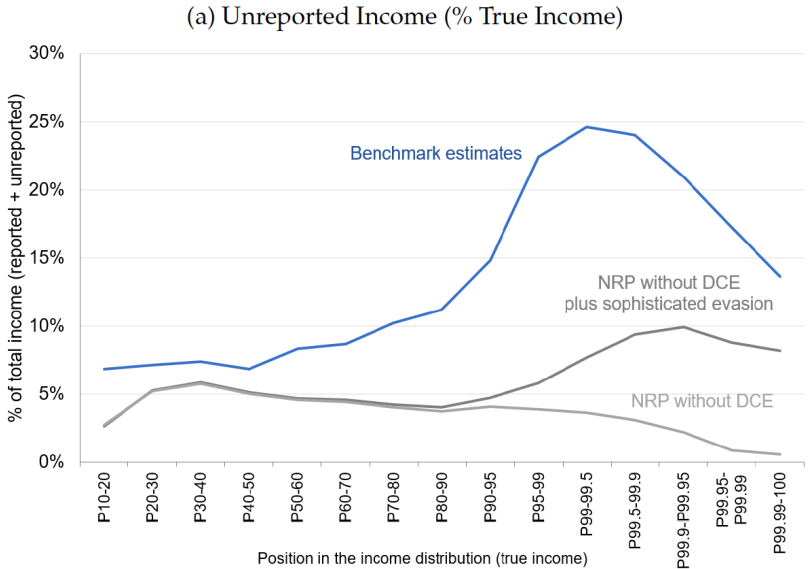
- Pass-through businesses (S-corporations & partnerships) don't pay corporate income tax, their income flows through to their owners.
- Business ownership highly concentrated at the top of the income distribution
- Much harder to audit since need to flow up to the underlying businesses' returns.
- To estimate impact on distribution of evasion follow 2 steps:

1. Make an assumption about overall evasion rate. Benchmark 20% of pass-through income, 5% of pass-through capital gains, 3% of pass-through dividends
2. Assume undetected income is distributed the same way as reported pass-through income.

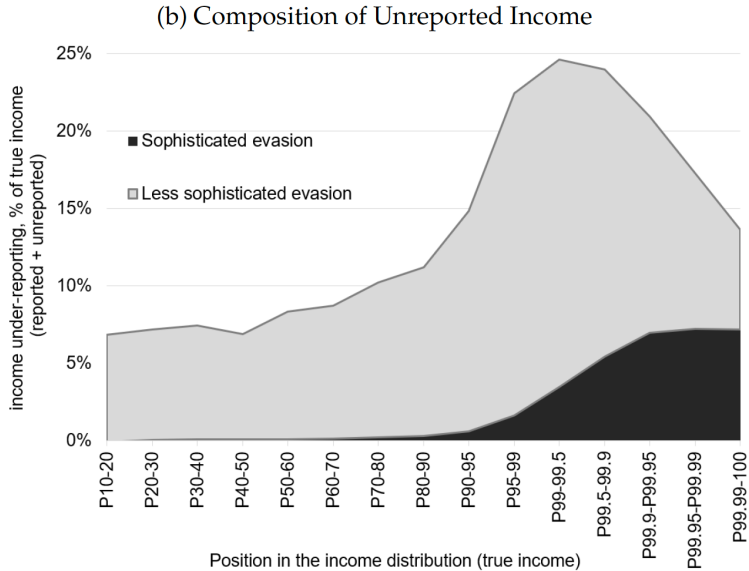
(a) Unreported Income (% True Income)



Guyton *et al.* (2021): Putting it All Together



Guyton *et al.* (2021): Putting it All Together



Outline

De Neve et al. (2021): Motivation

- As we have seen, there's lots of tax noncompliance. Closing this tax gap is an important policy goal in many countries.
- Knowing what drives compliance and how to increase it is therefore important.
- Allingham-Sandmo (1972) emphasizes pecuniary motives for compliance. Also literature on role of non-pecuniary motives, "tax morale" (Luttmer & Singhal, 2014)
- Evidence from several domains of importance of information frictions and complexity, e.g. benefit take-up (Bhargava & Manoli 2015), student loan repayment (Cox et al. 2018); college admissions (Dynarski et al. 2021)
- **This paper:** Evidence from a series of field experiments on role of complexity in communications with taxpayers and interactions with enforcement and tax morale.

De Neve et al. (2021): Simple Model

- Consider a simple Allingham-Sandmo style model. Taxpayer with true income y shold file and pay $T(y)$. Chooses report $\tilde{y} \in [0, y]$ to solve

$$\min_{\tilde{y} \in [0,y]} T(\tilde{y}) + \Phi_{\text{noncompliance}}(y - \tilde{y}) + \Phi_{\text{morale}}(y - \tilde{y}) + \Phi_{\text{compliance}}(\tilde{y})$$

- In special case where $T(x) = t \times x$ and $\Phi(x) = \phi \times x$, comply if

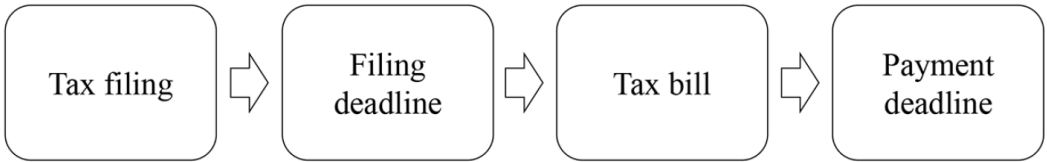
$$t + \phi_{\text{compliance}} \leq \phi_{\text{noncompliance}} + \phi_{\text{morale}}$$

- How to set the instruments? as in Keen & Slemrod (2017), equalize marginal cost of raising \$1:

$$\frac{\partial C / \partial \phi_j}{\partial T / \partial \phi_j} = \lambda$$

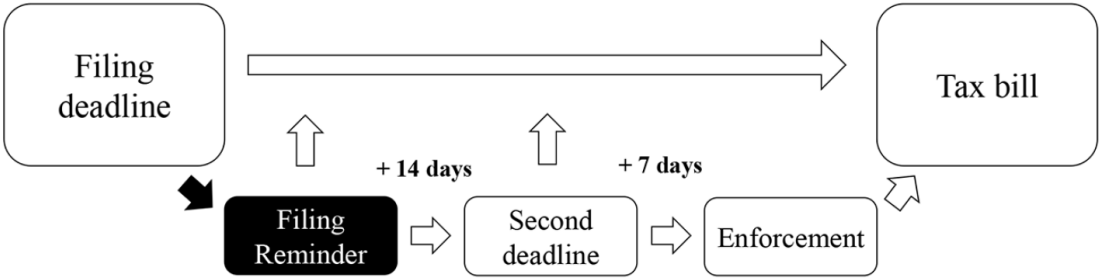
De Neve et al. (2021): Context

- 4 main steps in filing (federal) income taxes in Belgium

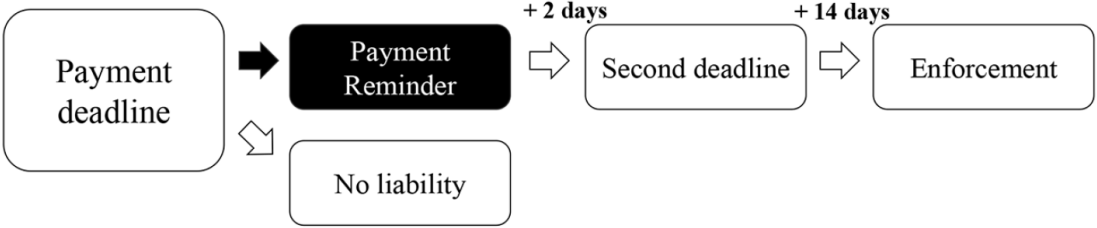


(a) Filing and payment

- Embed experiments in the four stages, in three consecutive fiscal years.



(b) Filing reminder process



(c) Payment reminder process

De Neve et al. (2021): Experiments

- Experiments on Tax Filing (TF), Tax Filing Reminder (TFR), Tax Payment (TP) and Tax Payment Reminder (TPR) in FY2014,15,16
- Categorize into *simplification, deterrence,* and *tax morale.*
- *Simplification*: simplify language. Shorten letters and focus on action-relevant information. Highlight important information in colors/boxes.
- *Deterrence*: add short message to simplified letter emphasizing consequences (penalties, tax increases etc) of noncompliance.
- *Tax morale*: add short message on social norms, reciprocity, public goods.

Letter A.3: Payment Reminder Experiment - Old Letter

Federal
Public Service
FINANCE

Sent from: TEAM INV NP HALLE
ZUSTER BERNARDASTRAAT 32 1500 HALLE

TAX COLLECTION AND RECOVERY

Tel.: +32 257 567 20
IBAN: BE66679200241443
BIC: PCHQBEBB

MR xx
Street yy
Zz City

OUR REFERENCE: Article 111.222.333
Municipality: BEERSEL
PAYMENTS MADE UNTIL 8,11,2016 HAVE BEEN TAKEN INTO ACCOUNT
PERSONAL INCOME TAX ASSESSMENT YEAR 2016

Dear Madam,
Dear Sir,

According to my information, the assessment referred to above remains unpaid for the following amounts:

Taxes due:	4,992.80
Costs due:	5.70
Interests due:	114.80
Amount already paid (taxes + costs + interests):	- 157.50
Balance to be paid:	EUR 4,885.80

I request you to settle this balance immediately. If you fail to make **an immediate payment by means of the transfer order below**, I will take legal actions in order to recover this debt. This will entail additional costs, which you shall bear.

INTEREST RATE UNTIL 31.12.98 = 9.6%, AS FROM 01.01.99 = 7%

More information can be found on the reverse.

Yours faithfully,

The tax collector

USEFUL INFORMATION

1. IF YOU HAVE ALREADY PAID, please contact my office and send me the proof of payment or a copy of that proof.
2. DO NOT WAIT UNTIL THE LAST DAY TO SETTLE THE PAYMENT!
   Some working days lapse between the order to pay and the execution of the payment.
3. IF YOU CONSIDER MODIFYING THE AMOUNT OR IF YOU WISH TO PAY IN ANOTHER MANNER THAN BY MEANS OF THIS TRANSFER FORM, you must copy the NOTIFICATION OF PAYMENT correctly from the payment form that is attached.
4. LEGAL MEANS OF RECOVERY
   In the absence of voluntary payment, the Tax Collector has the possibility to seize your wage and property and, if necessary, to sell that property.
5. In the event that this assessment is disputed, you are only required to make the immediate payment of the amount that is communicated:
   - either by the tax assessor entrusted with the rectification of the error made;
   - or by the official entrusted with the examination of your notice of objection (form 178 J). In the latter case, the Tax Collector may take precautionary measures (mortgage, protective seizure, etc.) in order to guarantee the payment of the balance (costs and interests included).

Federal

Public Service

FINANCE

Sent from: TEAM BIJZONDERE INV GENT
GASTON CROMMENLAAN 6 B202 BE-9050 GENT

General Administration of Tax Collection and Recovery

More information can be obtained from:
Tel.: +32 257 925 60
E-mail: tbigent@minfin.fed.be
Opening hours: as from 9 am to 12 pm
or by appointment

MR xx
Street yy
Zz City

Your file number: 111.222.333 – 83.05.21.301-71

Dear Mr xx yy,

You have an outstanding tax debt (see reverse).

Please pay the amount of **4,885.80 Euro within 48 hours** by transfer into the account number **BE50 6792 0023 8918,** mentioning the structured communication **+++066/5689/39627+++.**

If you fail to make a payment, we will take actions in order to recover this debt. You will bear the interests for late payment and the costs.

We thank you if in the meantime you have already made a payment.

Yours sincerely,

The recovery advisor - tax collector

Name	xx yy
National number	**83.05.21.301-71**
Tax type	PIT
Assessment year	2015
Article of the assessment book	111.222.333

Calculation

Established taxes	4,922.80
Costs	5.70
Interests	114.80
Amount already paid* (taxes + costs + interests)	- 157.50
Balance to be paid	**€ 4,885.80**

* Payments made until 8.11.2016 were taken into account

The interests for late payment will be calculated each month, at an annual interest rate of 7%. More information can be found on our website **www.financien.belgium.be** by entering the search term 'payment'.

If you lodged an objection, please contact us by e-mail (tbigent@minfin.fed.be) or by telephone (+32 257 925 60).
More information can be found on our website **www.financien.belgium.be** by entering the search term 'objection'.

Panel B: Payment Reminders

Deterrence	Explicit Penalty (EP) (FY2014, 2015)	These costs amount to 209.00 euro on average and may, depending on the situation, rise further.
	Active Choice (FY2014)	Not paying your taxes will be seen as an active choice.
	EP + Immediacy (FY2015)	These costs amount to 209.00 euro on average and may, depending on the situation, rise further. By paying now you may still avoid these costs.
	EP + Enforcement (FY2015)	These costs amount to 209.00 euro on average and may, depending on the situation, rise further. We will undertake actions to claim tax dues that may involve seizing your income or your assets.
	EP (Female Name First) (FY2015)	Woman's name, Man's name (instead of reversed)
Tax Morale	Social Norm (FY2014, 2015)	You belong to a minority of taxpayers who did not pay their taxes within the legal period: 95% of taxes in Belgium are paid on time. Why not follow this example?
	Public Goods (FY2014)	Paying taxes guarantees the provision of essential services by the government, such as public health, education, and public safety.
	Public Goods Negative (FY2014, 2015)	Not paying taxes puts at risk the provision of essential services by the government, such as public health, education, and public safety.

SUMMARY STATISTICS OF CONTROL VARIABLES BY EXPERIMENT

	All Taxpayers (1)	Tax Payment (2)	Payment Reminder (3)	Tax Filing (4)	Filing Reminder (5)
Demographics:					
Male dummy	.309	.324	.448	.276	.529
	(.462)	(.468)	(.497)	(.447)	(.499)
Couple dummy	.346	.415	.298	.445	.132
	(.476)	(.493)	(.457)	(.497)	(.339)
Age	49.495	53.354	47.764	47.596	42.229
	(18.129)	(16.382)	(15.611)	(15.585)	(16.249)
Number of children	.413	.351	.409	.579	.334
	(.869)	(.771)	(.830)	(.950)	(.836)
Married dummy				.476	
				(.499)	
Widowed dummy				.040	
				(.196)	
Divorced dummy				.156	
				(.363)	

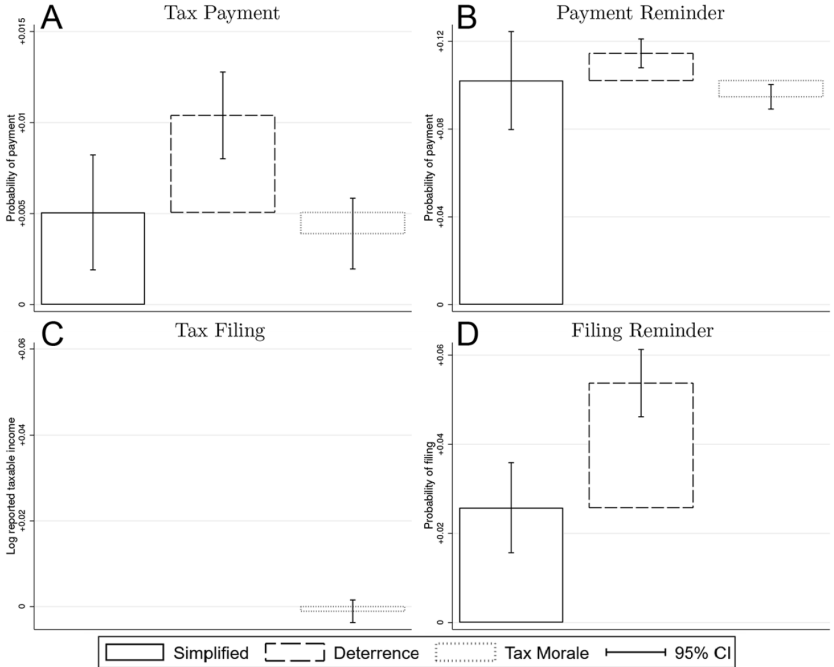
Region/language:					
Wallonia dummy	.327	.316	.367	.284	.390
	(.469)	(.465)	(.482)	(.451)	(.488)
Flanders dummy	.570	.596	.525	.637	.390
	(.495)	(.491)	(.499)	(.481)	(.488)
French dummy	.421	.386	.473	.357	.592
	(.494)	(.487)	(.499)	(.479)	(.491)
German dummy	.006	.011	-	.003	.007
	(.076)	(.104)		(.051)	(.084)
Other:					
Amount owed (€1,000s)	.569	2.676	1.891		
	(7.301)	(11.869)	(4.746)		
Income (€1,000s)			33.211		
			(28.804)		
Solvency score			11.657		
			(4.674)		
Observations	6,689,808	1,216,317	229,751	942,571	148,925

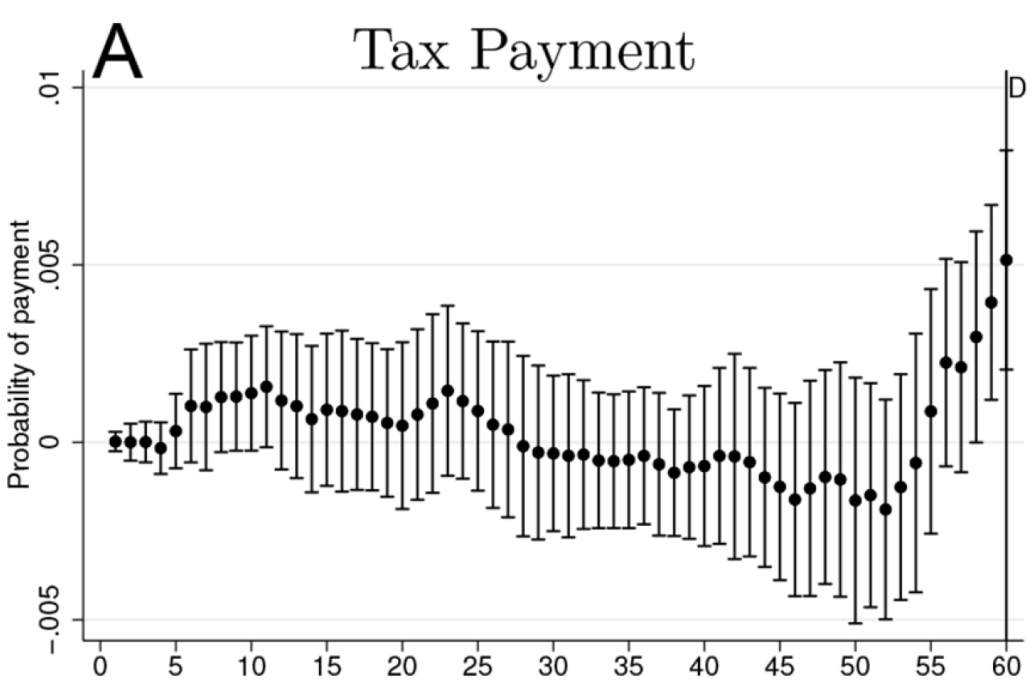
De Neve et al. (2021): Baseline Results

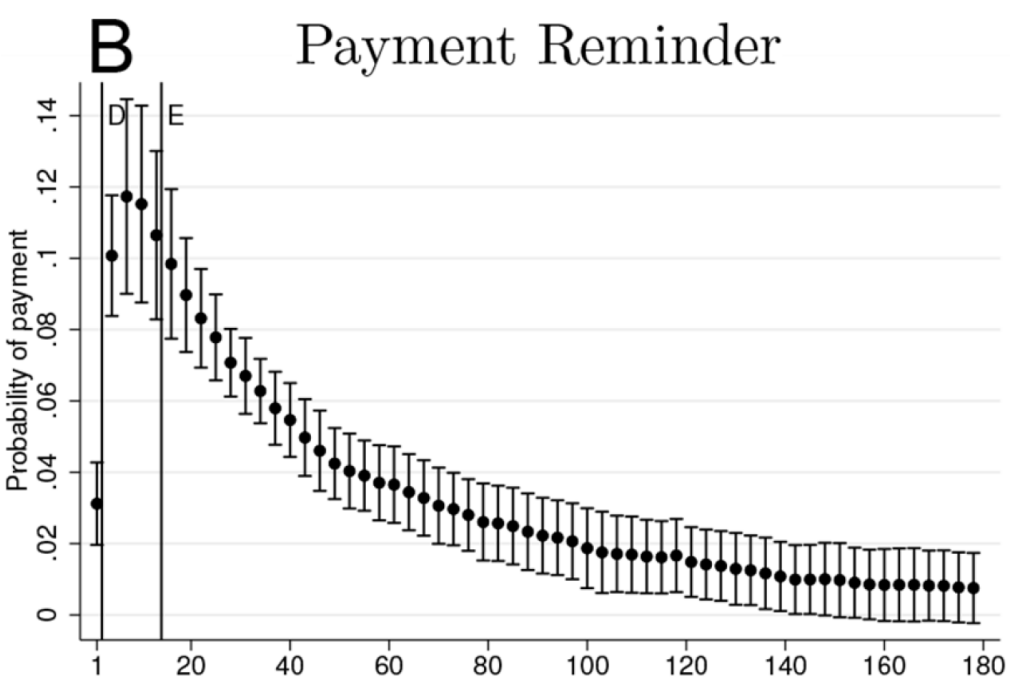
- Everything is randomized, so they can estimate

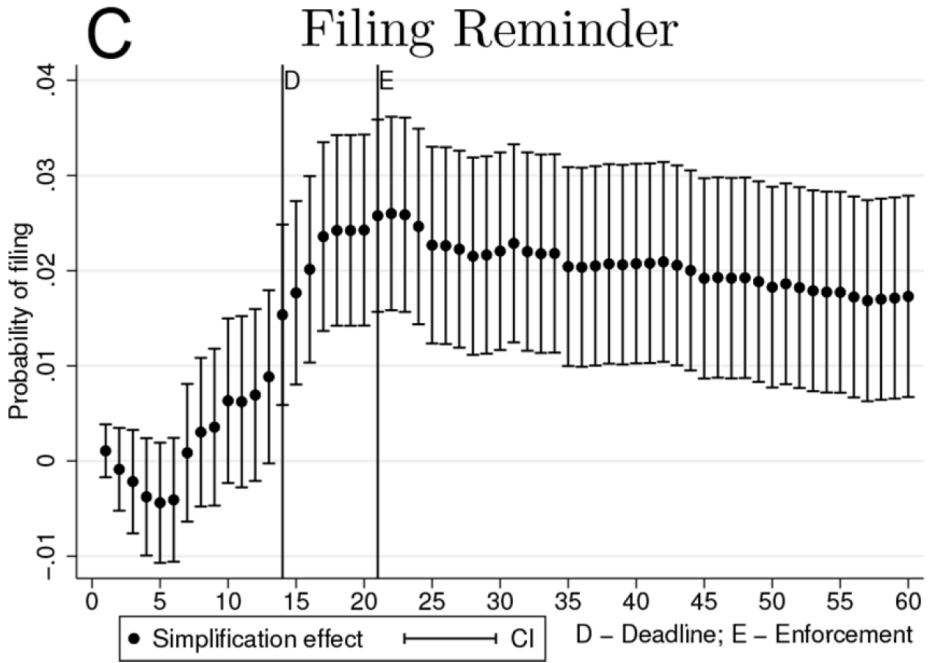
$$Y_i = \alpha + \beta_S S_i + \sum_j \beta_j T_j + \boldsymbol{\gamma} \mathbf{X}_i + \varepsilon_i$$

  where Y_i is the outcome, S_i is a dummy for the simplification treatment, T_j are the additional treatments (deterrence, tax morale), and $\mathbf{X}_i$ are controls including gender, couples, age, region, mother tongue, number of children, wave dummies for treatments sent in waves.
- Care about β_s and the β_js


A
Tax Payment
Probability of payment
0
+0.005
+0.01
+0.015
B
Payment Reminder
Probability of payment
0
+0.04
+0.08
+0.12
C
Tax Filing
Log reported taxable income
0
+0.02
+0.04
+0.06
D
Filing Reminder
Probability of filing
0
+0.02
+0.04
+0.06
Simplified
Deterrence
Tax Morale
95% CI

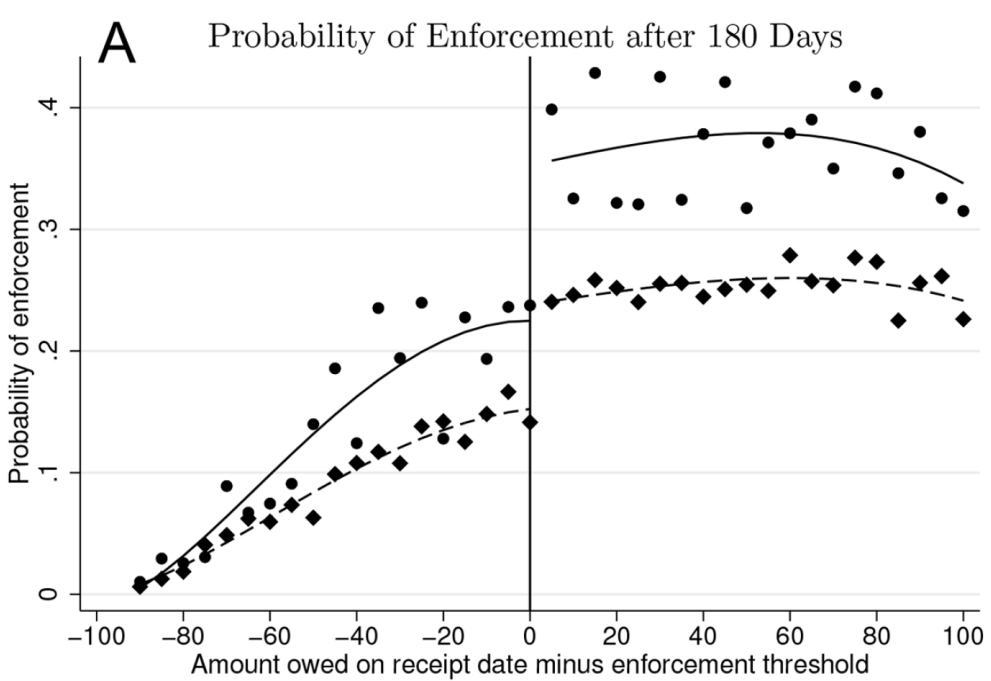

A
Tax Payment
Probability of payment
.01
.005
0
−.005
D
0
5
10
15
20
25
30
35
40
45
50
55
60

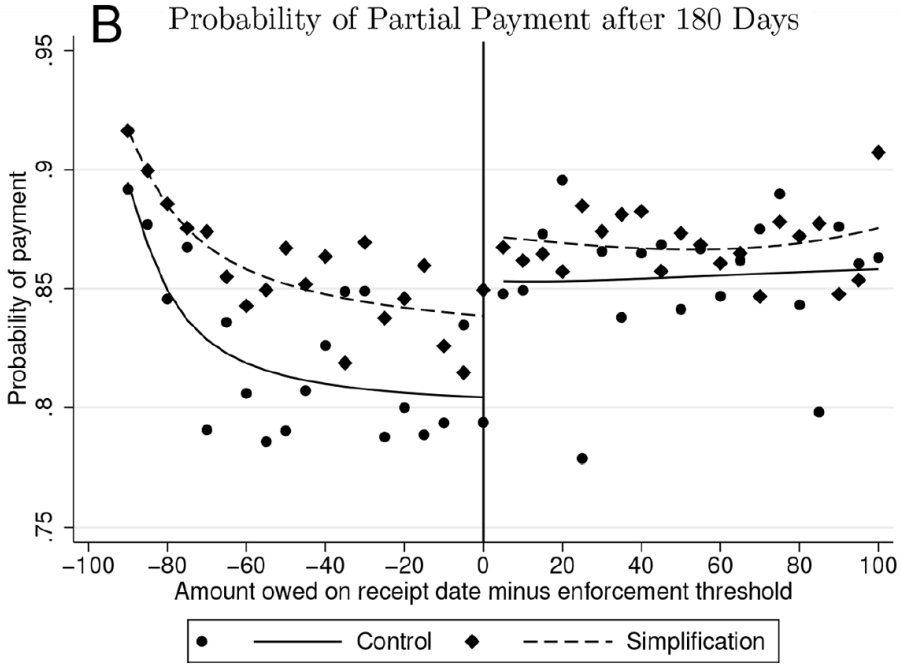

B
Payment Reminder
D
E
Probability of payment
0
.02
.04
.06
.08
.1
.12
.14
1
20
40
60
80
100
120
140
160
180


C
Filing Reminder
Probability of filing
−.01
0
.01
.02
.03
.04
D
E
0
5
10
15
20
25
30
35
40
45
50
55
60
Simplification effect
CI
D – Deadline; E – Enforcement

De Neve et al. (2021): Simplification and Enforcement

- We saw that the effects decay.
  - So much of what is happening is getting people to do things sooner than they otherwise would.
  - But they're also doing it voluntarily rather than needing the tax authority to enforce action $\rightarrow$ tax authority saves on these enforcement costs
- How cost effective are these nudges relative to "standard" enforcement techniques?
- Exploit threshold amount of outstanding tax liability above which there is more enforcement in a Regression Discontinuity Design (RDD)


A
Probability of Enforcement after 180 Days
Probability of enforcement
0
.1
.2
.3
.4
−100
−80
−60
−40
−20
0
20
40
60
80
100
Amount owed on receipt date minus enforcement threshold


B
Probability of Partial Payment after 180 Days
Probability of payment
.75
.8
.85
.9
.95
−100
−80
−60
−40
−20
0
20
40
60
80
100
Amount owed on receipt date minus enforcement threshold
Control
Simplification

De Neve et al. (2021): RD estimation

- Estimate treatment effects of enforcement and interaction with experimental simplification using

$$
\begin{aligned}
Y_i = \alpha &+ \beta_S S_i + \beta_E 1\{z_i - c > 0\} + \beta_{S,E} S_i \times 1\{z_i - c > 0\} \\
&+ \delta_{C,l}(z_i - c) + \delta_{C,r} 1\{z_i - c > 0\} \times (z_i - c) \\
&+ \delta_{S,l} S_i \times (z_i - c) + \delta_{S,r} S_i \times 1\{z_i - c > 0\} \times (z_i - c) + \boldsymbol{\gamma}\mathbf{X}_i + \varepsilon_i
\end{aligned}
$$

- Use Imbens - Kalyanaraman optimal bandwidth chosen in the control group

RDD: Effect of Simplification versus Enforcement in the FY2014 TPR Experiment

	Probability of Enforcement at 180 Days (1)	Probability of Some Payment at 14 Days (before Enforcement) (2)	Probability of Some Payment at 180 Days (after Enforcement) (3)
Simplified (S)	−.078	.151	.044
	(.021)	(.027)	(.014)
Enforcement (E)	.146	.006	.061
	(.027)	(.025)	(.018)
S × E	−.064	.000	−.027
	(.021)	(.019)	(.021)
p-values of tests:			
S + S × E = 0	.000	.000	.292
E + S × E = 0	.000	.606	.022
Control mean	.210	.489	.813
Observations	16,277	23,312	21,894

De Neve et al. (2021): Counterfactual Simplicity Treatment Effects

- The nudges' effect seems to dissipate to zero because of follow-up enforcement actions.
- Let's use the RD estimates to estimate what the treatment effect of nudges on compliance *would have been* if there had not been additional enforcement.
- Denote the payment probability be Y and the enforcement probability be F

$$
\begin{aligned}
CE &= \left[E\left[Y|_{S=1,z<c}\right] - E\left[F|_{S=1,z<c}\right] \frac{E\left[Y|_{S=1,z>c}\right] - E\left[Y|_{S=1,z<c}\right]}{E\left[F|_{S=1,z>c}\right] - E\left[F|_{S=1,z<c}\right]} \right] \\
&\quad - \left[E\left[Y|_{S=0,z<c}\right] - E\left[F|_{S=0,z<c}\right] \frac{E\left[Y|_{S=0,z>c}\right] - E\left[Y|_{S=0,z<c}\right]}{E\left[F|_{S=0,z>c}\right] - E\left[F|_{S=0,z<c}\right]} \right] \\
&= \left[\left(\hat{\alpha}^Y + \hat{\beta}_S^Y\right) - \left(\hat{\alpha}^F + \hat{\beta}_S^F\right) \frac{\hat{\beta}_E^Y + \hat{\beta}_{S,E}^Y}{\hat{\beta}_E^F + \hat{\beta}_{S,E}^F} \right] - \left[\hat{\alpha}^Y - \hat{\alpha}^F \frac{\hat{\beta}_E^Y}{\hat{\beta}_E^F} \right] = 0.077
\end{aligned}
$$

- $CE = 0.077$ is about half of the effect before enforcement (0.15)

Outline

Artavanis *et al.* (2016): Overview

- Seminal paper on measurement of evasion: Pissarides & Weber (EJ 1989)
- All households report food expenditure truthfully
  - Some households (3rd-party reported) report income truthfully →estimate Engel curve
  - Applying inverse Engel curve to other households → estimate of evasion
- Artavanis-Morse-Tsoutsoura insight:
  - Semi-formality: Firm is formal, but hides income.
  - Banks still lend, but base their lending on their inference of *true income*
- ⇒ if we can reverse-engineer banks' inference, we can predict level of tax evasion

Artavanis *et al.* (2016): Data

- Data from “a large Greek bank”.
- Universe of consumer credit applications
  - all variables on application form
- Tax authority data
  - zip-code $\times$ occupation $\times$ income decile data on reported income

Artavanis *et al.* (2016): Methodology

- Once applicant is deemed eligible, amount of credit is

$$\text{credit decision} = f\left(Y^{True}, Risk, SOFT\right)$$

- true income Y^{True}, credit score $Risk$, "soft information"

$$credit_{ij} = \beta_{1j} Y_{ij}^{True} + Risk_i \Phi + SOFT_{ij} \Psi$$

- Assume: wage workers don't evade, self employed evade differentially across industries. Reported income Y_{ij}^{R} relates to true income through

$$Y_{ij}^{True} = \begin{cases} Y_{ij}^{R} & \text{if } i \text{ is wage worker} \\ \lambda_j Y_{ij}^{R} & \text{if } i \text{ is self-employed} \end{cases}$$

Artavanis *et al.* (2016): Methodology

- Defining $SE_i = I\{\text{self-employed}\}$:

$$credit_{ij} = \beta_{1j} Y_{ij}^R (1 - SE_i) + (\beta_{1j}\lambda_j) Y_{ij}^R SE_i + Risk_i\Phi + SOFT_{ij}\Psi$$

- So estimate

$$credit_{ij} = \beta_{1j} Y_{ij}^R (1 - SE_i) + \beta_{2j} Y_{ij}^R SE_i + f.e.^{CreditGrade} + SOFT_{ij}\Psi + \varepsilon_{ij}$$

where $SOFT_{ij}$ includes wealth, neighborhood info, income risk

- $\Rightarrow \lambda_j = \beta_{2j}/\beta_{1j}$

Artavanis *et al.* (2016): Methodology

- λ_j identified if E $\left[\varepsilon_{ij} SE_i | Y_{ij}^R, Risk_i, SOFT_{ij}\right] = 0$

1. Wage workers don't evade
   - Restrict to workers at large companies
2. $dcredit/dY_{ij}^R$ same for wage and SE (conditional on risk)
   - saturate model, add year, industry*SE and bank FEs
3. credit depends on hidden and true income in same way
   - evasion is a norm, can't garnish wages for debts.
4. unobservables orthogonal to Y_{ij}^R
   - no ex-post differences in defaults
5. $credit_{ij}$ is bank's supply, not demand-driven debt.
   - focus on constrained borrowers, requested amt > approved amt

Dependent Variable: Credit Capacity = Outstanding Debt + Approved Loan								
	(1)	(1a)	(2)	(2a)	(3)	(3a)	(4)	(4a)
	OLS	λ	OLS	λ	OLS	λ	Quantile	λ
Income*Wage Worker	0.3185***		0.3235***		0.3391***		0.3610***	
	[0.0467]		[0.0491]		[0.0544]		[0.0023]	
Income*SE	0.5575***	1.75***	0.5755***	1.78***	0.6257***	1.84***	0.6490***	1.79***
	[0.0602]		[0.0569]		[0.0514]		[0.0025]	
IncomeRisk					1,811		-663	
					[2,983]		[671]	
SE*IncomeRisk					1,564		878	
					[3,197]		[821]	
Lag(Income Growth)					1,729		-8,501***	
					[9,857]		[1,434]	
SE*Lag(Income Growth)					8,336		9,814***	
					[10,517]		[1,810]	
Real Estate Wealth					0.9400***		0.1968***	
					[0.3193]		[0.0576]	
SE*Real Estate Wealth					-0.1045		0.0608	
					[0.5807]		[0.1255]	
Credit Grade F.E.	Yes		Yes		Yes		Yes	
Industry*SE F.E.	Yes		Yes		Yes		Yes	
Branch F.E.	No		Yes		Yes		Yes	
Year F.E.	Yes		Yes		Yes		Yes	
Adj. R^2	0.100		0.118		0.120		0.140	
Tax Evasion Rate		42.85%		43.82%		45.65%		44.13%

Artavanis *et al.* (2015): Results

The table presents aggregate estimates of tax evasion at the economy level. The lambda multiples (λ) are from Table II. The aggregate reported income for the self-employed is from the annual bulletin of the Ministry of Finance. A range of economy-wide tax evaded income for the self-employed individuals and foregone taxes is calculated based on low and high estimated lambda multiples from Table II. Estimations based on the median lambda multiple are provided in parentheses. Foregone taxes are estimated under a 40% tax rate. Total and primary (in parentheses) deficits are from Eurostat. Amounts are in billions of euros.

		Low	Median	High
	Lambda Estimate:	1.75	1.79	1.84
	Reported Income (Self-Employed)	Tax Evaded Income Low-High (Median)	Foregone Taxes Low-High (Median)	Deficit (Primary)
Year 2006	28.8	21.6 - 24.2 (22.8)	8.64 - 9.68 (9.10)	8.0 (3.6)
Year 2007	30.4	22.8 - 25.5 (24.0)	9.12 - 10.21 (9.60)	14.8 (5.0)
Year 2008	32.4	24.6 - 27.6 (25.9)	9.84 - 11.02 (10.36)	23.3 (12.1)
Year 2009	35.7	26.8 - 29.9 (28.2)	10.71 - 12.00 (11.28)	35.4 (24.3)

Dependent Variable: Credit Capacity = Outstanding Debt + Approved Loan

Income*SE	OLS (1) Estimate	OLS (1.a) λ	OLS (1.b) Tax-Evaded Income	OLS (2) Estimate	OLS (2.a) λ	OLS (2.b) Tax-Evaded Income	Quintile (3) Estimate	Quintile (3.a) λ	Quintile (3.b) Tax-Evaded Income
Income*WageWorker	0.308***			0.313***			0.366***		
	[0.0487]			[0.0529]			[0.00399]		
*Accounting & Finance	0.526***	1.71*	14,477	0.600***	1.92	18,732	0.670***	1.83*	16,971
	[0.138]			[0.233]			[0.0279]		
*Bus.Services & Trade	0.627***	2.04***	17,654	0.690***	2.20***	20,508	0.620***	1.69***	11,833
	[0.0656]			[0.0821]			[0.00940]		
*Constr. & Transport	0.571***	1.85***	11,555	0.649***	2.07***	14,508	0.705***	1.93***	12,522
	[0.0600]			[0.0959]			[0.0202]		
*Education	0.781***	2.54***	24,689	1.028***	3.29***	36,687	0.821***	2.24***	19,971
	[0.105]			[0.228]			[0.0608]		
*Engineering & Science	0.756***	2.46***	28,306	0.996***	3.18***	42,477	0.703***	1.92***	17,913
	[0.129]			[0.212]			[0.0198]		
*Farming	0.182	not sig	–	0.0910	not sig	–	0.552***	1.51*	6,121
	[0.125]			[0.0799]			[0.0103]		
*Law	0.716***	2.33***	29,415	0.871***	2.79***	39,557	0.762***	2.08***	23,965
	[0.116]			[0.119]			[0.0193]		
*Lodging & Tourism	0.496***	1.61	9,952	0.866***	2.77***	28,700	0.660***	1.80**	13,059
	[0.186]			[0.178]			[0.0240]		
*Manufacturing	0.403***	1.31	5,382	0.393***	1.26	4,457	0.617***	1.69	11,975
	[0.0884]			[0.112]			[0.0123]		
*Media & Entert.	0.587***	1.91*	15,039	0.904***	2.89***	31,290	0.691***	1.89**	14,718
	[0.158]			[0.155]			[0.0566]		
*Medicine	0.683***	2.22***	29,346	0.811***	2.59**	38,275	0.826***	2.25***	30,021
	[0.129]			[0.233]			[0.0142]		
*Personal Services	0.343***	1.11	1,661	0.470***	1.50	7,329	0.620***	1.69	10,131
	[0.111]			[0.176]			[0.0714]		
*Retail	0.468***	1.52**	10,342	0.480***	1.53**	10,635	0.634***	1.73**	14,588
	[0.0451]			[0.0630]			[0.0103]		

Artavanis *et al.* (2015): Results

Outline

Outline

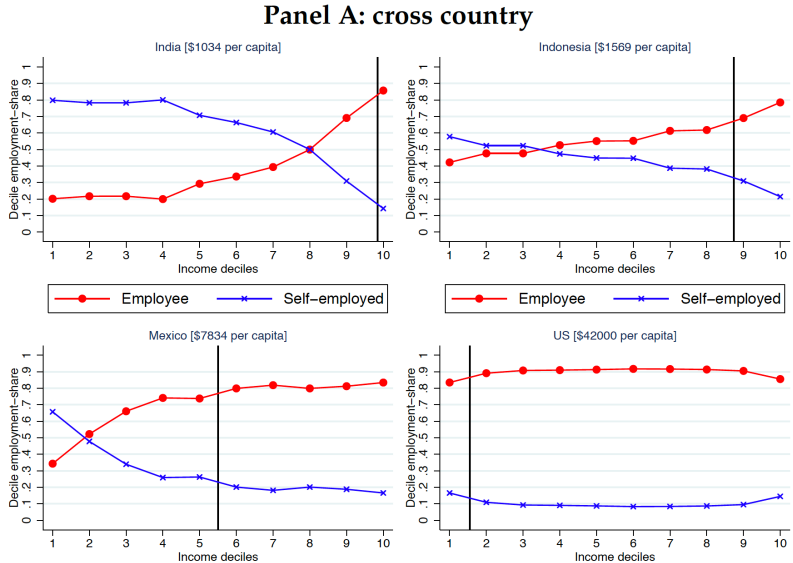
Jensen (2019): Overview

- Why do Low- and Middle- income countries rely so much less on direct (income) taxes?
- Gather household-level data on many countries over many years and show
  - the share of self-employed people falls with development
  - the gradient with income gets flatter with development
  - The income tax exemption tax threshold moves down the income distribution as this happens.
- To deal with endogeneity, look at historical US experience.
  - Instrument for employee share with exogenous timing of passage of Industrial Development Bonds that exogenously shift workers into manufacturing.
  - Shows same, striking, patterns.

Jensen (2019): Data

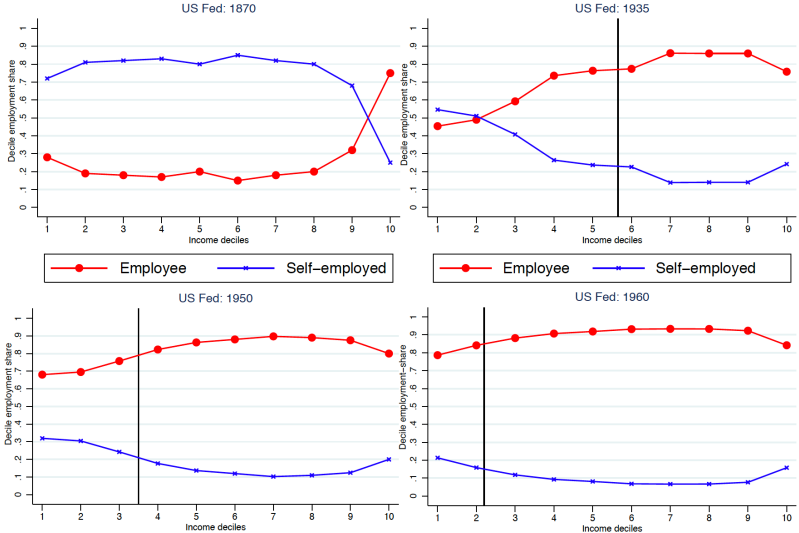
1. Household microdata from 90 countries around the world containing
   - information on type of work
   - earnings information (not expenditure proxies)
2. Historical data on the US
   - Census microdata 1950–2010
   - 1870 & 1935 from historians (Williamson & Lindert)
   - state income tax schedules
   - BLS serveys of employment by industry and type of work 1939–2002
   - Dates of passage and implementation of IDBs

Jensen (2019): Stylized Facts

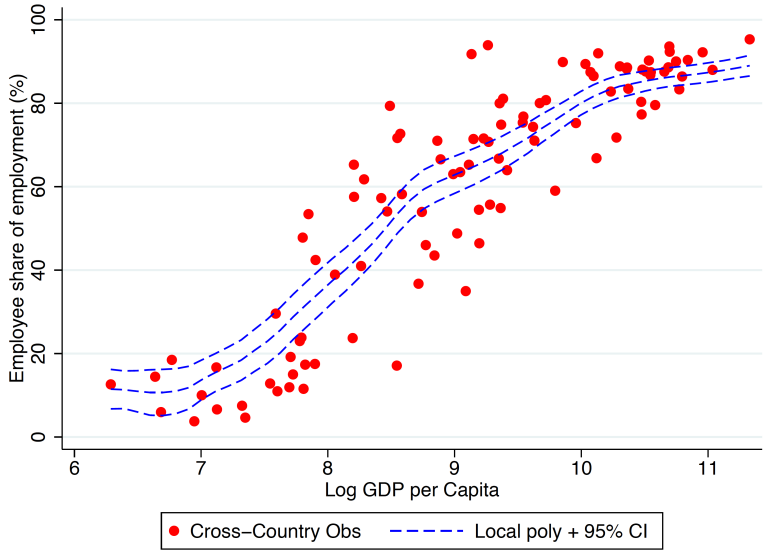


Jensen (2019): Stylized Facts

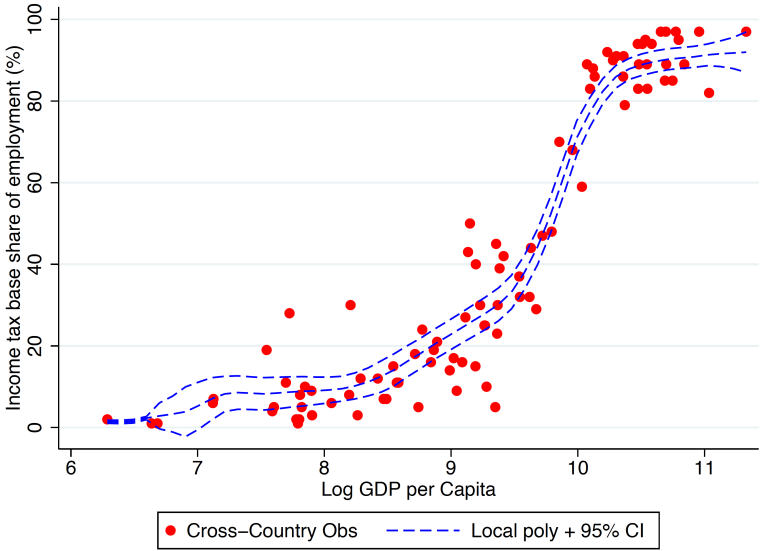
Panel B: within country over time US 1870-1960



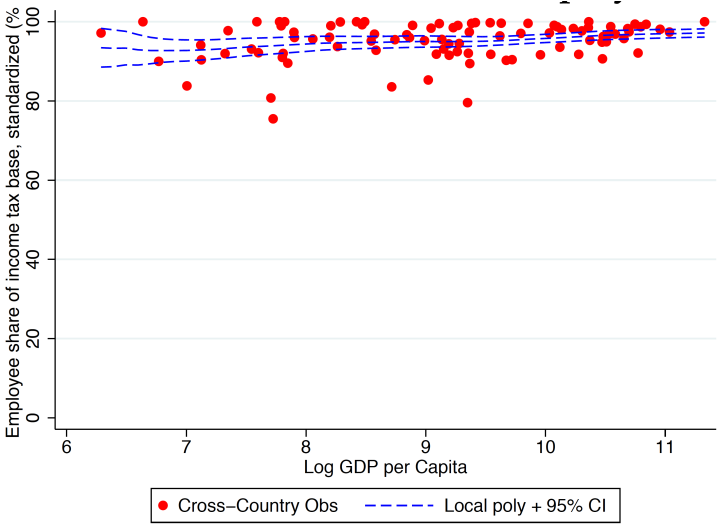
Jensen (2019): Stylized Facts



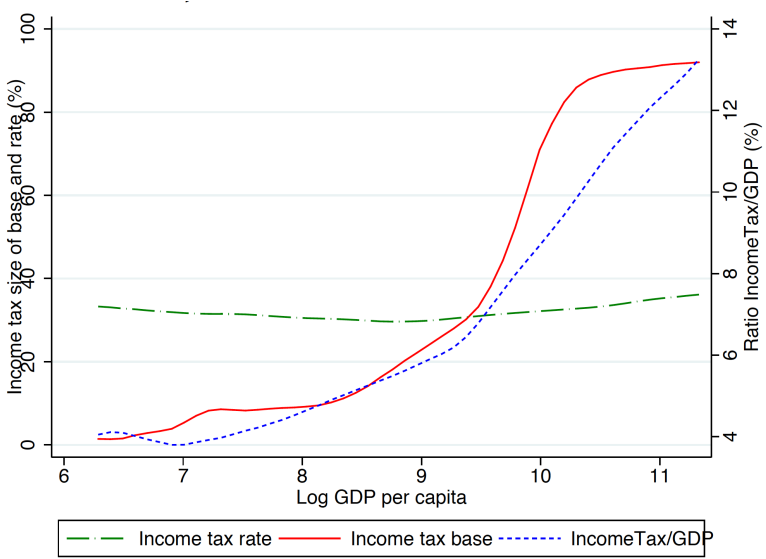
Jensen (2019): Stylized Facts



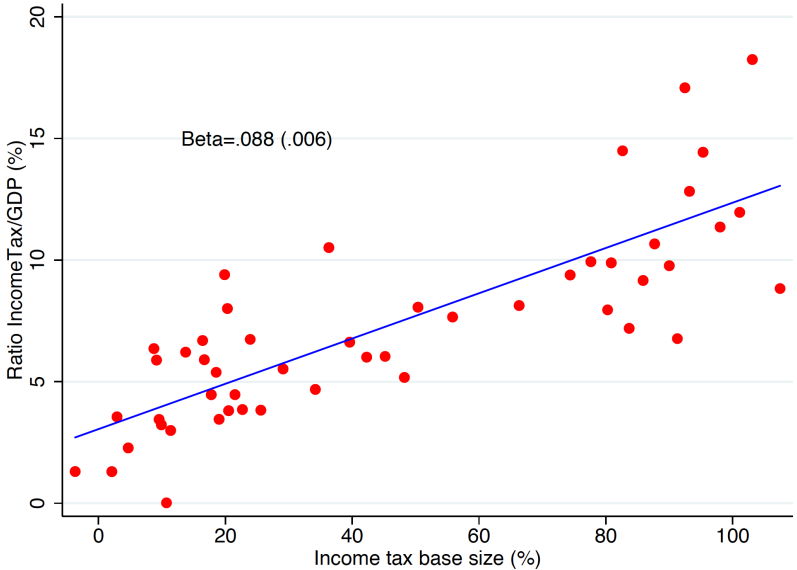
Jensen (2019): Stylized Facts



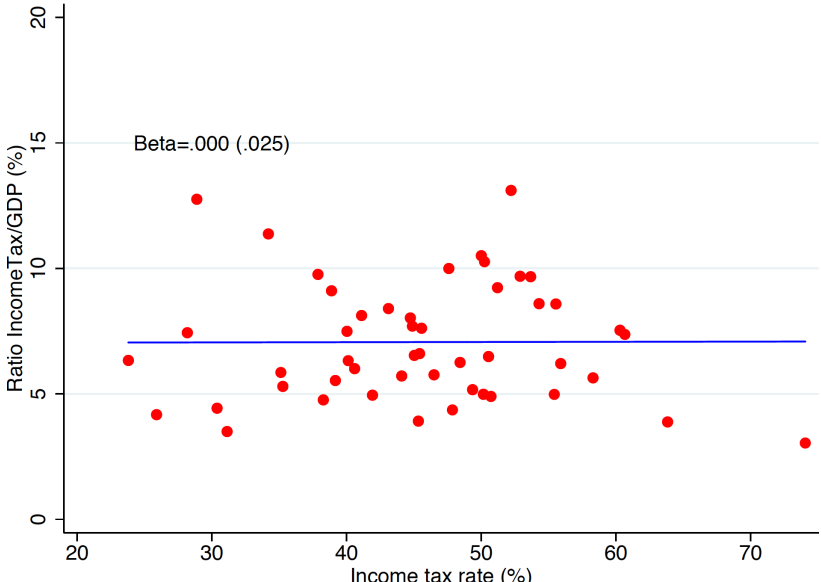
Jensen (2019): Stylized Facts



Jensen (2019): Stylized Facts



Jensen (2019): Stylized Facts



Jensen (2019): Causal Evidence

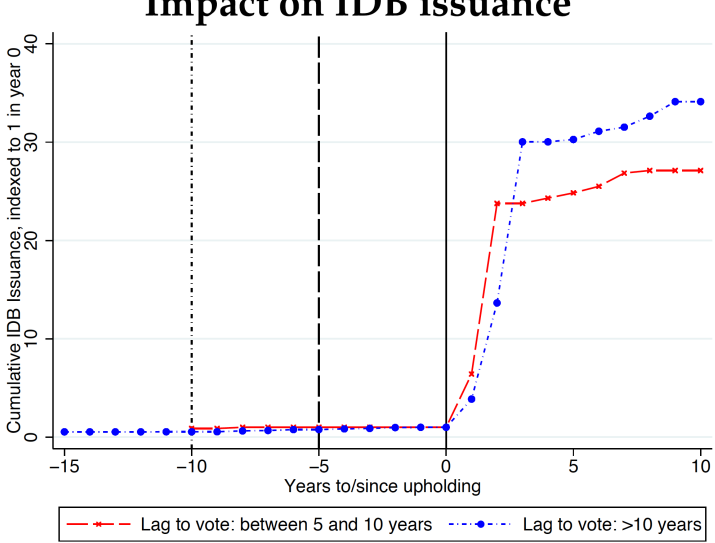
- These cross-country and over-time patterns are compelling, but are they causal?
- Do countries move their tax thresholds *because* they have fewer self-employed workers?
- Use timing of implementation of Industrial Development Bonds.
- Each state votes on whether to issue a bond. However, not implemented until each state's highest court confirms it is constitutional. When this happens is uncertain.
  → Look at time trends around implementation date.

$$y_{st} = \beta + \alpha \mathbf{1}\left(\text{Vote in}\right)_{st} + \theta \mathbf{1}\left(\text{Upheld}\right)_{st} + \lambda \mathbf{X}_{st} + \mu_s + \gamma_t + \varepsilon_{st}$$

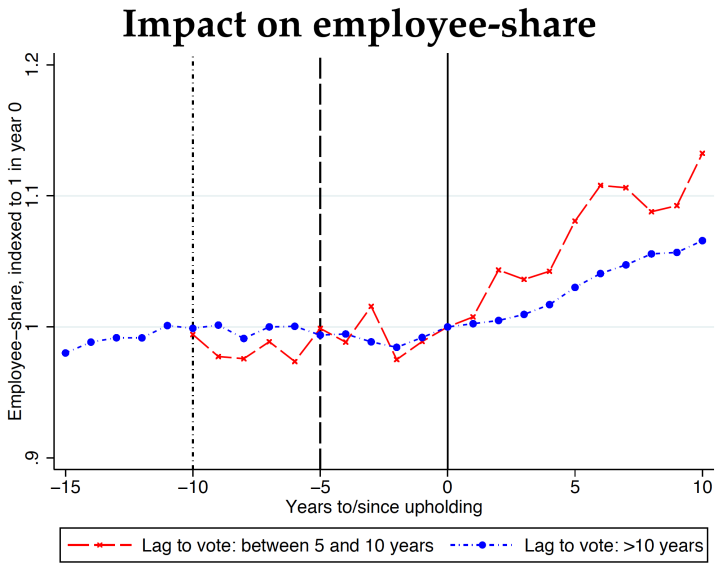
- Argue that mechanism is change in fiscal enforcement cost. Heterogeneity: with(out) Exchange of Information (EOI) w/ IRS.

$$\begin{aligned} y_{st} = \beta &+ \alpha \mathbf{1}\left(\text{Vote in}\right)_{st} + \theta \mathbf{1}\left(\text{Upheld}\right)_{st} + \sigma \mathbf{1}\left(\text{Upheld}\right)_{st} \times \mathbf{1}\left(\text{EoI}\right)_{st} \\ &+ \lambda \mathbf{X}_{st} + \mu_s + \gamma_t + \varepsilon_{st} \end{aligned}$$

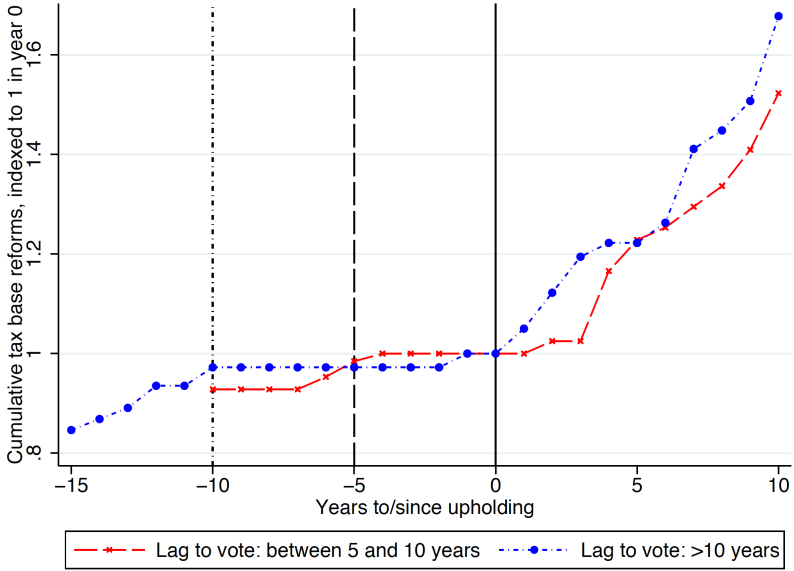
Jensen (2019): Results



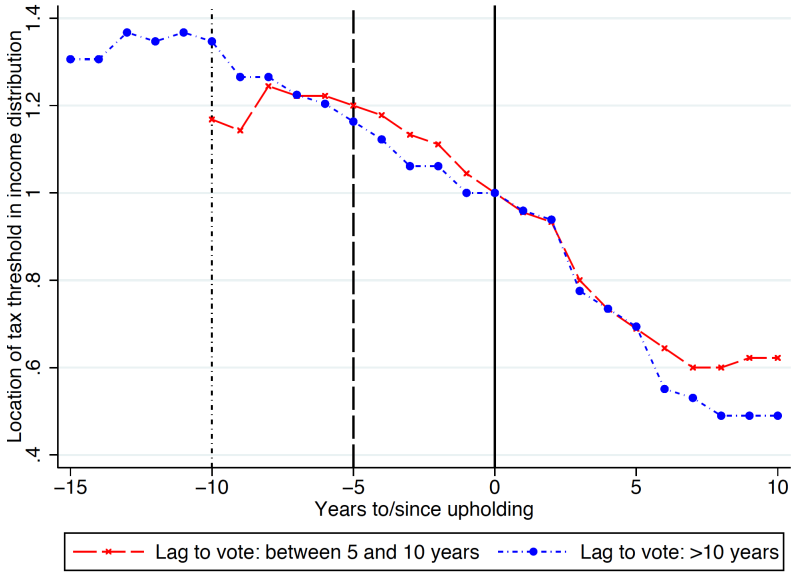
Jensen (2019): Results



Jensen (2019): Results



Jensen (2019): Results



Jensen (2019): Results

TABLE 2: EFFECTS OF IDB PROGRAM ON EMPLOYMENT AND INCOME TAX OUTCOMES

	(E-share)		(K/y)		Log(PIT/GDP)
	(1)	(2)	(3)	(4)	(5)
1(Vote)	.003	.003	-.357	-.343	.027
	(.005)	(.235)	(.232)	(.232)	(.039)
1(Uphold)	.017	.015	-.639	-.794	.176
	(.005)***	(.006)***	(.278)**	(.334)**	(.083)**
1(Uphold)x**1**(EoI)		.003		.356	-.244
		(.007)		(.197)*	(.137)*
F-test: **1**(Uphold) + **1**(Uphold)x**1**(EoI)		10.17		1.50	0.51
(p-value)		(.003)		(.230)	(.481)
Mean outcome variable	0.771	0.771	7.084	7.084	.972
State FE	x	x	x	x	x
Year FE	x	x	x	x	x
State-year controls	x	x	x	x	x
States	28	28	28	28	28
State-year Obs	466	466	466	466	466

Jensen (2019): Results

Panel A

	Log(CorpIncTax/GDP)	Log(SalesTax/GDP)	Log(PropertyTax/GDP)	**1**(PIT Withholding)	PIT MTR	Tax Administration
	(1)	(2)	(3)	(4)	(5)	(6)
1(Vote)	-.030	.067	-.038	-.000	.123	.006
	(.050)	(.056)	(.026)	(.001)	(.104)	(.043)
1(Uphold)	-.058	-.047	-.030	-.001	.034	-.025
	(.136)	(.051)	(.049)	(.002)	(.152)	(.080)
1(Uphold)x**1**(EoI)	.003	.114	-.056	-.000	.006	-.020
	(.101)	(.098)	(.070)	(.001)	(.142)	(.076)
Mean outcome variable	.991	2.521	.860	.014	.129	2.492
State FE	x	x	x	x	x	x
Year FE	x	x	x	x	x	x
State-year controls	x	x	x	x	x	x
States	28	28	28	28	28	28
State-year Obs	466	466	466	466	466	466

Jensen (2019): Results

Panel B

	Income per Capita	Top 1 percent income share	Max Unemp Benefits	**1**(Right to Work Laws)	Political Competition	Democratic Vote Share
	(1)	(2)	(3)	(4)	(5)	(6)
1(Vote)	27.401	.162	-17.910	.008	-.001	-.022
	(26.799)	(.114)	(9.226)*	(.009)	(.009)	(.019)
1(Uphold)	-8.165	.040	-10.448	.050	-.004	-.016
	(35.421)	(.223)	(18.530)	(.046)	(.014)	(.017)
1(Uphold)x**1**(EoI)	35.958	.067	-2.422	-.037	.004	-.022
	(36.605)	(.202)	(18.085)	(.035)	(.009)	(.013)*
Mean outcome variable	7641.297	13.433	307.366	.234	-.112	.539
State FE	x	x	x	x	x	x
Year FE	x	x	x	x	x	x
State-year controls	x	x	x	x	x	x
States	28	28	28	28	28	28
State-year Obs	466	466	466	466	466	466

Outline

Bachas et al. (2020): Overview

- How much can we rely on consumption taxes to reduce inequality in developing countries?
- Use comprehensive household expenditure data from 31 countries to document patterns of informal (untaxed/untaxable!) consumption, summarized in the *informality Engel Curve*.
- Descriptive findings suggest consumption taxes are strikingly progressive (contrary to consensus view)
- Plug these moments into a simple optimal tax framework

Bachas et al. (2020): Data

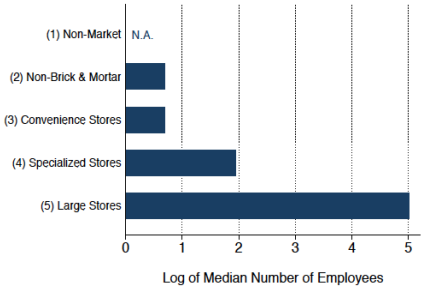
- Look across the world for household survey datasets that satisfy
  1. nationally representative
  2. consumption data from open diaries
  3. Records *store type* (this is the one that binds in practice)
- $\Rightarrow$data from 31 countries on 400K+ households

Bachas et al. (2020): Proxy For Informality

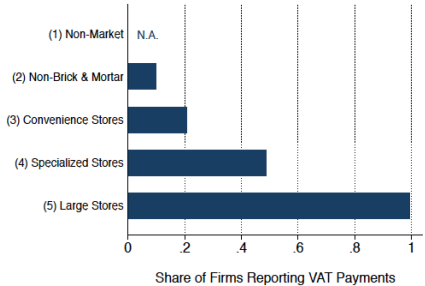
- Proxy for informality using the place of purchase
- 5 categories of store:
  1. non-market consumption (eg home production)
  2. non brick-and-mortar stores
  3. corner/convenience stores
  4. specialized stores (e.g. clothing stores)
  5. large stores (supermarkets, department stores etc)
- Working definition: (1)–(3) are informal; (4) & (5) are formal
- See also Lagakos (2016) and

Bachas et al. (2020): Proxy for Informality

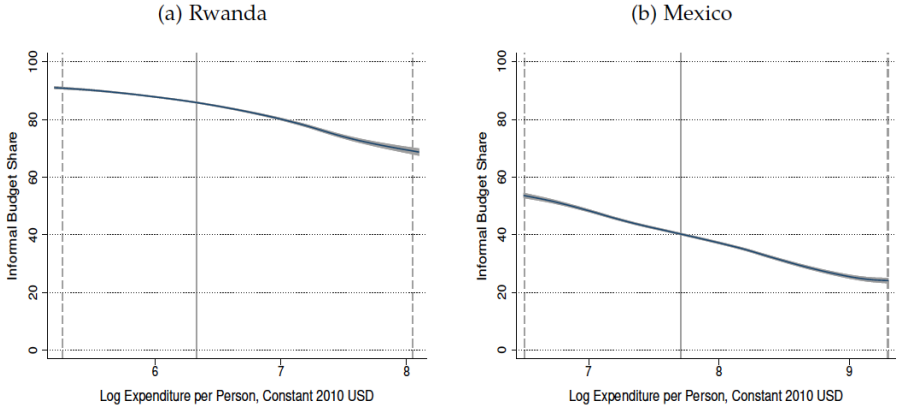
(b) # Employees by Store in Mexico



(c) % Paying VAT by Store in Mexico

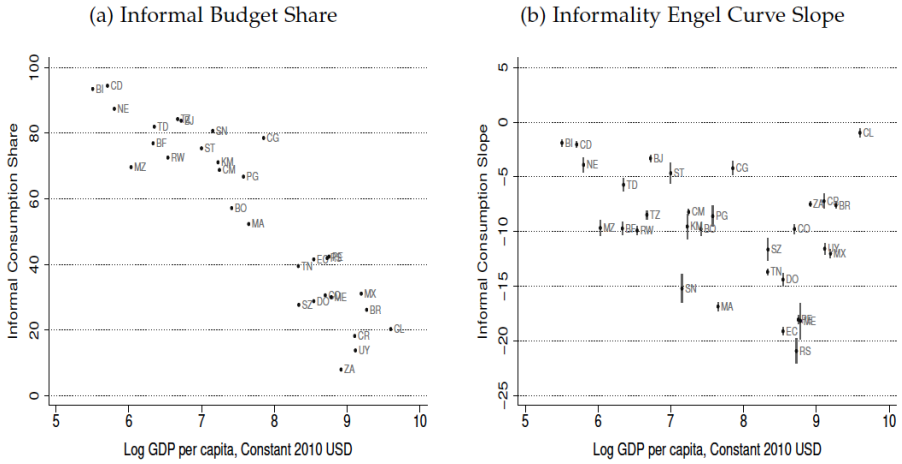


Bachas et al. (2020): Informality Engel Curves



1. Intercept higher in poorer country
2. Negative, roughly constant slope

Bachas et al. (2020): Informality Engel Curves



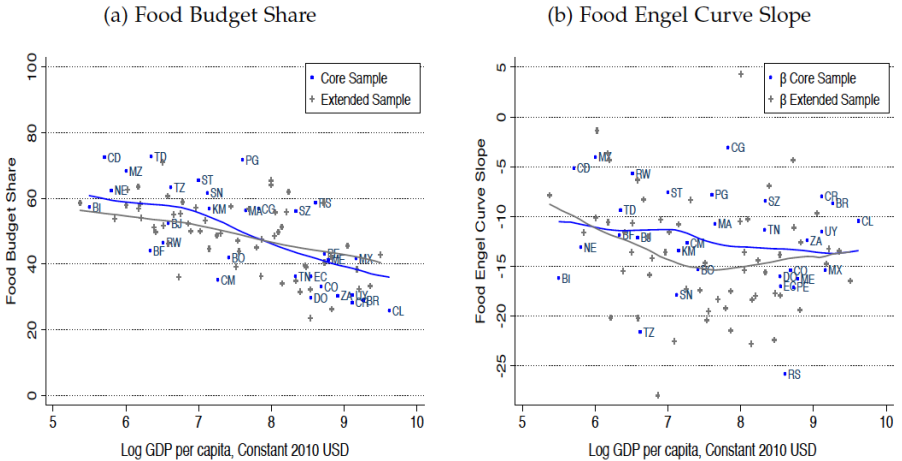
- $ShareInformal_i = \beta \ln(expenditure_i) + \varepsilon_i$

Bachas et al. (2020): Informality Engel Curves

Specification:	**Main**		**Geography**			**Product Codes**			**All**
Avg. of 31 Countries	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(Negative of) Slope	9.8	10.6	9.2	8.5	6.9	6.3	6.1	5.4	4.3
Confidence Interval	[9.2,10.4]	[9.9,11.2]	[8.5,9.9]	[7.7,9.2]	[6.2,7.4]	[5.7,6.7]	[5.5,6.5]	[4.8,5.7]	[3.7,4.7]
# of p-values < 0.05	31	31	31	30	30	29	30	29	28
R^2 adjusted	0.19	0.21	0.25	0.41	0.43	0.51	0.51	0.50	0.54
Household Characteristics		X	X	X	X	X	X	X	X
Urban/Rural			X						
Survey Blocks				X					X
Food Products					X				
COICOP 2-dig						X			
COICOP 3-dig							X		
COICOP 4-dig								X	X

- $ShareInformal_i = \beta \ln(expenditure_i) + \Gamma X_i + \varepsilon_i$

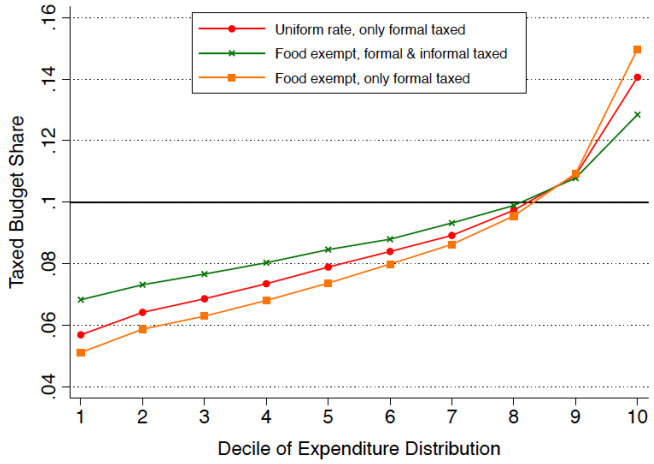
Bachas et al. (2020): Food Engel Curves



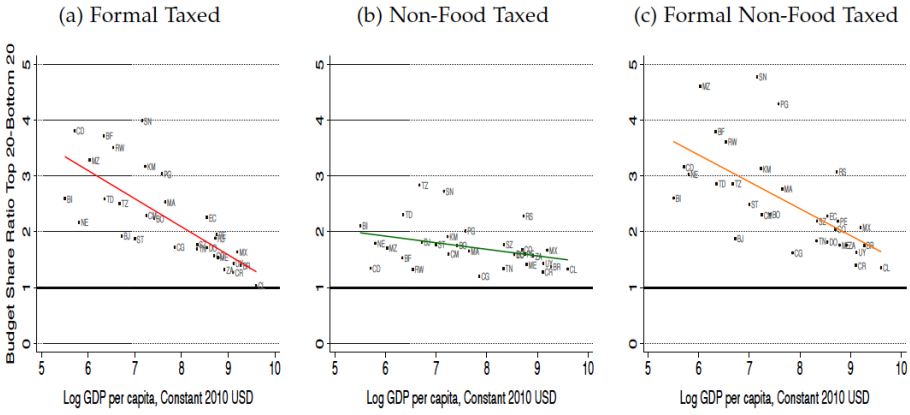
- Can we approximate informality-targeting by just exempting food? Depends how steep the food engel curve is.

Bachas et al (2020): Implications for Progressivity

Figure 5: Progressivity of Tax Policy Scenarios



Bachas et al (2020): Implications for Progressivity



Bachas et al (2020): Optimal Consumption Taxation

- The classic reference here is Diamond (1975). Extends Ramsey (1927) to many individuals.
- Recap of Ramsey (1927):
  - consumers solve

$$\max_x U(x) \;\; s.t. \sum_i q_i x_i \leq 0 \quad \Rightarrow V(q)$$

  - Government needs to finance spending of $\sum_i p_i g_i$ out of tax revenue $\sum_i t_i x_i$. Solves

$$\max_q V(q) \;\; s.t. \; F(x(q) + g) = 0$$

  - Firms are in the background maximizing profits subject to production function $F(y)$ where $y_i = x_i + g_i$
  - Optimal taxes satisfy

$$\sum_i \frac{\tau_i}{1+\tau_i} \varepsilon_{ji}^C = \theta \quad \text{(equal "discouragement")}$$

  - Special case: $\varepsilon_{ji}^C = 0 \; \forall i \neq j \Rightarrow \frac{\tau_i}{1+\tau_i} = \theta / \varepsilon_i^C$ (“inverse elasticity rule”)

Bachas et al (2020): Optimal Consumption Taxation

- Diamond (1975)
  - Many households k
  - Second best problem:

$$\max_{q,I} \sum_k \lambda^k V^k\left(q, I\right) \pi^k \; s.t. \; F\left(\sum_k h^k\left(q, V^k\left(q, I\right)\right) \pi^k + g\right) = 0$$

  where I incorporates lump-sum tax, $\lambda^k$are pareto weights, π^k population shares
  - Optimality condition:

$$\mathsf{E}_k\left[\sum_i t_i \frac{\partial h_j^k}{\partial q_i}\right] = \mathsf{Cov}_k\left[x_j^k \theta^k\right] = X_j \mathsf{Cov}_k\left(\frac{x_j^k}{X^j}, \theta^k\right) \; \forall j$$

  where X_j is aggregate demand for j; and $\theta^k = \frac{\lambda^k V_I^k}{\gamma} - 1 + \sum_i t_i \frac{\partial x_i^k}{\partial I}$ is social marginal utility of income

Bachas et al (2020): Optimal Consumption Taxation

- Setup
  - continuum of mass 1 of households i with exogenous incomes y^i
  - j goods. Each good has 2 varieties v which are imperfect substitutes. $v = 0$ if informal, $v = 1$ if formal.
  - Producer prices q_{jv} are exogenous and consumer prices are $p_{j1} = q_{j1}(1 + t_j)$ for the formal variety of good j, and $p_{j0} = q_{j0}$ for the informal variety.
  - maximization by households $\Rightarrow$ indirect utility $v(p, y^i)$
  - Denote budget share hh i spends on variety v of good j by s^i_{jv} and $s^i_j = s^i_{j0} + s^i_{j1}$ with price elasticity of demand ϵ_j
- Assumptions on preferences:
  - Compensated elasticities are equal across households.
  - zero cross price elasticities across goods, but non-zero cross-price elasticity across varieties within goods.

$$\epsilon_{j1} = \underbrace{\epsilon^C}_{\text{PED (c)}} - \underbrace{\eta_{j1} s_{j1}}_{\text{income effect}} - 2 \underbrace{\bar{\epsilon}^C}_{\text{cross-variety elasticity}} \underbrace{\alpha_j}_{\text{informal consumption share}}$$

Bachas et al (2020): Optimal Consumption Taxation

- Government Solves

$$\max_{t_j} W = \int_i G\left(v\left(p, y^i\right)\right) di + \mu \sum_j t_j q_{j1} x_{j1}$$

- Case 1: Uniform commodity tax. Only formal varieties can be taxed

$$\tau^* = \frac{t^*}{1+t^*} = \frac{\int_i \left(\bar{g} - g^i\right) \phi^i \frac{s_1^i}{s_1} di}{-\epsilon_1 \bar{g}}$$

  where g^i are the hhs' marginal welfare weights with mean $\bar{g}$, $s_1 = \sum_j \int_i s_{j1}^i di$ is agg budget share of formal varieties, and $\phi^i = y^i/\bar{y}$
- Optimal rate increasing in covariance between income and formal budget shares. Big cov means de facto exemption of informal goods is progressive.

Bachas et al (2020): Optimal Consumption Taxation

- What happens as countries get richer? Imagine "development" as
  - all households getting richer by the same proportion.
  - Budget shares change according to the Engel curves with the slopes we saw above

$$\frac{\partial \tau^*}{\tau^*} = \frac{\int_i \left(\bar{g} - g^i\right) \phi^i \frac{s_1^i}{s_1} \left(\frac{\partial s_{1i}}{s_1^i} - \frac{\partial s_1}{s_1}\right) di}{\int_i \left(\bar{g} - g^i\right) \phi^i \frac{s_1^i}{s_1} di} + \frac{\partial \epsilon_1}{\epsilon_1}$$

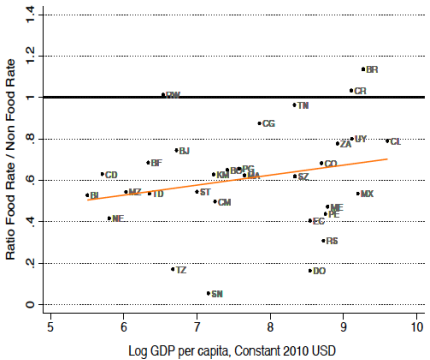
- Proposition:
  - *The redistribution gain from taxing all products uniformly is decreasing over the development path as long as i) the formal Engel curve is upward sloping, ii) the aggregate formal budget share increases more than the slope of the formal Engel curve.*
  - *The efficiency cost of taxing all products uniformly is decreasing over the development path as long as, in addition, $\tilde{\epsilon}^C > \eta_1/2$, where η_1 is the income elasticity of demand for al formal varieties and $\tilde{\epsilon}^C$ is the cross-variety price elasticity of demand.*

Bachas et al (2020): Calibration

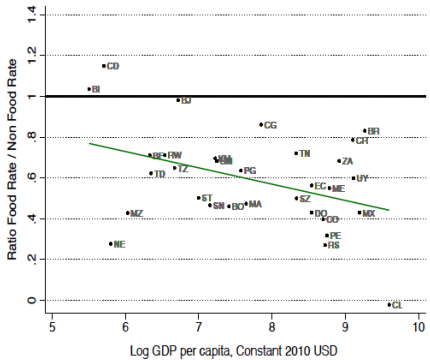
Parameter	Value	Justification
Budget shares s_j^i and s_{j1}^i	Varying	Observed in our data
Household income (scaled) ϕ^i	Varying	Observed in our data
Income elasticities of goods η_j	Food: 0.65, Non-food: 1.2	From our data, using $\eta_j = 1 + \frac{\beta_j}{s_j} 1$
Income elasticities of formal varieties η_{j1}	Food: 1.14, Non-food: 1.31, All goods: 1.25	From our data, using $\eta_{j1} = 1 + \frac{\beta_{j1}}{s_{j1}} 1$
Informal share of consumption α_j	Varying	From our data
Cross-variety compensated elasticity $\tilde{\epsilon}^C$	1.5	Faber and Fally (2017); Atkin et al. (2018b)[2]
Own-price compensated elasticity ϵ^C	-0.7	Deaton et al. (1994)[3]
Government preferences g^i	1-10	Uniform tax rates in the $[0.10, 0.25]$ range[4]

Bachas et al (2020): Calibration

(c) All Varieties Taxed, With Efficiency Change



(d) Only Formal Varieties Taxed, With Efficiency Change



Outline

Bergeron, Tourek & Weigel (2021): Motivation

- How much revenue can be raised, and the welfare effect of taxation is determined by fiscal capacity
- In the Besley & Persson formulation, fiscal capacity reduces the elasticity of the tax base by making it costlier to evade.
- If the elasticity of the tax base goes down, then the revenue-maximizing (Laffer) rate goes up
- Conduct a field experiment to test these ideas. Exploit experimental variation in
  - tax abatements (= tax rates?)
  - tax enforcement (letters, more/less effective tax collectors)

Bergeron, Tourek & Weigel (2021): Setting

- Experiment conducted in Kanaga, a large (1M pop) city in DRC.
  - Median monthly HH income in Kananga is $106.
  - DRC ranked 188th out of 200 in terms of tax/GDP
- Property tax campaign in 2018 in two steps

1. Registration visit: tell property owners about the property tax, assess high or low band property, exemption. Gave owner a letter with (randomly) assigned tax rate
2. Follow-up visits to collect the tax. Given one month to pay.

- Randomly assigned tax rates stratifying by neighborhood and tax band.

Bergeron, Tourek & Weigel (2021): Tax Rates

TABLE 1: TAX ABATEMENT TREATMENT ALLOCATION

Tax Rate Abatement Treatment Groups	Tax Rates by Type of Property			
	Low-value band properties		High-value band properties	
	Rate	N	Rate	N
Status Quo Tax Rate	3,000 CF	8,282	13,200 CF	971
17% Reduction in Tax Rate	2,500 CF	8,569	11,000 CF	1,047
33% Reduction in Tax Rate	2,000 CF	8,372	8,800 CF	1,113
50% Reduction in Tax Rate	1,500 CF	8,633	6,600 CF	1,041

Bergeron, Tourek & Weigel (2021): Data

1. Administrative data. Tax payments and property registration
2. Baseline survey: July - December 2017. Skip pattern: Visit every X properties on a street. N = 3,358
3. Midline survey: 4-6 weeks after tax collection ended. property/owner characteristics. Bribe payment and other tax payments. N = 22,667 owners plus 6,967 non-owner interviews
4. Endline survey: March-September 2019. Other tax payments, views of govt, perceptions of tax system. N= 2,760.
5. Property Value: Predicted value of 38,023 properties using ML on training sample of 1,654 properties.

Bergeron, Tourek & Weigel (2021): Results

- Estimate effect of each abatement treamtments by OLS:

$$y_{i,n} = \beta_0 + \beta_1 17\% \text{ Abatement}_{i,n} + \beta_2 33\% \text{ Abatement}_{i,n} + \beta_3 50\% \text{ Abatement}_{i,n} + \gamma_{i,n} + \delta_n + \varepsilon_i$$

where $y_{i,n}$ is outcome for individual i in neighborhood n, $\gamma_{i,n}$ indicates high-value property, δ_n are neighborhood FEs.

- To get elasticities use
-

$$y_{i,n} = \alpha + \beta \log(\text{Tax Rate}_{i,n}) + \gamma_{i,n} + \delta_n + \nu_{i,n}$$

- Convert to elasticities using

$$\hat{\varepsilon}_{y,T} = \frac{\partial y}{\partial T} \times \frac{T}{y} = \frac{\partial y}{\frac{\partial T}{T}} \times \frac{1}{y} \approx \hat{\beta} / \bar{y}_{i,n}$$

where $\bar{y}_{i,n}$ is the mean of the outcome of interest.

Bergeron, Tourek & Weigel (2021): Results

TABLE 2: TREATMENT EFFECTS ON TAX COMPLIANCE AND REVENUE

	Outcome: Tax Compliance (Indicator)				Outcome: Tax Revenue (in CF)			
	All properties		Low-value properties	High-value properties	All properties		Low-value properties	High-value properties
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Treatment Effects								
50% Reduction	0.074***	0.073***	0.076***	0.050***	28.675**	24.711*	28.270**	16.743
	(0.004)	(0.004)	(0.004)	(0.012)	(14.145)	(13.828)	(9.201)	(109.071)
33% Reduction	0.044***	0.044***	0.046***	0.026**	35.616**	34.069**	35.327***	17.659
	(0.004)	(0.004)	(0.004)	(0.010)	(15.316)	(14.937)	(9.837)	(113.175)
17% Reduction	0.011**	0.011***	0.014***	-0.013	-20.518	-20.202	6.404	-253.891**
	(0.003)	(0.003)	(0.004)	(0.009)	(14.750)	(14.420)	(10.034)	(109.150)
Mean (control)	0.056	0.056	0.057	0.046	216.903	216.903	170.611	611.74

Bergeron, Tourek & Weigel (2021): Results

Panel B: Marginal Effects								
ln(Tax Rate in CF)	-0.112***	-0.110***	-0.114***	-0.085***	-62.089***	-55.870**	-47.027***	-170.321
	(0.006)	(0.006)	(0.006)	(0.016)	(18.669)	(18.274)	(12.267)	(142.544)
Mean (sample)	0.088	0.088	0.092	0.062	229.662	229.662	188.888	560.547
Panel C: Elasticities								
Elasticity	-1.266	-1.246	-1.241	-1.37	-0.270	-0.243	-0.249	-0.304
	(0.063)	(0.061)	(0.063)	(0.232)	(0.083)	(0.081)	(0.065)	(0.247)
p-value (elasticity=0)					0.0011	0.0026	0.0001	0.2195
Observations	38028	38028	33856	4172	38028	38028	33856	4172
Sample	All properties	All properties	Low-value properties	High-value properties	All properties	All properties	Low-value properties	High-value properties
FE: Property Value Band	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE: Neighborhood	No	Yes	Yes	Yes	No	Yes	Yes	Yes

Bergeron, Tourek & Weigel (2021): Results

TABLE 3: TREATMENT EFFECTS ON COMPLIANCE — ROBUSTNESS: ACCOUNTING FOR KNOWLEDGE OF OTHERS' RATES, PAST RATES, EXPECTATIONS OF FUTURE RATES, AND PAST EXPOSURE TO TAX COLLECTION

	Outcome: Tax Compliance (Indicator)									
	Neighbors' rate		Neighbors' rate		Discounts		Past rates		Past tax campaign	
	Ctrl for 5	Ctrl for 10	Doesn't Know	Knows	Doesn't Know	Knows	Doesn't Know	Knows	No	Yes
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Treatment Effects										
50% Reduction	0.073***	0.073***	0.084***	0.093***	0.062***	0.241	0.113***	0.159*	0.081***	0.069***
	(0.004)	(0.004)	(0.008)	(0.022)	(0.012)	(0.221)	(0.023)	(0.085)	(0.007)	(0.005)
33% Reduction	0.044***	0.044***	0.055***	0.067**	0.043***	0.094	0.046**	0.084	0.042***	0.045***
	(0.004)	(0.004)	(0.007)	(0.022)	(0.011)	(0.195)	(0.022)	(0.089)	(0.006)	(0.005)
17% Reduction	0.011**	0.011**	0.006	-0.002	0.002	-0.013	-0.016	0.027	0.008	0.013**
	(0.003)	(0.003)	(0.006)	(0.020)	(0.010)	(0.161)	(0.019)	(0.088)	(0.005)	(0.004)
Mean (control)	0.056	0.056	0.071	0.104	0.064	0.114	0.079	0.143	0.055	0.056
Tests of coef. equality:										
50% Reduction			$p_{50\%}$ =0.687		$p_{50\%}$ =0.617		$p_{50\%}$ =0.455		$p_{50\%}$ =0.102	
33% Reduction			$p_{33\%}$ =0.562		$p_{33\%}$ =0.565		$p_{33\%}$ =0.551		$p_{33\%}$ =0.855	
17% Reduction			$p_{17\%}$ =0.260		$p_{17\%}$ =0.769		$p_{17\%}$ =0.487		$p_{17\%}$ =0.768	
All Reductions			$p_{All\%}$ =0.780		$p_{All\%}$ =0.785		$p_{All\%}$ =0.873		$p_{All\%}$ =0.265	

Bergeron, Tourek & Weigel (2021): Revenue-Maximizing Rate

- Consider property owners choosing between paying tax T or not paying (only extensive margin).
- If don't pay, expected cost of tax delinquency is $\alpha = p\pi$, p = pr(caught) and π = fine. α = enforcement capacity
- Also idiosyncratic utility from compliance $\Lambda \sim F(\cdot)$

$$\begin{cases} \text{Compliance if} & \Lambda > T - \alpha \\ \text{Delinquency if} & \Lambda \leq T - \alpha \end{cases}$$

- Fraction of owners who pay is

$$\mathbb{P}(T, \alpha) = 1 - F(T - \alpha) = \int_{T-\alpha}^{\infty} f(\lambda)\, d\lambda$$

- Revenue is

$$\mathbb{R}(T, \alpha) = T\mathbb{P}(T, \alpha) - \mathbb{C}(\alpha)$$

as in Besley & Persson, think of capacity as something to invest in at cost $\mathbb{C}(\alpha)$.

Bergeron, Tourek & Weigel (2021): Revenue-Maximizing Rate

- What if you raise rate by a small dT?

Mechanical Effect : $dM = \mathbb{P}(T, \alpha)\, dT$ *Behavioral Effect* : $dB = T \frac{d\mathbb{P}(T, \alpha)}{dT} dT$

- Proposition 1: Revenue-maximizing rate $(dM + dB = 0)$

$$T^* = \frac{\mathbb{P}(T^*, \alpha)}{-\left.\frac{d\mathbb{P}(T,\alpha)}{dT}\right|_{T=T^*}}$$

- Proposition 2: Revenue-maximizing enforcement capacity α^* satisfies

$$T \left.\frac{d\mathbb{P}(T, \alpha)}{d\alpha}\right|_{\alpha=\alpha^*} = \left.\frac{d\mathbb{C}}{d\alpha}\right|_{\alpha=\alpha^*}$$

- Proposition 3: Revenue-maximizing rate is increasing in enforcement capacity α

Bergeron, Tourek & Weigel (2021): Revenue-Maximizing Rate

- With this theory, estimate

$$\mathbb{P}(T, \alpha) = \beta_0(\alpha) + \beta_1(\alpha) T$$

yields maximizing rate

$$T^* = \frac{\beta_0(\alpha)}{-2 \times \beta_1(\alpha)}$$

- Also consider quadratic specification

$$\mathbb{P}(T, \alpha) = \beta_0(\alpha) + \beta_1(\alpha) T + \beta_2(\alpha) T^2$$

with accompanying maximizing rate

$$T^* = \frac{-2\beta_1(\alpha) - \sqrt{(2\beta_1(\alpha))^2 - 4 \times \beta_0(\alpha \times 3\beta_2(\alpha))}}{-2 \times 3\beta_2(\alpha)}$$

Bergeron, Tourek & Weigel (2021): Results

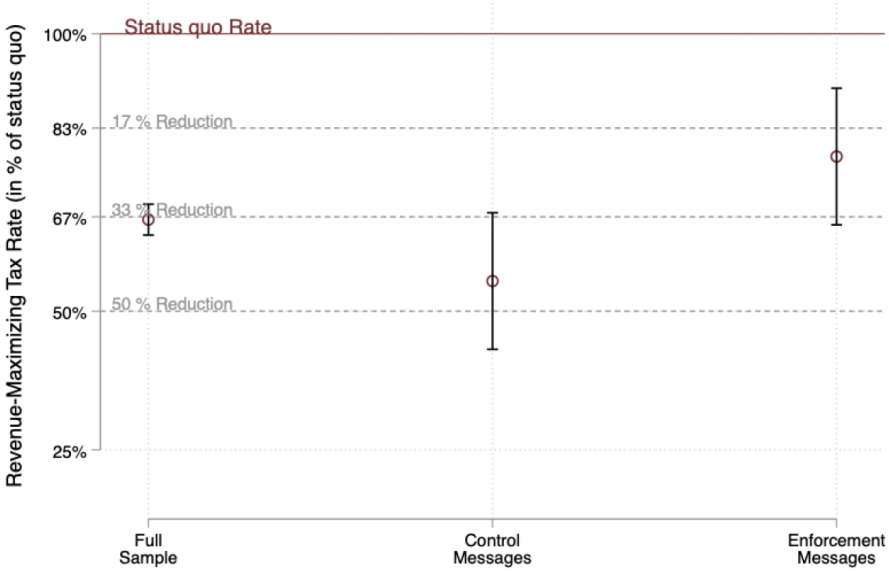
	Linear Specification		Quadratic Specification	
	(1)	(2)	(3)	(4)
Panel A: Effect of Tax Rates on Tax Compliance				
Tax Rate (in % of status quo)	-0.154***	-0.152***	-0.410***	-0.391***
	(0.008)	(0.008)	(0.080)	(0.077)
Tax Rate Squared (in % of status quo)			0.171***	0.160**
			(0.051)	(0.049)
Constant	0.203***	0.202***	0.293***	0.293***
	(0.006)	(0.006)	(0.029)	(0.028)
Panel B: Revenue-Maximizing Tax Rate (RMTR)				
RMTR (in % of status quo rate)	0.661	0.665	0.541	0.553
	(0.014)	(0.014)	(0.045)	(0.046)
Implied Reduction in Tax Rate	33.93%	33.50%	45.95%	44.71%
Observations	38028	38028	38028	38028
Sample	All properties	All properties	All properties	All properties
FE: Property Value Band	Yes	Yes	Yes	Yes
FE: Neighborhood	No	Yes	No	Yes
Quadratic Tax Rate Term	No	No	Yes	Yes

Bergeron, Tourek & Weigel (2021): Enforcement Letters

- During registration, property owners get letters with information about the property tax and rate.
- Some also received a randomized enforcement message

1. *"Refusal to pay the property tax entails the possibility of audit and ivestigation by the provincial tax ministry"*
2. *"Refusal to pay the property tax entails the possibility of audit and ivestigation by the chef de quartier"*

Bergeron, Tourek & Weigel (2021): Results



Bergeron, Tourek & Weigel (2021): Randomized Tax Collectors

- Tax collectors also randomized to neighborhoods. Use fixed effects specification to estimate enforcement capacity of collector c

$$y_{in} = \sum_{c} E_c \mathbf{1}\left[c\left(n\right) = c\right] + \delta_{i,n} + \varepsilon_{in}$$

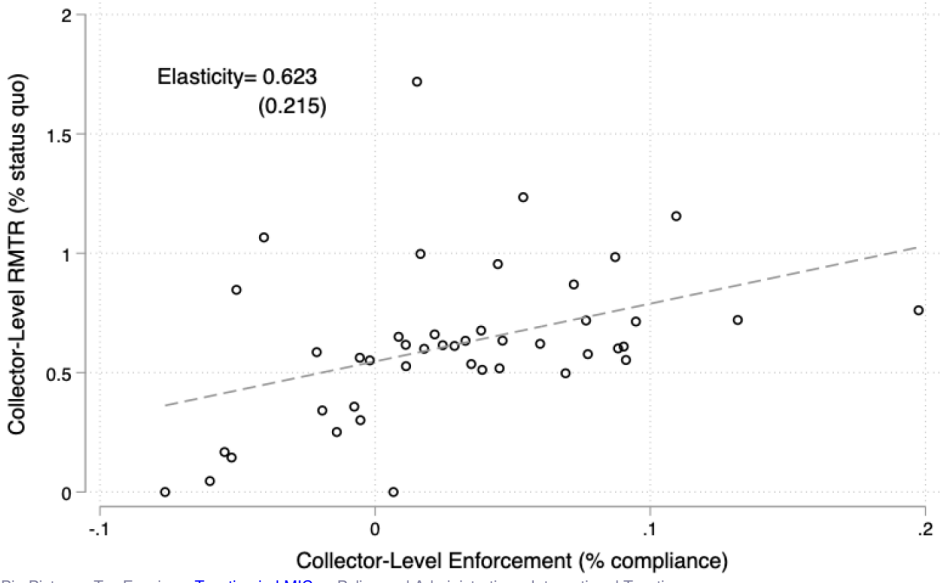
- Now can estimate collector-specific RMTRs:

$$y_{i,n} = \sum_{c} \beta_c^0 \mathbf{1}\left[c\left(n\right) = c\right] + \sum_{c} \beta_c^1 \mathbf{1}\left[c\left(n\right) = c\right] \times \text{Tax Rate}_{i,n} + \delta_{i,b} + \varepsilon_{i,n}$$

yielding RMTRs

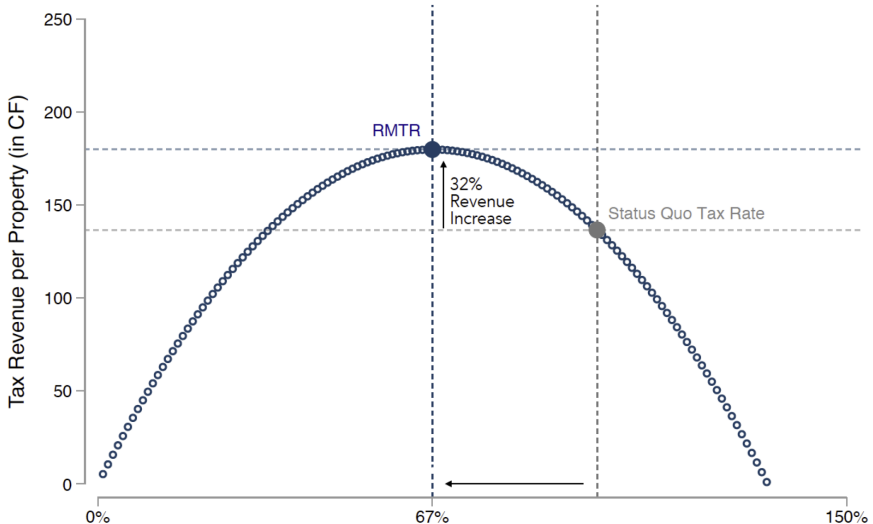
$$T_c^* = \frac{\beta_c^0}{-2 \times \beta_c^1}$$

Bergeron, Tourek & Weigel (2021): Results



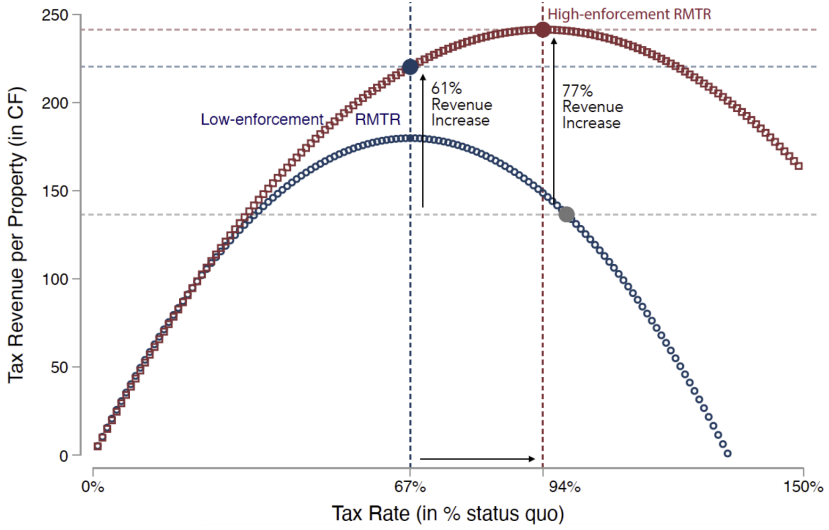
Bergeron, Tourek & Weigel (2021): Laffer Curve

A: Setting Tax Rates at the Revenue-Maximizing Rate



Bergeron, Tourek & Weigel (2021): Enforcement and RMTR

Imagine replacing bottom 25% of tax collectors with average



Outline

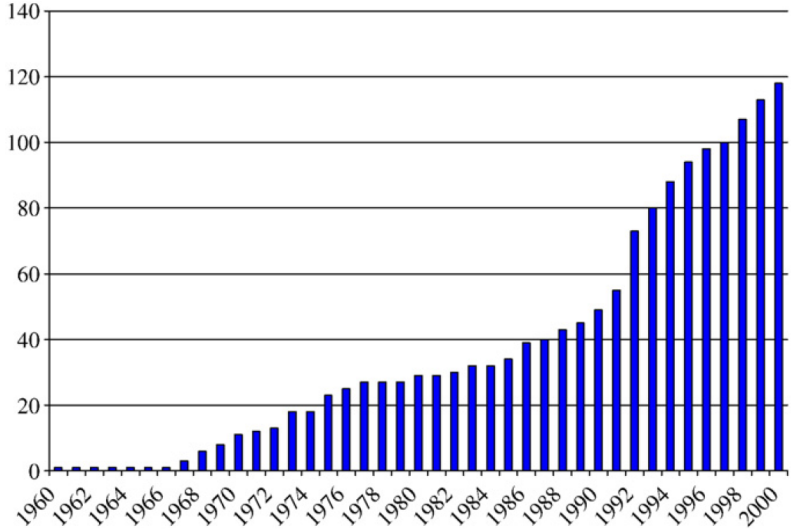
Various Ways to Tax Sales

- **Turnover Taxes** used to tax all sales: business to consumer (B-C) and business to business (B-B): Creates multiple layers of taxes along a production chain
  $\Rightarrow$ Higher total tax when B-B-C than B-C: *cascading*
  production inefficient

- **Retail Sales Tax** imposed on B-C sales only [B-B] exempt: difficult to distinguish B-B and B-C (shifting), strong evasion incentive for B-C [ST doesn't work well with small retailers]
  production efficient, but hard to enforce

- Value-Added-Tax (VAT) taxes only value added [sales minus purchases] in all transactions (B-B and B-C): equivalent to retail sales tax economically, but easier to enforce [automatic upstream enforcement]
  production efficient, but easier to enforce?

Spread of the VAT Around the World



Source: Keen & Lockwood (JPubE 2009)

Pomeranz (2015): Self-Enforcing Properties of the VAT

- Consider a value chain of firms indexed by $i \in 1, 2, \ldots, N$. Tax liability is $\tau_v (s_i - c_i)$
- When i trades with $i+1$, $i+1$ wants a receipt (paper trail) from i to deduct s_i from its costs c_{i+1}
- Mechanism breaks down at firm N. No firm $N+1$, instead, a consumer with no incentive to request receipt.
- Firms don't actually report every sale in most countries. Paperwork could be uncovered in an audit $\Rightarrow$threat of audit should affect evasion.
- 2 types of evasion:

1. Unilateral evasion: $\hat{c}_i > c_i$ or $\hat{s}_i < s_i \Rightarrow \hat{c}_i > \hat{s}_{i-1}$ or $\hat{s}_i < \hat{c}_{i+1}$
2. Collusive evasion: $\hat{c}_i \neq c_i$ but $\hat{c}_i = \hat{s}_{i-1}$ or $\hat{s}_i \neq s_i$ but $\hat{s}_i = \hat{c}_{i+1}$

Pomeranz (2015): Audit Threat Predictions

TABLE 1—RESPONSES TO INCREASE IN AUDIT PROBABILITY: COLLUSIVE AND UNILATERAL EVASION

Position in supply chain	Collusive evasion		Unilateral evasion	
Supplier	Sales ↑	VAT ↑	Sales ↑	VAT ↑
Treated firm	Inputs ↑ Sales ↑	VAT (↑)	Inputs ↓ Sales ↑	VAT ↑
Client	Inputs ↑	VAT ↓	Inputs ↓	VAT ↑

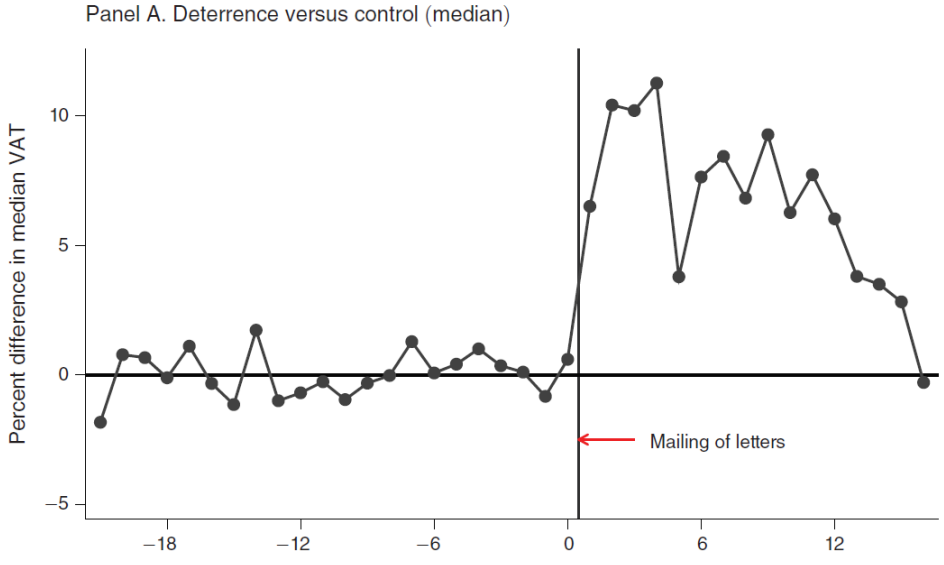
Pomeranz (2015): Experiment 1-Threat of Audit Letters

- Sent letters to VAT-liable firms in Chile from the tax authority
  - Letter 1: Deterrence (N=102,031)
  - Letter 2: Tax Morale (N=18,579)
  - Letter 3: Placebo (N=18,519)
  - Control Group (N=306,605)
- Look for differential effects on transaction types/firm types

Pomeranz (2015): Experiment 2-Spillovers

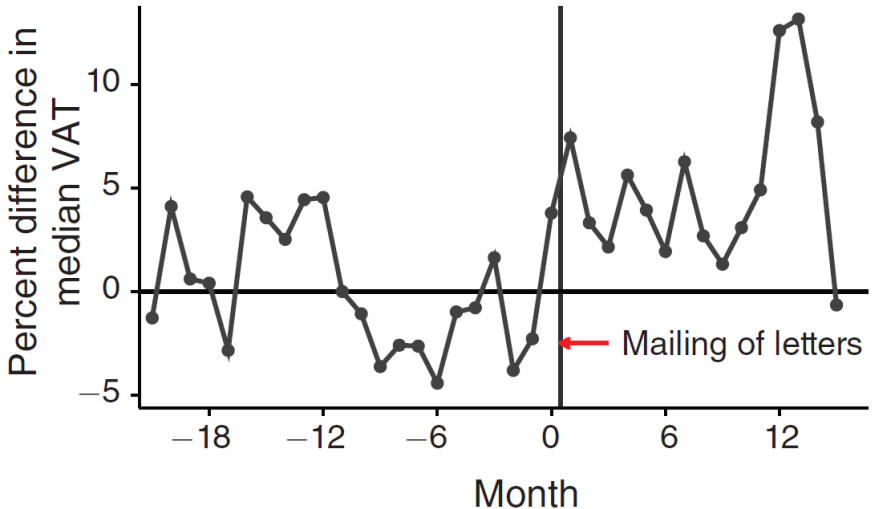
- Look directly for spillovers onto trading partners
- Sample of 5,600 suspected evaders already chosen for audit
- Randomly preannounce audit to half of them
- During audit, auditors gather data on trading partners
- Look at VAT declarations before and after announcement of audit of trading partners

Pomeranz (2015): Experiment 1 Results

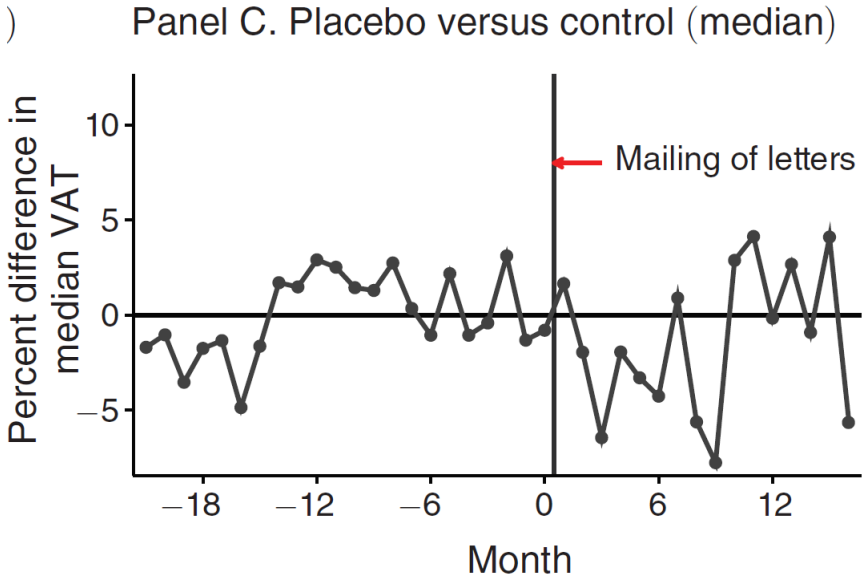


Pomeranz (2015): Experiment 1 Results

Panel B. Motivational versus control (median



Pomeranz (2015): Experiment 1 Results



Pomeranz (2015): Experiment 1 Results

	Percent sales > previous year (1)	Percent input costs > previous year (2)	Percent intermediary sales > previous year (3)	Percent final sales > previous year (4)
Deterrence letter × post	1.17***	0.16	0.12	1.33***
	(0.22)	(0.21)	(0.19)	(0.21)
Constant	55.39***	53.25***	38.37***	45.04***
	(0.13)	(0.13)	(0.12)	(0.12)
Month fixed effects	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes
Observations	2,392,529	2,392,529	2,392,529	2,392,529
Number of firms	133,156	133,156	133,156	133,156
Adjusted R^2	0.25	0.22	0.30	0.32

Pomeranz (2015): Experiment 2 Results

	Percent VAT > previous year (1)	Percent VAT > predicted (2)	Percent VAT > previous year (3)	Percent VAT > predicted (4)	Percent VAT > previous year (5)	Percent VAT > predicted (6)
Audit announcement × post	2.41**	2.03*				
	(1.14)	(1.11)				
Audit announcement × supplier × post			4.28***	3.92***	4.14***	3.83***
			(1.54)	(1.50)	(1.52)	(1.52)
Audit announcement × client × post			−0.26	−0.28	−0.14	−0.28
			(1.64)	(1.51)	(1.67)	(1.55)
Supplier × post			−0.64	0.34	−1.11	0.60
			(1.62)	(1.59)	(1.67)	(1.64)
Constant	52.07***	49.06***	52.07***	49.06***	52.75***	50.11***
	(0.95)	(0.94)	(0.95)	(0.94)	(0.96)	(0.96)
Controls × post	No	No	No	No	Yes	Yes
Controls × audit announcement × post	No	No	No	No	Yes	Yes
Month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	45,264	45,264	45,264	45,264	44,288	44,288
Number of firms	2,829	2,829	2,829	2,829	2,768	2,768
Adjusted R^2	0.05	0.11	0.05	0.11	0.05	0.10

Outline

Naritomi (2018): Overview

- Kleven et al (2011) shows how important third-party information is for suppressing evasion.
- Pomeranz (2015) shows that audit (threats) spill over onto firms connected through paper trails.
- What happens when there's an increase in the level of third-party information?
- Naritomi (2018) studies the impact of a program in Sao Paulo, Brazil that increases third-party information on firms' sales:
- When consumers got a receipt for their purchases, the receipt acted as a lottery ticket.

Naritomi (2018): Model

- Consider an Allingham-Sandmo style model with only government monitoring
- When firms evade an amount $E = \overline{Y} - Y$, they are audited with probability $a(E)$. If audited, evasion is detected with probability d

$\Rightarrow$ Caught evading with probability $p = a(E)\, d$, $p'(E) > 0$.

$$Y^* = \arg\max_Y \pi = \left(\overline{Y} - \tau Y\right)(1-p) + \left[(1-\tau)\,\overline{Y} - \theta\tau\left(\overline{Y} - Y\right)\right] p$$

with FOC

$$\left[a(E) + a'(E) \cdot E\right] d\,(1+\theta) = 1$$

(same as in Kleven *et al.* 2011)

Naritomi (2018): Model

- Now add in consumer monitoring. Consumers receive reward $\alpha \in [0, 1]$ share of the tax τ that firms pay on the transaction.
- Consumers value the rewards at $\kappa(\alpha) \geq 0$.
  - $\kappa(0) = 0$ = government monitoring only.
  - with rewards, why might $\kappa(\alpha) \neq \alpha$?
- Firms and consumers can split the surplus from not issuing a receipt. Assume firms make take it or leave it offer of a discount $(\overline{y} - y)$ to the consumer. Consumer accepts if discount matches the reward $\kappa(\alpha)\tau(\overline{y} - y)$

Naritomi (2018): Model

- With probability $\varepsilon > 0$ the discount bargaining breaks down and the consumer blows the whistle on the firm, triggering an audit. With N consumers probability of detection is now

$$d_c(N) = 1 - (1-d)(1-\varepsilon)^N \geq d$$

- To attempt to strike a deal with a consumer has a fixed cost of ρ. Evasion requires colluding with all consumers (can be relaxed)

$$Y^{**} = \arg\max_Y \pi = \left(\overline{Y} - \tau Y\right)(1-p_c) + \left[(1-\tau)\overline{Y} - \theta\tau\left(\overline{Y} - Y\right)\right] p_c$$
$$- \underbrace{\kappa(\alpha)\,\tau\left(\overline{Y} - Y\right)}_{\text{discounts}} - \underbrace{\rho N}_{\text{fixed cost}}$$

Naritomi (2018): Model

- Now optimal evasion satisfies

$$\left[a + a'(E) \cdot E\right] d_c (1 + \theta) = 1 - \kappa(\alpha)$$

- The MC (LHS) is higher: $d_c \geq d$
- The MB (RHS) is lower: $\kappa(\alpha) \geq 0$.
- Fixed cost ρN affects extensive margin (comply fully vs optimal evasion)
- Revenue effects:
  - Lottery costs $\alpha\tau Y^{**}$
  - Revenue increase is $\tau(Y^{**} - Y^{*})$
  - Need $(Y^{**} - Y^{*})/Y^{*} > \alpha/(1 - \alpha)$

Naritomi (2018): Context

- Sao Paulo's *Nota Fiscal Paulista* (NFP) program
- Created in 2007 to increase VAT compliance
- Introduced targeted incentives for consumers to ensure firms report final sales
- Targets 2 types of evasion
  - not reporting a transaction at all
  - underreporting the transaction value
- Consumers report their SSN at time of purchase. SSN attached to receipt sent to tax authority
- Receipts give consumers
  - 30% tax rebate
  - a lottery ticket for every US$50 spent (prizes from $5 to $500,000)

Naritomi (2018): Context

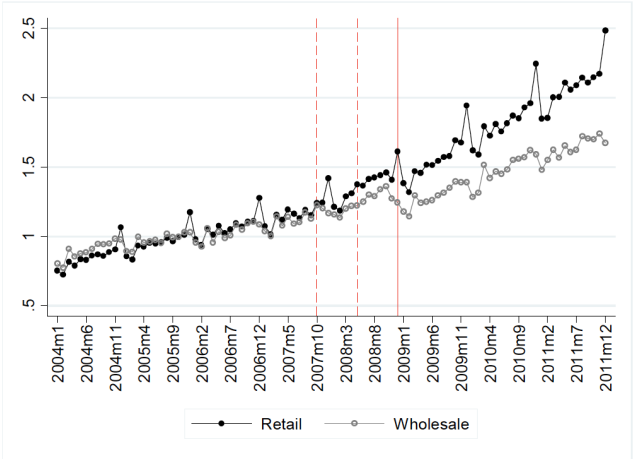
- Timeline:
  - NFP rolled out 10/2007–12/2008
  - Rebates every 6 months from 4/2009
  - Lotteries ~15th of every month from 12/2008

Naritomi (2018): Data

- Admin data on firms' tax returns (sales, costs, taxes etc.)
- Receipts reported through NFP (consumer ID, firm ID, amount)
- Complaints (whistleblowers) issued through NFP
- Lottery results

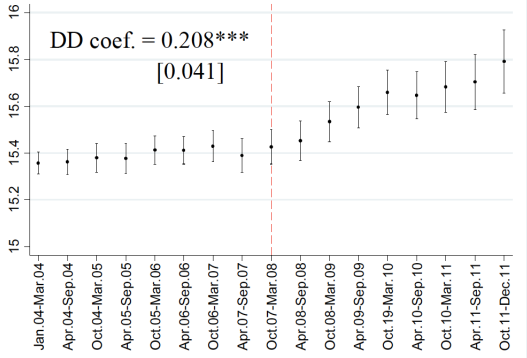
Naritomi (2018): Results

- Firm Sales. Compare retailers to wholesalers.



a. Raw data: reported revenue changes

Naritomi (2018): Results



b. Difference coefficients for 6-month time bins

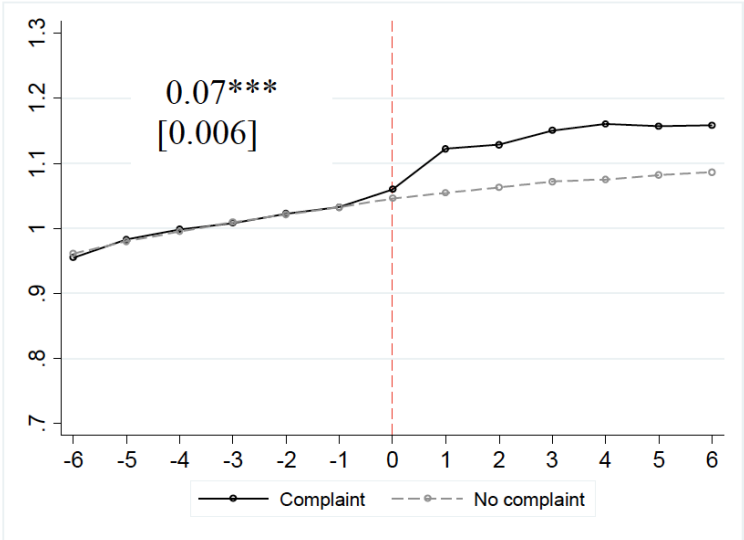
- Aggregate firm data to 7-digit-sector $\times$ 6-months. Run

$$\ln R_{st} = \eta_s + \gamma_t + \sum_{k=-8}^{8} \beta^k \left(Treat_s \cdot Period_t^k \right) + u_{st}$$

Naritomi (2018): Results

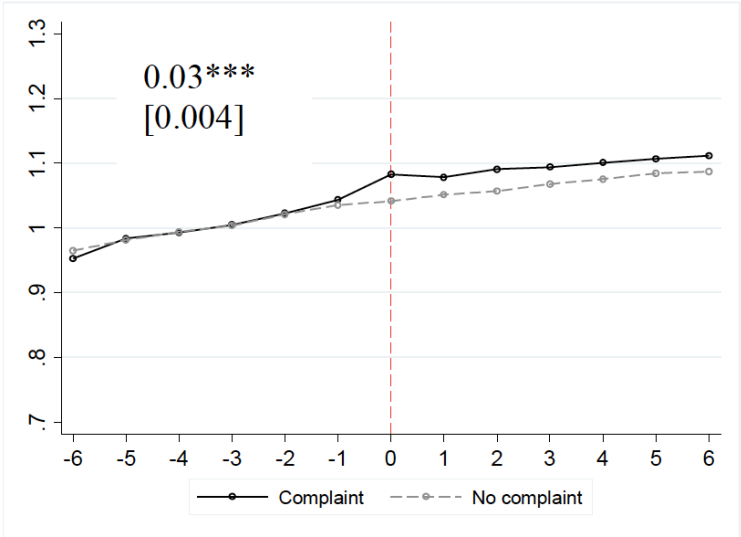
	log Reported Revenue				
	[1]	[2]	[3]	[4]	[5]
DD (Post Oct 07 * Retail)	0.254***				
	[0.0722]				
DD * Large firms		0.253***			
		[0.0732]			
DD * Small firms		0.350***			
		[0.0511]			
DD * High volume of different consumers			0.246***		
			[0.0705]		
DD * Low volume of different consumers			0.0329		
			[0.0919]		
DD * High volume of transactions				0.253***	
				[0.0335]	
DD * Low volume of transactions				0.0181	
				[0.0391]	
DD * High value of transactions					0.0969
					[0.0689]
DD * Low value of transactions					0.285***
					[0.0754]
3rd-order polynomial of firm size * DD			X	X	X
Time FE	X	X	X	X	X
Firm FE	X	X	X	X	X
Observations	1,035,268	1,035,268	1,035,268	1,035,268	1,035,268
Adjusted R-squared	0.907	0.907	0.908	0.909	0.908

Naritomi (2018): Whistleblower Results



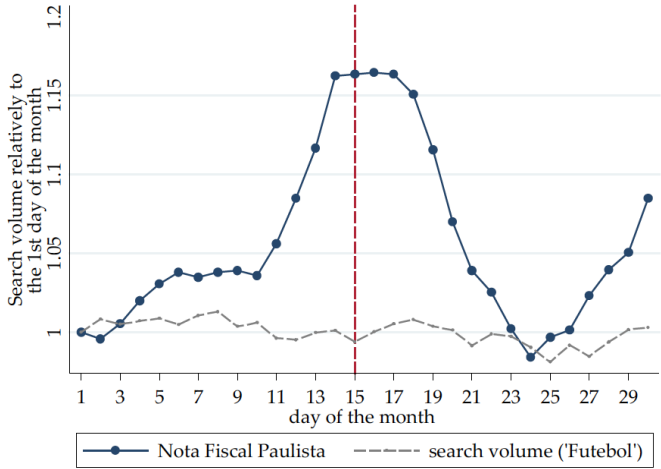
a. Changes in the number of receipts issued

Naritomi (2018): Whistleblower Results



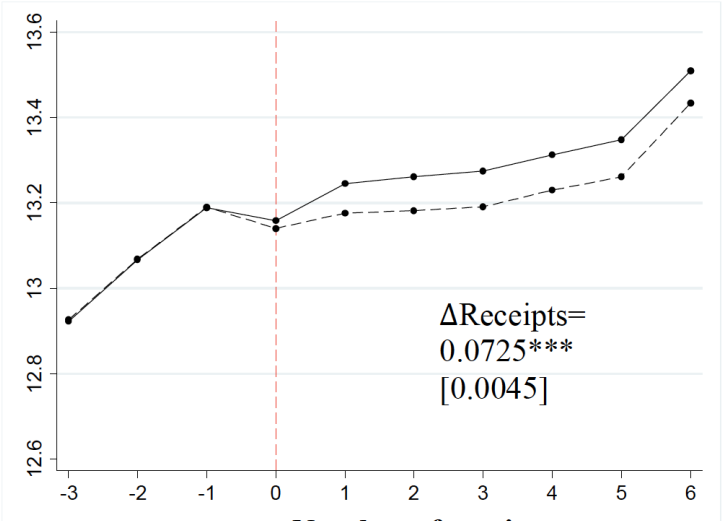
b. Changes in reported revenue

Naritomi (2018): Lottery Salient?

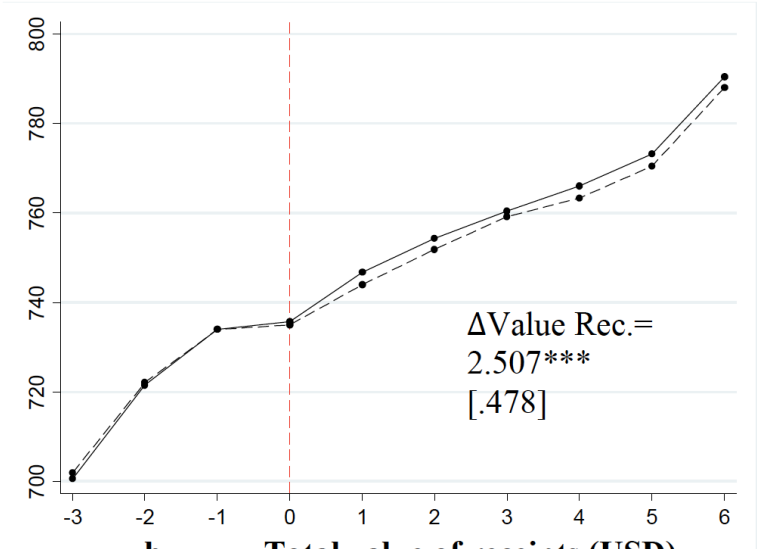


a: Timing of lottery results - Google searches for *Nota Fiscal Paulista*.

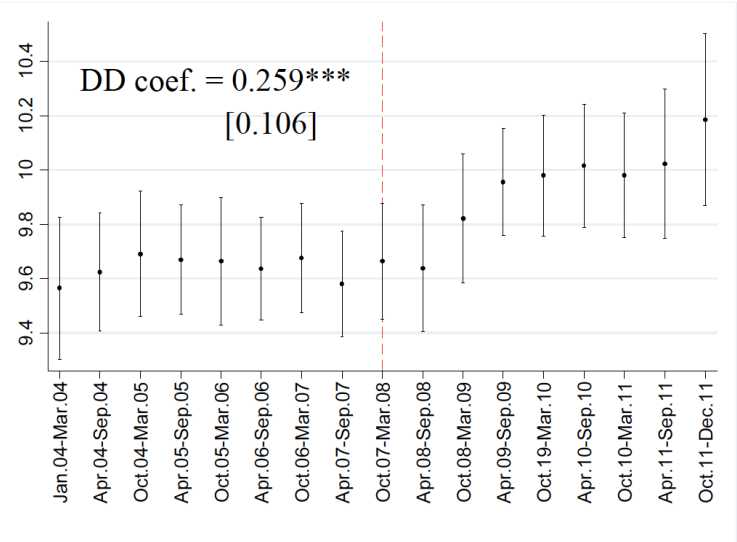
Naritomi (2018): Lottery Event Study Results



Naritomi (2018): Lottery Results



Naritomi (2018): Effects on Government Revenue



a. Tax liabilities – Retail vs Wholesale

Naritomi (2018): Effects on Government Revenue

Panel A: Tax sample

	Log of Reported Revenue [1]	Log of Tax Liability [2]	Positive tax liability [3]
DD (Post Oct 07 * Retail)	0.311**	0.316**	0.0434
	[0.151]	[0.137]	[0.0350]
Firm FE	X	X	X
Time FE	X	X	X
Observations	167,110	133,950	167,110
Adjusted R-squared	0.85	0.876	0.801

Panel B: Expenses, output and value added - firms that were always VAT

	Log of Reported Revenue [1]	Log of Reported Inputs [2]	Log of Reported Value Added [3]	Positive Value Added [4]
DD (Post Oct 07 * Retail)	0.363***	0.302***	0.387***	0.0192
	[0.0824]	[0.0833]	[0.105]	[0.0153]
Firm FE	X	X	X	X
Time FE	X	X	X	X
Observations	88,422	88,422	70,845	88,422
Adjusted R-squared	0.87	0.85	0.90	0.71

Outline

Ulyssea (2018): Motivation

- Informality is widespread, especially in low- and middle-income countries.

Size of the Informal Economy by Alternative Measures

Country		*Measure of informality*				
Income quartile	*GDP/ population*	*% GDP informal (World Economic Forum)*	*% Tax evasion (Enterprise Survey)*	*% Self-employment*	*% GDP informal (electricity consumption)*	*Registered firms/ population (1,000s)*
Bottom	429	35.4	29.0	46.4	38.9	3.2
Second	1,362	33.7	23.3	35.7	42.7	8.2
Third	4,002	27.6	19.7	23.1	31.3	28.7
Top	20,348	17.3	8.2	13.3	17.6	41.8
Sample mean	10,015	27.6	22.5	26.5	29.0	24.7
Difference 1st vs. 4th quartile	−19,919*	−18.1*	−20.8*	−33.1*	−21.4*	38.7*
Observations	185	125	95	133	57	83

Source: La Porta and Shleifer (2008).

Ulyssea (2018): Motivation

- What are the implications of widespread informality for the economy? How can policymakers respond?
- High informality $\rightarrow$ widespread tax evasion $\rightarrow$ small budget for public goods provision
- Informality may distort firm decisions such as labor input choices (see also Best *et al*. 2015).
- Informality may permit small, unproductive firms to compete with large, productive, formal firms $\rightarrow$ misallocation of resources across firms (Hsieh & Klenow, 2009)
- Informality provides de facto freedom from burdensome/inefficient regulations

Ulyssea (2018): Overview

- Propose a model to capture these phenomena with two features:
  1. Firms choose whether to register: *extensive margin* of informality
  2. Firms choose how many of their workers to register: *intensive margin* of informality
- Model encompasses and can quantify three views of informal firms:

1. Informal firms as reservoir of productive entrepreneurs deterred by high regulatory costs
2. Informal firms as “parasite firms” earning rents by evading taxes and regulations
3. Informal firms as a survival strategy for low-skill individuals

- Conduct counterfactual policy simulations to (i) reduce entry costs; (ii) reducing payroll taxes on formal workers; (iii) increase cost of informality by raising enforcement on extensive margin (iv) raise enforcement on intensive margin.

Ulyssea (2018): Stylized Facts

- Use 3 datasets

1. *Pesquisa de Economia Informal Urbana (ECINF):* a repeated (1997 and 2003) cross section of small (≤ 5 workers) firms
2. *Registro Anual de Informações Sociais (RAIS):* administrative employer-employee matched social security data
3. National Household survey (PNAD): repeated cross-section of households

Ulyssea (2018): Formal firms are bigger and more productive

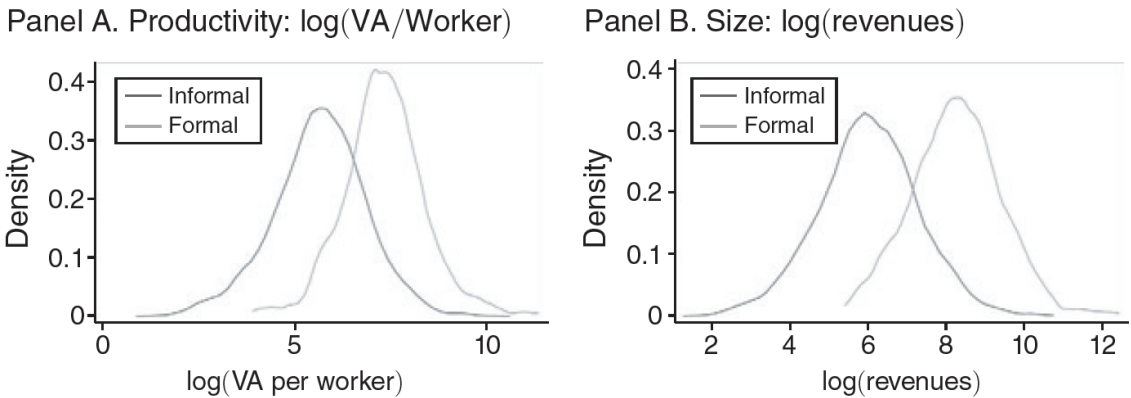


FIGURE 1. PRODUCTIVITY AND SIZE DISTRIBUTIONS AMONG ENTRANTS

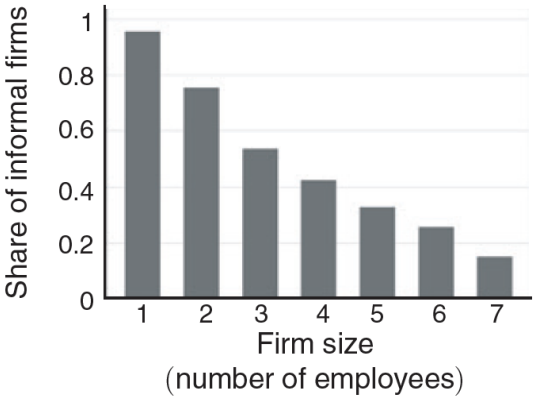
Ulyssea (2018): Worker Selection

TABLE 2—FORMAL-INFORMAL WAGE GAPS USING HOUSEHOLD SURVEYS AND MATCHED EMPLOYER-EMPLOYEE DATA

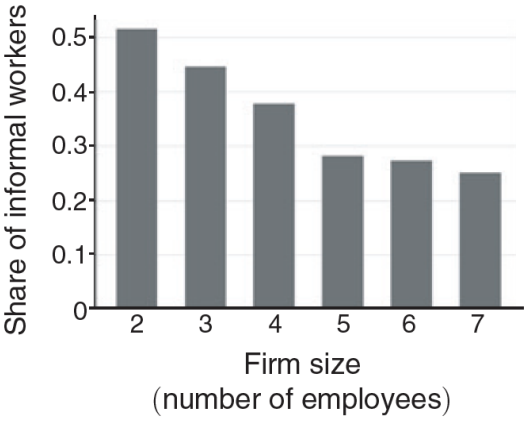
	log(*wage*)		
	PNAD (1)	ECINF (2)	ECINF (3)
Formal contract (dummy)	0.2864	0.2413	0.0311
	(0.007)	(0.030)	(0.080)
High skill (dummy)	0.4583	0.1373	0.0921
	(0.006)	(0.031)	(0.0519)
Male (dummy)	0.2980	0.1256	0.1793
	(0.007)	(0.035)	(0.0434)
Age (years)	0.0740	0.0674	0.0365
	(0.002)	(0.007)	(0.010)
Age squared	−0.0008	−0.0007	−0.0003
	(0.000)	(0.000)	(0.000)
Observations	60,899	4,502	2,675
R^2	0.446	0.401	0.872
Firm fixed effects	No	No	Yes

Ulyssea (2018): Informality Margins and Firm Size

Panel A. Extensive margin



Panel B. Intensive margin



Ulyssea (2018): Model

- Heterogeneous firms indexed by their productivity θ face competitive product and labor markets.
- Produce using only labor

$$y(\theta, l) = \theta q(l)$$

- Informal firms avoid labor and other taxes but at cost wedge $\tau_i(l)$ (with $\tau_i' > 0$ and $\tau_i'' > 0$).
- Profits of informal (incumbent) firms are then

$$\Pi_i(\theta, w) = \max_l \{\theta q(l) - w\tau_i(l)\}$$

Ulyssea (2018): Formal Incumbents

- Formal firms have to comply with regulations/taxes, but can still hire (some) workers off the books
- Wedge on hiring informal workers is $\tau_{fi}(l)$ (with $\tau'_{fi} > 0$ and $\tau''_{fi} > 0$) while formal workers cost $(1 + \tau_w) w$
  - as a result, firms start out hiring informal workers and at some point $\tilde{l}$ the marginal cost of formal workers is cheaper so they switch and start hiring formal workers
- Profits are

$$\Pi_f(\theta, w) = \max_l \{(1 - \tau_y) \theta q(l) - C(l)\}$$

where

$$C(l) = \begin{cases} \tau_{fi}(l) w & \text{for } l \leq \tilde{l} \\ \tau_{fi}\left(\tilde{l}\right) w + (1 + \tau_w)\left(l - \tilde{l}\right) & \text{for } l > \tilde{l} \end{cases}$$

- Firms also pay per-period fixed costs of operation $\bar{c}_s$, $s \in (i, f)$

Ulyssea (2018): Entry

- Each period, a mass M of potential entrants chooses whether or not to enter.
- Observe signal $v \sim G$ of potential productivity if enter
- Entering requires paying fixed entry cost $0 < E_f < E_i$
- Upon entry draw realized productivity from $F(\theta|v)$ with $\partial F/\partial v < 0$
- After entry, face exogenous exit probabilities κ_s
- If productivity is too low, can stop producing and exit immediately, so value of a firm (normalizing discounting to 1) is

$$V_s(\theta, w) = \max\left\{0, \frac{\pi_s(\theta, w)}{\kappa_s}\right\}$$

Ulyssea (2018): Entry

- Therefore ex-ante value of a signal v is

$$V_s^e(v, w) = \int V_s(\theta, w)\, dF(\theta|v)$$

- Enter formal sector if $V_f^e(v, w) - E_f > \max\{V_i^e(v, w) - E_i, 0\}$
- Enter informal sector is $V_i^e(v, w) - E_i > \max\left\{V_f^e(v, w) - E_f, 0\right\}$
- Free entry conditions:

$$V_i^e(\bar{v}_i, w) = E_i$$
$$V_f^e(\bar{v}_f, w) = V_i^e(\bar{v}_i, w) + (E_f - E_i)$$

Ulyssea (2018): Equilibrium

- Close the model: representative household supplies $\bar{L}$ units of labor inelastically. No savings, no disutility from work $\rightarrow$ consumption = welfare
- Consumption is $w\bar{L} + \Pi + T$ (where Π is net of entry costs and wedges).
- Measure of entrants is $M_i = [G(\bar{v}_f) - G(\bar{v}_i)]\, M$ and $M_f = [1 - G(\bar{v}_f)]\, M$
- Look for a stationary equilibrium: all aggregate variables are constant.
- Total number of active firms μ_s is constant:

$$\mu_s = \frac{1 - F_{\bar{\theta}_s}\left(\bar{\theta}_s\right)}{\kappa_s} M_s$$

- Equilibrium satisfies (i) labor market clearing: $L_i + L_f = \bar{L}$; (ii) zero profits of marginal entrants: $\pi_s\left(\bar{\theta}_s, w\right) = 0$; (iii) free entry conditions $V_s^e\left(\bar{v}_s, w\right) = E_s$; (iv) both sectors constant sizes μ_s

Ulyssea (2018): Estimation

- Roadmap for Estimation

1. Parameterize remaining functions
2. Calibrate first set of parameters from external data
3. Estimate remaining parameters using Simulated Minimum Distance (SMD) estimator

Ulyssea (2018): Estimation: Parameterize Remaining Functions

- Pre-entry productivity assumed Pareto:

$$F_v\left(v \geq x\right) = \begin{cases} \left(\frac{v_0}{x}\right)^{\xi} & \text{for } x \geq v_0 \\ 1 & \text{for } x < v_0 \end{cases}$$

- Actuall productivity $\theta = \varepsilon v$, $\varepsilon \sim$log-Normal with mean 0 and variance σ^2
- Production: $y\left(\theta, l_s\right) = \theta l_s^{\alpha}$
- Wedges: $\tau_i\left(l_i\right) = \left(1 + \frac{l_i}{b_i}\right)$ and $\tau_{fk} = \left(1 + \frac{l_{fk}}{b_{fk}}\right) l_{fk}$ ($k = 1, 2$ in the paper there are two types of worker)
- Fixed costs $\bar{c}_s = \gamma_s w_2,\ 0 < \gamma_s \leq 1$
- Full set of parameters $\Gamma = \{\psi, \varphi\}$
  - ψ = parameters to calibrate
  - φ = parameters to estimate

Ulyssea (2018): Estimation: Calibration

- Paraeters to calibrate $\psi = \{\tau_w, \tau_y, \kappa_f, v_0, \gamma_f\}$
- Taxes set to statutory rates $\tau_w = 0.375,\ \tau_y = 0.293$
- Exit probability from RAIS data $\kappa_f = 0.129$
- Pareto scale parameter v_0 picked so smallest firm has 1 worker
- Fixed cost of operation set to half a monthly wage $\gamma_f = 0.5$

Ulyssea (2018): Estimation: SMD

- Estimation parameters $\varphi = \{\kappa_i, \gamma_i, b_i, b_{f,1}, b_{f,2}, \eta_f, \eta_i, \rho, \xi, \alpha, E_f, E_i, \sigma\}$
- How does SMD work? Calculate some moments in the data and pick the parameters of the model so that simulating from the model matches the moments
  1. Fix all parameters Γ, wages w_1, w_2 and productivity shocks for all firms $v_j, \varepsilon_j \rightarrow$ model completely characterizes behavior
  2. Simulate data from this model by drawing shocks
  3. Calculate the same moments you want to match in the data
  4. Update parameters
  5. Find the parameters that minimizes distance (quadratic form with "optimal weights") between simulated model and real data
- Define $\hat{m}_N = \frac{1}{N}\sum_{i=1}^{N} m_i$ the moments computed from the real data, and $\tilde{m}_S(\varphi;\psi) = \sum_{s=1}^{S} \tilde{m}_s(\varphi;\psi)$ the moments from S series of simulated data.
- Define $g_{NS}(\varphi;\psi) = \hat{m}_N - \tilde{m}_S(\varphi,\psi)$ then the SMD estimator solves

$$\hat{\varphi} = \arg\min_{\varphi} Q(\varphi;\psi) = \left\{ g_{NS}(\varphi,\psi)' \mathbf{W}_N g_{NS}(\varphi,\psi) \right\}$$

Ulyssea (2018): Estimation: SMD

- Use 16 moments from the data:
- informality shares of low-skill, high-skill, overall employees (PNAD)
- overall share of informal firms and by firm size (1-2,3-4,5-10 employees) (ECINF/RAIS)
- average share of informal workers in formal firms of size 2-3 and 4-5 workers (ECINF)
- share of informal firms with ≤ 2 and ≤ 5 workers (ECINF)
- share of formal firms with $\leq 5, 5-10, 11-20, 21-50, >50$ workers (RAIS)

Ulyssea (2018): Results: Parameter Values

TABLE 3—PARAMETER VALUES

Parameter	Description	Source	Value	SE
First step				
τ_w	Payroll tax	Statutory values	0.375	—
τ_y	Revenue tax	Statutory values	0.293	—
κ_f	Formal sector's exit probability	Panel estimation	0.129	—
ν_0	Pareto's location parameter	Calibrated	7.7	—
γ_f	Per-period fixed cost of operation (formal)	Calibrated	0.5	—
Second step				
α	Cobb-Douglas coefficient	Estimated	0.605	0.008
b_{f1}	Intensive mg. cost: skilled	Estimated	2.61	0.702
b_{f2}	Intensive mg. cost: unskilled	Estimated	4.94	0.864
b_i	Extensive mg. cost	Estimated	5.01	0.301
κ_i	Informal sector's exit probability	Estimated	0.381	0.040
γ_i	Per-period fixed cost of operation (informal)	Estimated	0.248	0.065
ξ	Pareto's shape parameter	Estimated	3.08	0.073
σ	Post-entry shock variance	Estimated	0.245	0.006
ρ	CES elasticity parameter	Estimated	0.290	0.097
η_I	Informal CES share parameter	Estimated	0.481	0.026
η_F	Formal CES share parameter	Estimated	0.593	0.015
E_f^{a}	Formal sector's entry cost	Estimated	4,286.2	502.1
E_i^{a}	Informal sector's entry cost	Estimated	2,023.4	353.9

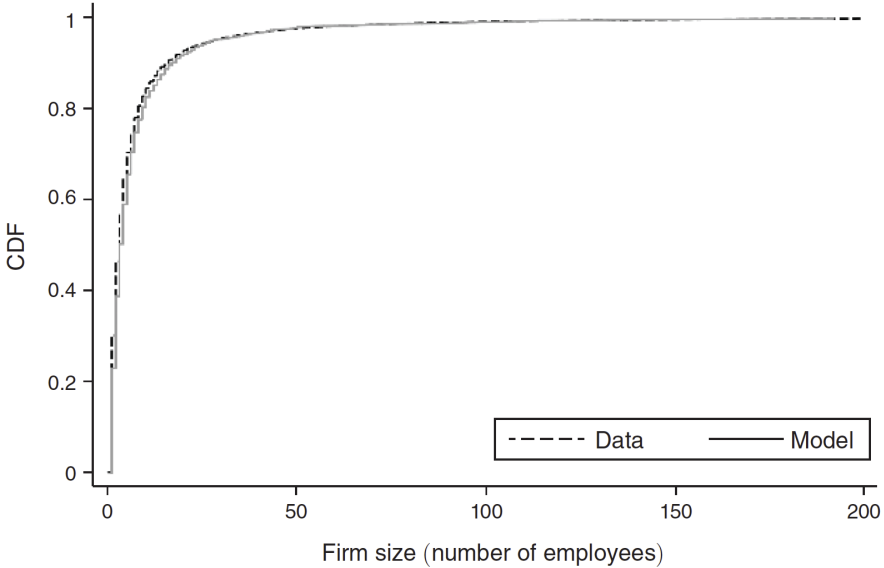
Note: Formal and informal sector's estimates and SE expressed in R$ of 2003.

Ulyssea (2018): Results: Model Fit

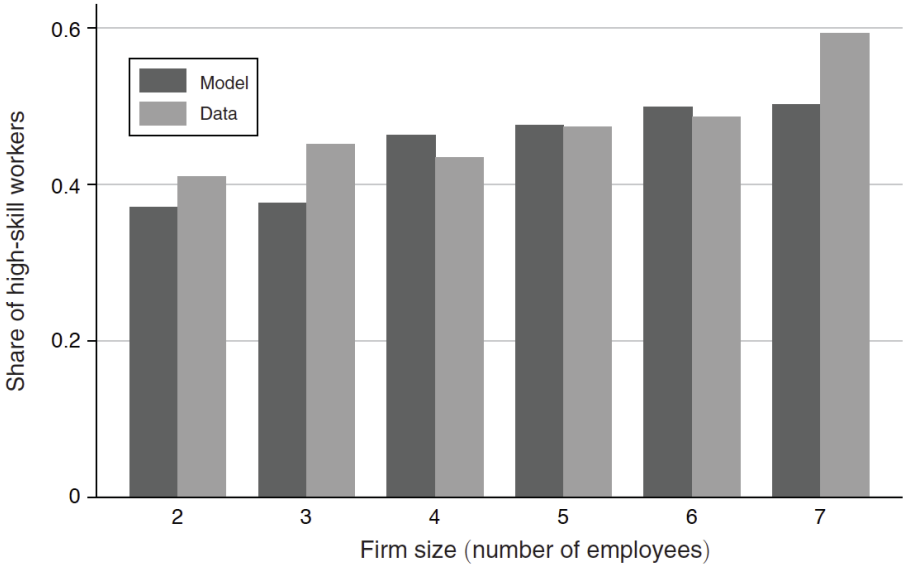
TABLE 4—MODEL FIT

Moments	Source	Model	Data
Share of informal workers			
All	PNAD	0.354	0.354
Low-skilled	PNAD	0.428	0.424
High-skilled	PNAD	0.269	0.260
Share of informal firms	ECINF + RAIS	0.687	0.698
Size distribution: informal firms			
$\leq$2 employees	ECINF	0.772	0.957
$\leq$5 employees	ECINF	0.996	0.998
Size distribution: formal firms			
$\leq$5 employees	RAIS	0.704	0.701
6–10 employees	RAIS	0.146	0.141
11–20 employees	RAIS	0.081	0.083
21–50 employees	RAIS	0.046	0.048
50+	RAIS	0.024	0.027

Ulyssea (2018): Results: Model Fit



Ulyssea (2018): Results: Model Fit



Ulyssea (2018): Results: Model Fit

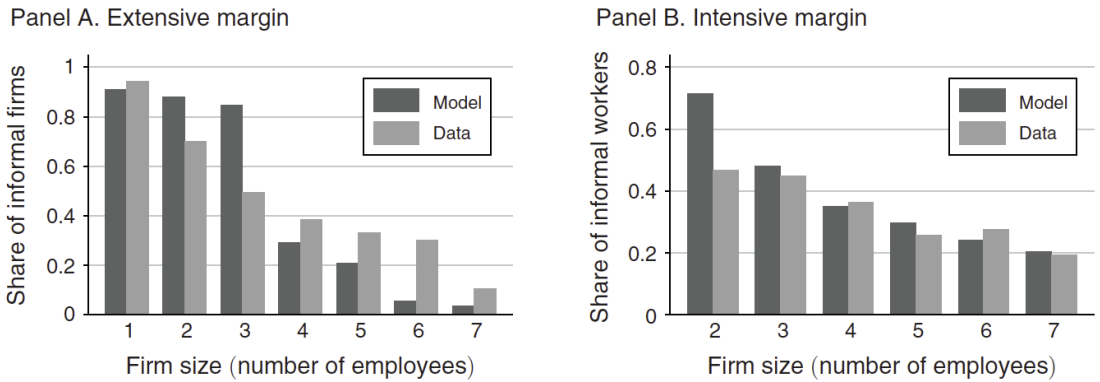


FIGURE 5. INFORMALITY MARGINS: DATA VERSUS MODEL

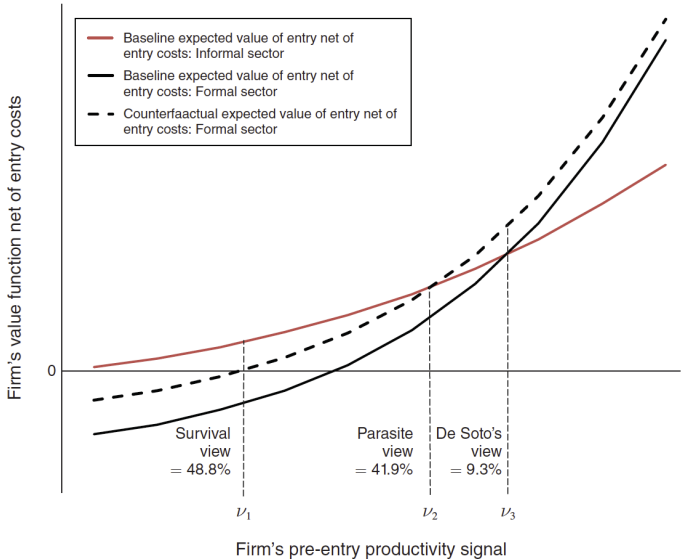
Ulyssea (2018): Counterfactuals

- Exercise 1: Quantify the diverging views on what informal firms are

1. *Survival view*: Firms too unproductive to ever be formal even with no costs of formality
2. *Parasite view:* Firms that could be formal but choose to be informal because it's more profitable
3. *De Soto's view:* Firms that would be formal if entry costs were low enough

- Thought experiment: What if we reduce entry costs into formality? set $E_f = E_i$
  - Type 3 firms would formalize
  - Type 2 firms remain informal
  - Type 1 firms exit
- Estimated model yields productivity signals v for each fir. Simulate counterfactual with $E_f = E_i$

Ulyssea (2018): Results



Outline

Outline

Best *et al.* (2015): Production Efficiency

- **Production Efficiency Theorem** (Diamond & Mirrlees 1971):
  Any second-best optimal tax system maintains production efficiency

- **Key policy implications**:
  - Permits taxes on consumption, wages and profits
  - Precludes taxes on inputs, turnover and trade

- The theorem has been influential in the policy advice given to developing countries

Best *et al.* (2015): Production Efficiency vs Revenue Efficiency

- Production Efficiency Theorem **assumes perfect tax enforcement**
  $\rightarrow$ Violated everywhere, but especially in developing countries

- **Tax evasion** introduces a trade-off between production and revenue efficiency in tax design

- In the context of firm taxation in Pakistan, we provide:
  - **Simple model** on the optimal production-revenue efficiency trade-off
  - **Quasi-experimental evidence** on the evasion elasticity w.r.t taxes
  - **Link model & evidence** to quantify optimal policy

Best *et al.* (2015): Novel Quasi-Experimental Approach

- **Minimum Tax Scheme:** firms taxed either on profits or turnover (lower rate on turnover) depending on which liability is larger
  - This production inefficient policy is motivated by tax compliance
- **Non-standard kink** where both tax rate and tax base jump
  - Kink changes real and evasion incentives differentially
  - Novel method for estimating tax evasion based on a bunching approach
- **Wide applicability** of our approach: such schemes are ubiquitous

Best *et al.* (2015): Firm Behavior: Real vs Evasion Responses

- Real output y, real cost $c(y)$, declared cost $\hat{c}$, penalty $g(\hat{c} - c(y))$
- Tax liability $T = \tau[y - \mu\hat{c}]$
- Maximization of after-tax profits

$$\begin{aligned} c'(y) &= 1 - \tau_E \\ g'(\hat{c} - c(y)) &= \tau\mu \end{aligned}$$

- **Effective Marginal Tax Rate** $\tau_E = \tau\frac{1-\mu}{1-\tau\mu}$:
  - $\tau_E = 0$ for a profit tax $\mu = 1$ [**production efficiency**]
  - $\tau_E = \tau$ for a turnover tax $\mu = 0$ [**production inefficiency**]

Best *et al.* (2015): Proposition [Production Inefficiency]

*With **perfect enforcement**, optimal tax base is pure profits* ($\mu = 1$)

*With **imperfect enforcement**, the optimal tax base is*

- *Between pure profits and turnover* ($0 < \mu < 1$)
- *Depends on the evasion-output elasticity ratio*

$$\underbrace{\frac{\tau}{1-\tau} \times \frac{\partial \tau_E}{\partial \tau}(\mu)}_{\text{effective wedge } (\downarrow \text{ in } \mu)} = \underbrace{G(\mu)}_{\text{tax gap } (\uparrow \text{ in } \mu)} \times \underbrace{\frac{\varepsilon_{\hat{c}-c}}{\varepsilon_y}}_{\text{elasticity ratio}}$$

Best *et al.* (2015): Partial Equilibrium: Intuition

$$\underbrace{\frac{\tau}{1-\tau} \times \frac{\partial \tau_E}{\partial \tau}(\mu)}_{\text{effective wedge } (\downarrow \text{ in } \mu)} = \underbrace{G(\mu)}_{\text{tax gap } (\uparrow \text{ in } \mu)} \times \underbrace{\frac{\varepsilon_{\hat{c}-c}}{\varepsilon_y}}_{\text{elasticity ratio}}$$

- Broader base (smaller μ) when:
  - $G(\mu)$ is higher: Evasion *level* is higher
  - $\varepsilon_{\hat{c}-c}/\varepsilon_y$ is higher: Evasion decisions relatively more responsive than production decisions.
- More generally, with two bases, one easier to evade than the other:
  - shift towards hard to evade base
  - go further from efficiency the bigger the problem is, and the more responsive evasion is to tax policy.
- $\Rightarrow$ have expressed optimal policy in terms of sufficient statistics $G(\mu)$ and $\varepsilon_{\hat{c}-c}/\varepsilon_y$ which we can, in principle, take to the data.

Best *et al.* (2015): Tax Policy in General Equilibrium

General equilibrium extension raises two additional considerations

1. **Cascading effect**: Distortions travel through production chain
2. **Incidence effect**: Price changes shift income between final and intermediate sectors

Simple 2-sector model:

- Intermediate sector A

$$y_A = l_A$$

- Final goods sector B

$$y_B = F(l_B, y_A)$$

Best *et al.* (2015): Firm Behavior

- Intermediates

$$p_A = w/(1-\tau_E)$$

***Incidence* effect**: τ_E distorts scale and income of sector A

- Final goods

$$\begin{aligned} w &= F'_{l_B} \times (1-\tau_E) = F'_{y_A} \times (1-\tau_E)^2 \\ \text{MRTS}_{l_B,y_A} &= F'_{l_B}/F'_{y_A} = 1-\tau_E \end{aligned}$$

***Cascading* effect**: y_A taxed twice $\Rightarrow$ τ_E distorts input mix in sector B

Best *et al.* (2015): Optimal Policy

*With **perfect enforcement**, optimal tax base is pure profits* ($\mu = 1$)

*With **imperfect enforcement**, the optimal tax base is interior* ($0 < \mu < 1$) and satisfies

$$\frac{\tau}{1-\tau} \times \frac{\partial \tau_E}{\partial \tau}(\mu) \times \left\{ \frac{\beta\left[1+\alpha(\mu)\right]}{1+(1-\beta)\,\varepsilon_{p_A}} \right\} = G(\mu) \times \frac{\varepsilon_{\hat{c}-c}}{\varepsilon_y}$$

$$\alpha = \frac{\text{MRTS}}{1+\text{MRTS} \times \left(\frac{\partial l_B}{\partial \tau_E} \Big/ \frac{\partial y_A}{\partial \tau_E} \right)} \qquad \beta = \frac{y_B}{p_A y_A + y_B} \qquad \varepsilon_{p_A} = \frac{\partial \log p_A}{\partial \log \tau_E}$$

Best *et al.* (2015): Optimal Policy

*With **imperfect enforcement**, the optimal tax base is interior* $(0 < \mu < 1)$ and satisfies

$$\frac{\tau}{1-\tau} \times \frac{\partial \tau_E}{\partial \tau}(\mu) \times \left\{ \frac{\beta\left[1+\alpha(\mu)\right]}{1+(1-\beta)\,\varepsilon_{p_A}} \right\} = G(\mu) \times \frac{\varepsilon_{\hat{c}-c}}{\varepsilon_y}$$

$$\alpha = \frac{\text{MRTS}}{1+\text{MRTS} \times \left(\frac{\partial l_B}{\partial \tau_E} / \frac{\partial y_A}{\partial \tau_E} \right)} \qquad \beta = \frac{y_B}{p_A y_A + y_B} \qquad \varepsilon_{p_A} = \frac{\partial \log p_A}{\partial \log \tau_E}$$

- partial equilibrium analysis $\Rightarrow$ smaller μ (broader base) if
  - α large: l_B & y_A highly substitutable
  - β large: final goods large part of economy

Best *et al.* (2015): Minimum Tax Scheme

- Combination of profit tax ($\mu = 1$) and turnover tax ($\mu = 0$):

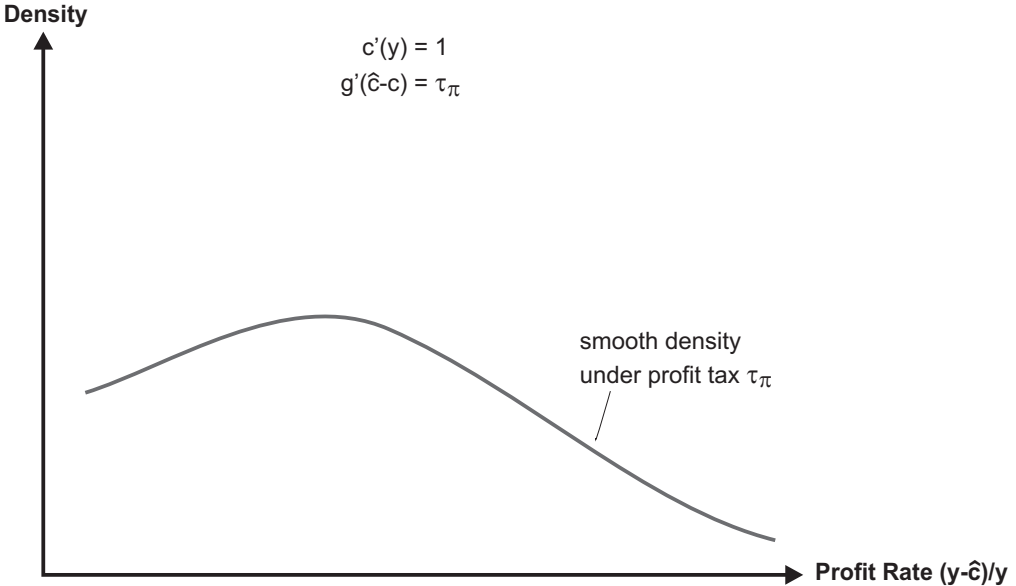
$$T = \max\left\{\tau_\pi\left(y - c\right); \tau_y y\right\}.$$

- Firms switch between the two taxes depending on profit rate $\hat{\pi}$:

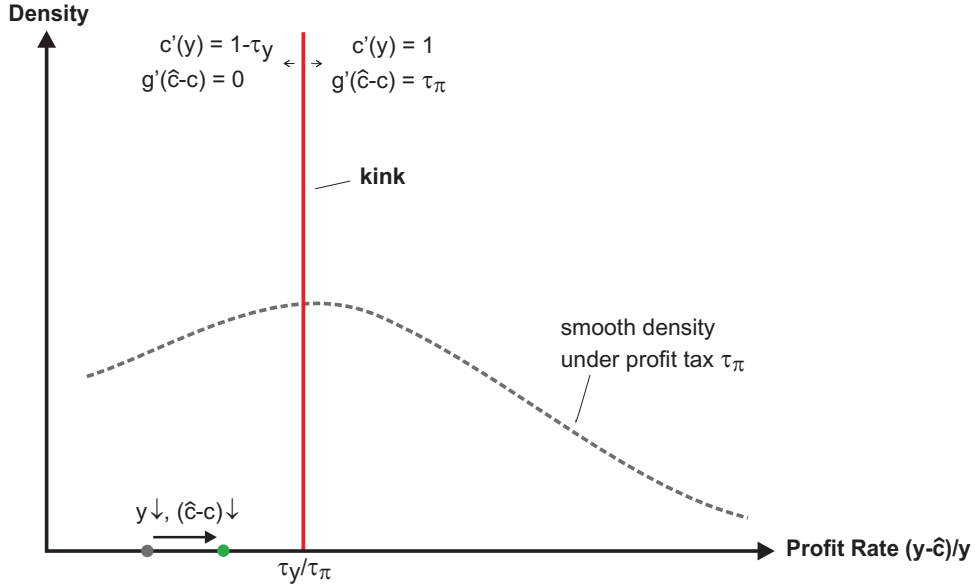
$$\tau_\pi\left(y - c\right) = \tau_y y \quad \Leftrightarrow \quad \hat{\pi} \equiv \frac{y - c}{y} = \frac{\tau_y}{\tau_\pi}.$$

- **Kink: tax base and marginal tax rate change discontinuously, but tax liability is continuous**

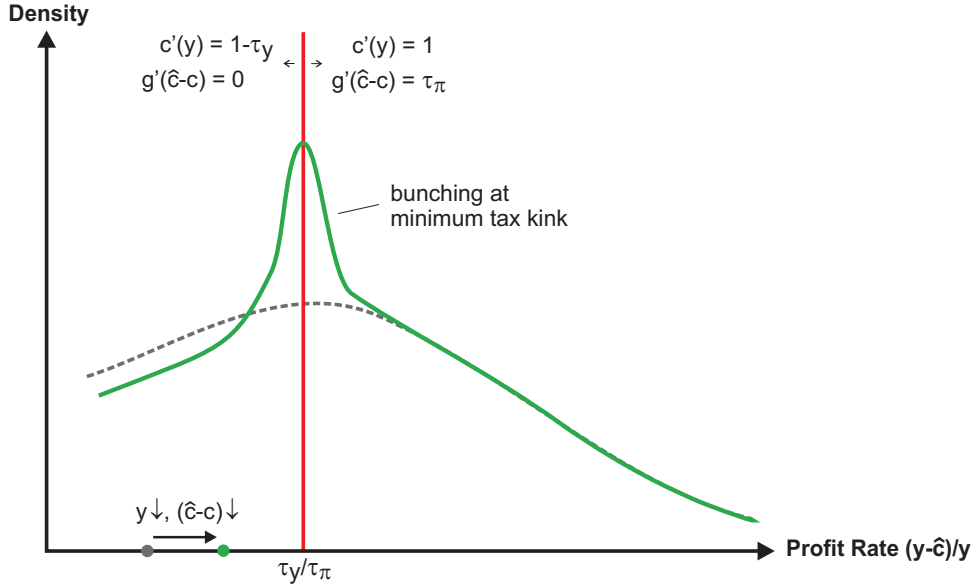
Best *et al.* (2015): Bunching at the Minimum Tax Kink



Best *et al.* (2015): Bunching at the Minimum Tax Kink



Best *et al.* (2015): Bunching at the Minimum Tax Kink



Best *et al.* (2015): Minimum Tax Kink Ideal for Eliciting Evasion

- **Real output response:**
  - Firms choose real output based on $1 - \tau_E$
  - At the kink, production wedge τ_E changes from 0 to τ_y (≈ 0)
    $\Rightarrow$ almost no variation and therefore small real response
- **Evasion response:**
  - Firms choose evasion based on $\tau\mu$
  - At the kink, $\tau\mu$ changes from τ_π $(\gg 0)$ to 0
    $\Rightarrow$ large variation and therefore large evasion response
- **Bunching B identifies (mostly) evasion:**

$$B \propto \frac{\tau_y^2}{\tau_\pi}\varepsilon_y - \frac{\Delta\left(\hat{c} - c\right)}{y}$$

Best *et al.* (2015): Data

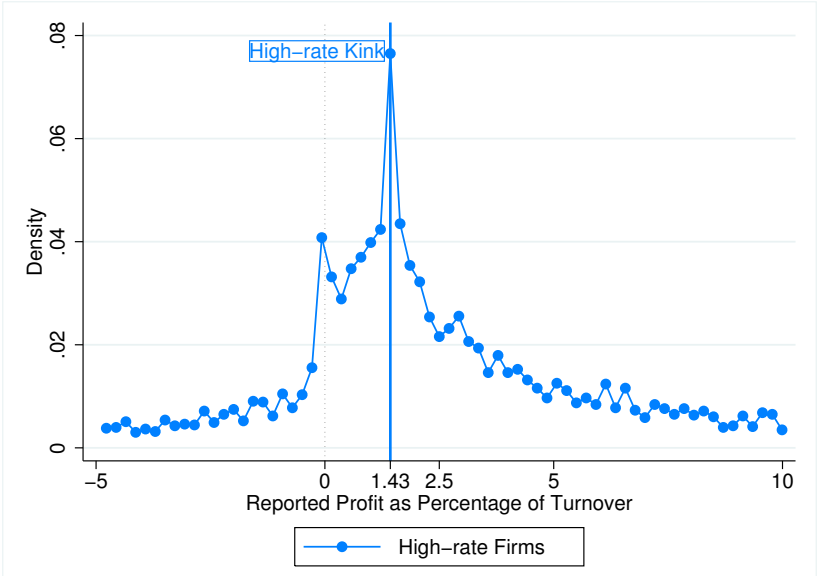
- Administrative data from FBR Pakistan
- All corporate tax returns from 2006-2010 ($\sim$15,000 returns/year)
- New electronic data collection system in place for this time period
- In each year, about half of the firms are turnover tax payers and half of them are profit tax payers

Best *et al.* (2015): Variation in Minimum Tax Kink

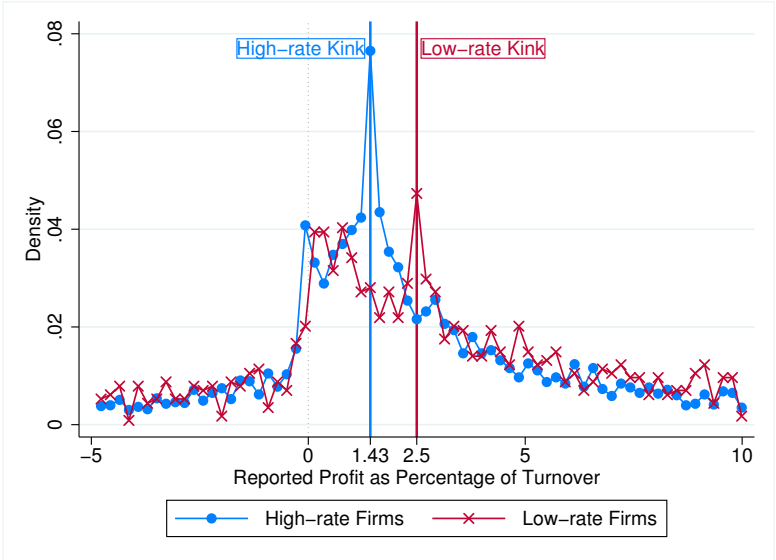
- **Variation in profit tax rate τ_π across firms:**
  - High rate of 35%, low rate of 20%
    [depends on incorporation date, turnover, assets, #employees]

- **Variation in turnover tax rate τ_y over time:**
  - 2006-07: tax rate of 0.5%
  - 2008: turnover tax scheme withdrawn
  - 2009: tax rate of 0.5%
  - 2010: tax rate of 1%

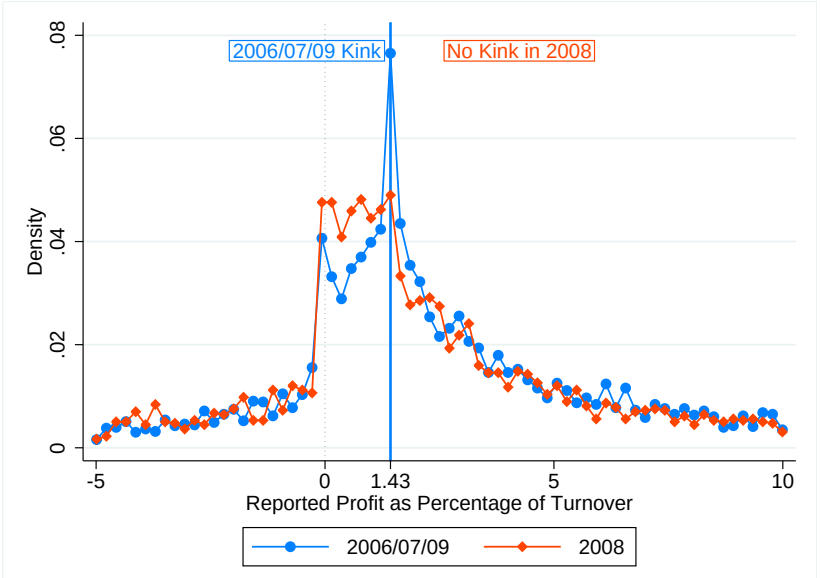
Best *et al.* (2015): Bunching Evidence



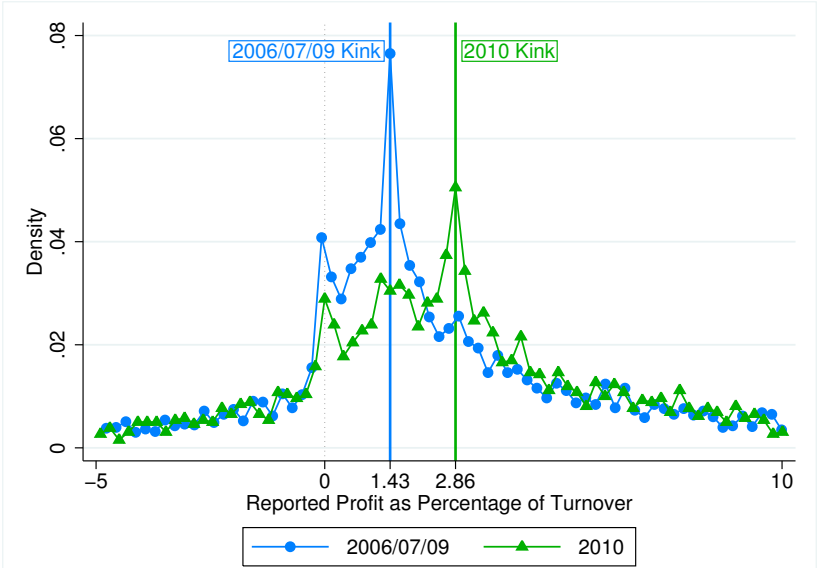
Best *et al.* (2015): Bunching Evidence



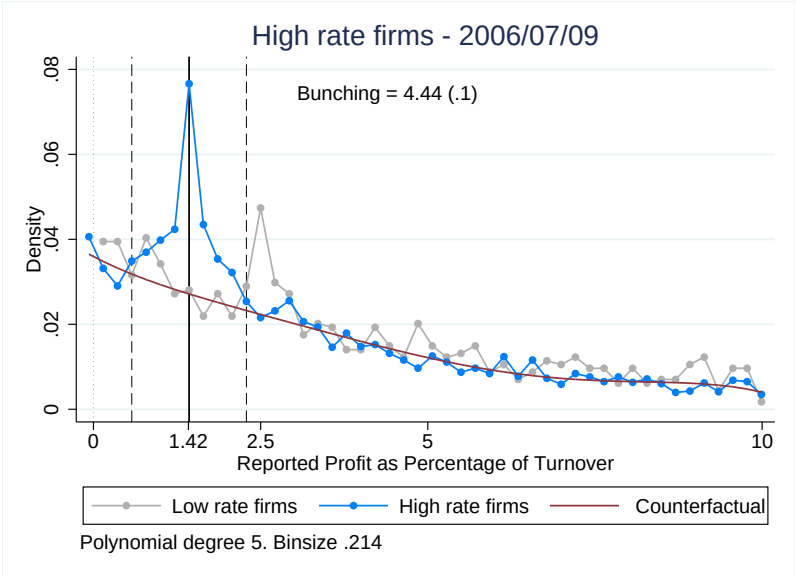
Best *et al.* (2015): Bunching Evidence



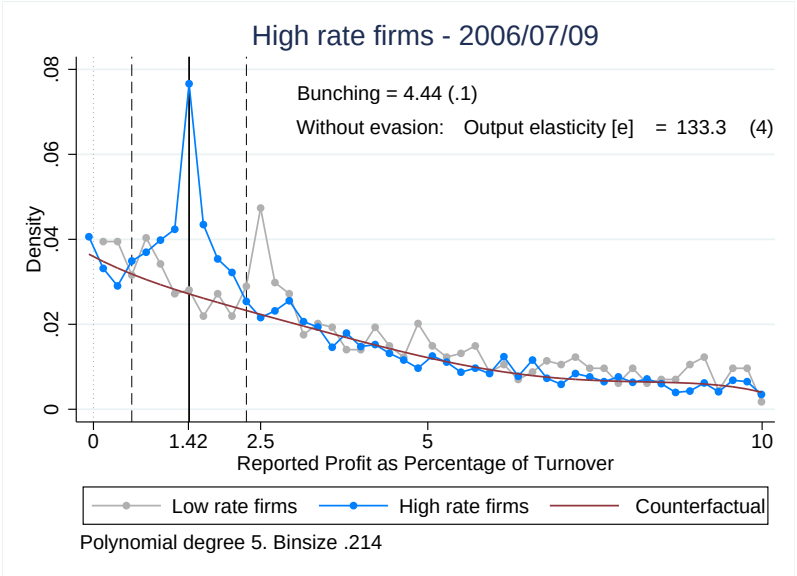
Best *et al.* (2015): Bunching Evidence



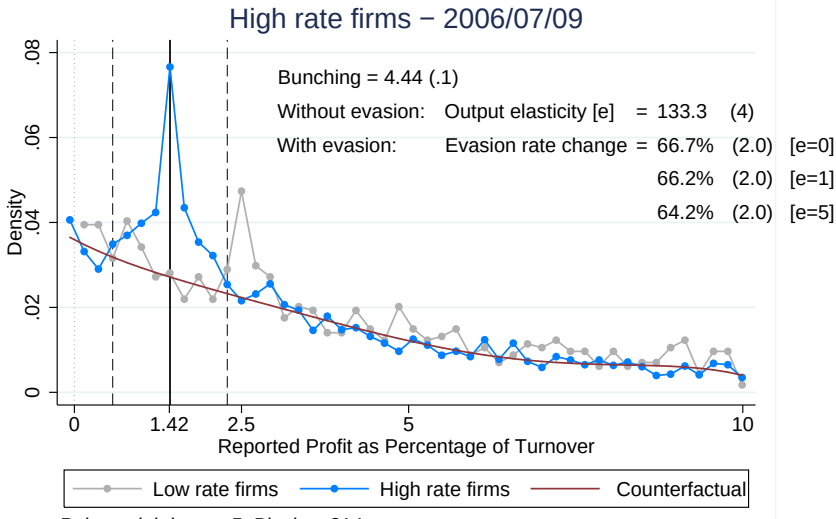
Best *et al.* (2015): Estimating Evasion



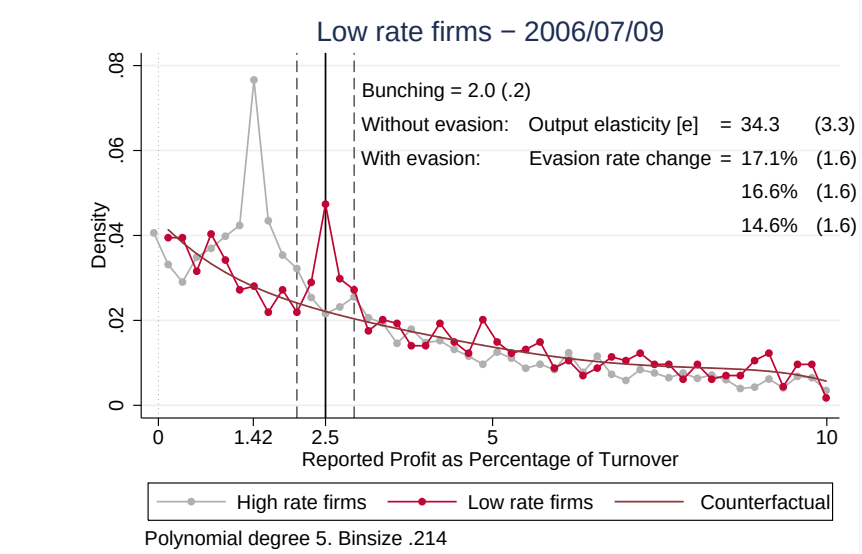
Best *et al.* (2015): Estimating Evasion



Best *et al.* (2015): Estimating Evasion



Best *et al.* (2015): Estimating Evasion



Best *et al.* (2015): Robustness

- **Distortionary profit tax**
  - If $\tau_E > 0$ under profit tax, then turnover tax may improve real incentives

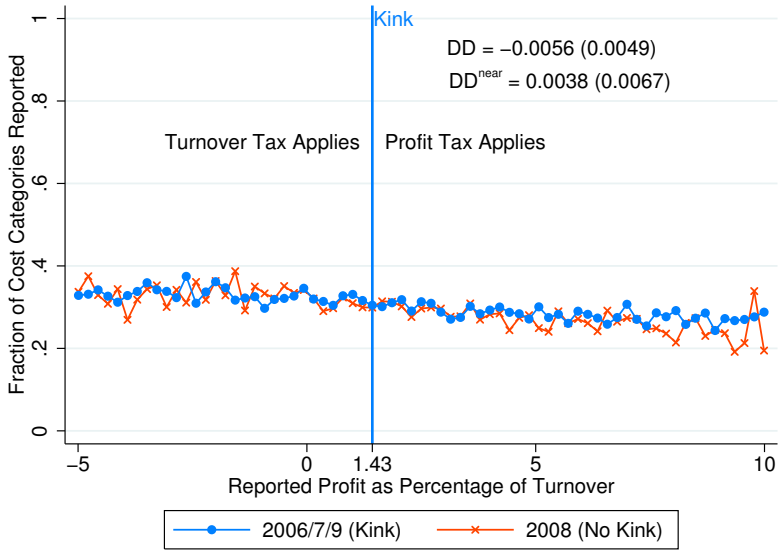
    $\Rightarrow$ firms move away from the kink and **create a hole**
- **Output evasion**
  - If firms can underreport output, the turnover tax reduces output evasion (due to $\tau_y < \tau_\pi$) in addition to cost evasion

    $\Rightarrow$ bunching identifies **combined output and cost evasion**
- **Filing Costs (Lazy Reporting)**
  - If adding line items to return involves a fixed cost, then underreport costs under turnover tax

    $\Rightarrow$ bunching **conflates evasion and filing responses**

    $\Rightarrow$ kink should affect **number of items reported**

Best *et al.* (2015): Testing for Lazy Reporting



Best *et al.* (2015): Numerical Analysis: Methodology

- Welfare increased by broader base and lower rate $(\mu \downarrow, \tau \downarrow)$ if

$$\frac{\tau}{1-\tau} \cdot \frac{\partial \tau_E}{\partial \tau}(\mu) < G(\mu) \cdot \frac{\varepsilon_{\hat{c}-c}}{\varepsilon_y} \simeq -\frac{d(\hat{c}-c)}{\Pi} / \varepsilon_y$$

- lhs $\in [0, 0.54]$. Estimate rhs $\simeq 1.22$
  $\Rightarrow$ welfare gains from broadening base

- Evaluate welfare gains of moving from pure profit tax to pure turnover tax holding aggregate profits fixed
  - Assume iso-elastic production function and evasion cost function
  - Calibrate to match empirical distributions of turnover, costs and evasion rate responses

Best *et al.* (2015): Simulation Results

	Panel A: Pure Turnover Tax			Panel B: Optimal Tax		
Output Elasticity (ε_y)	**Revenue Gain** (%)	**Tax Base** (μ)	**Tax Rate** (τ)	**Revenue Gain** (%)	**Tax Base** (μ)	**Tax Rate** (τ)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0.5	74	0	0.005	76	0.522	0.009
1	73	0	0.005	76	0.706	0.015
5	70	0	0.005	75	0.889	0.037
10	66	0	0.005	75	0.944	0.067
30	62	0	0.005	77	0.986	0.170

Outline

Basri et al (2020): Overview

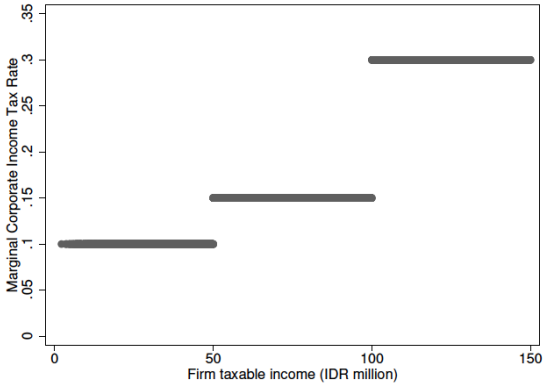
- Motivation
  - We've seen several papers now on how to use enforcement techniques to improve compliance and raise revenue
  - We also saw one paper (Best et al. 2015) on how to use policy design (bases, rates) to improve compliance and raise revenue
  - Say that you have to choose between improving tax administration and improving tax compliance. How should you think about the tradeoff between the two?
- This paper:
  - Apply Keen & Slemrod (2017) framework to Indonesia
  - Leverage quasi-experimental variation from admin reform and from tax rate reform to estimate key elasticities
  - Plug elasticities into the sufficient statistics framework to quantify tradeoffs

Basri et al (2020): Context

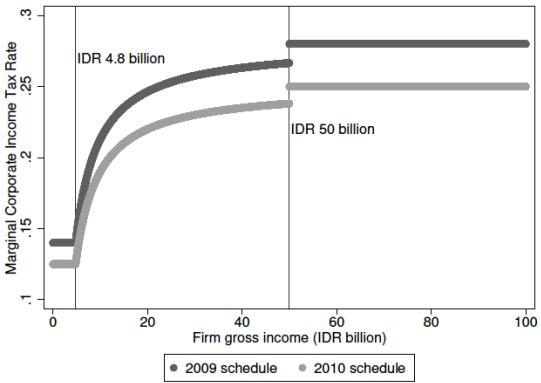
- Study corporate income tax administered by Directorate General of Taxation (DGT)
- Big administrative reforms started in 2002
  1. largest 200 firms' admin moved to centralized Large Taxpayer Office (LTO) in Jakarta. Several hundred taxpayers in each region $\rightarrow$ handled by Medium Taxpayer Offices (MTOs). Focus on big wave of MTOs created in 2007.
  2. Offices restructured. pre-reform offices organized by tax type. Post-reform each taxpayer assigned to an office and a single contact person.
- Corporate income tax rate reform in 2009. Pre-reform there was a progressive tax with MTR increasing in taxable profit. Post-reform tax schedule depends on gross income, and rate is flat with discounts:

Basri et al (2020): Tax Reform

Panel A: Tax schedule prior to 2009
(Marginal tax rates vs. taxable income)



Panel B: Tax schedule 2009 and later
(Marginal tax rates vs. gross income)



Basri et al (2020): Model

- Firm has a continuum of "business lines" indexed from $[0, L]$.
- Line l provides revenue y_l and has convex cost $c(y_l)$. Lines are symmetric with output price normalized to 1. Profits from line l are $\pi(y_l) = y_l - c(y_l)$. $\Rightarrow$ with no taxes $c'(y_l) = 1$ for all lines.
- Assume only a proportion $0 < \mu < 1$ of costs are deductible. Firms pay tax τ on sales minus deductible profits. For lines on which tax is paid, the firm solves

$$\max_{y_l} (1-\tau) y_l - (1-\tau\mu) c(y_l)$$

- At its optimum the firm sets

$$c'(y^p) = 1 - \tau^E \quad \text{where } \tau^E \equiv \frac{\tau(1-\mu)}{1-\tau\mu}$$

Basri et al (2020): Model

- Firms can evade by hiding some business lines. Hiding line l costs $\alpha b\left(y_l\right) h\left(l\right)$.
- Lines are implicitly ordered by evasion: $h'\left(l\right) > 0$. Assume $h'\left(0\right) = 0$ so all firms evade a little,
- $b\left(\cdot\right)$ assumed increasing and convex: bigger lines more easily detectable, harder to evade.
- α captures level of enforcement (policy parameter govt can choose)
- If line l hidden, output solves

$$\max_{y_l} y_l - c\left(y_l\right) - \alpha b\left(y_l\right) h\left(l\right) \quad \Rightarrow c'\left(y^e\right) = 1 - \alpha b'\left(y^e\right) h\left(l\right)$$

- Firms hide all lines up to l^* satisfying

$$y^e\left(\alpha\right) - c\left(y^e\left(\alpha\right)\right) - \alpha b\left(y^e\left(\alpha\right)\right) h\left(l^*\right) = \left(1-\tau\right) y^p - \left(1-\tau\mu\right) c\left(y^p\right)$$

- Tax collected from the firm is $\tau z = \tau \int_{l^*}^{L} y_l^p - \mu c\left(y_l^p\right) dl$

Basri et al (2020): Changing Enforcement and Taxes

- Increasing enforcement α: Evasion costs go up making evasion less attractive. But if continue to evade, output declines. $\Rightarrow$ output goes down on evaded lines, but firms evade on fewer lines.
- The marginal lines that firms stop evading $\Rightarrow$ reported revenues y and costs c *both* increase.
- Effect on real activity ambiguous: Switching to formality removes "enforcement tax" $\alpha b'(y)\, h(l^*)$ but replaces it with effective formal tax τ^E. Real output increases iff

$$\alpha b'(y)\, h(l^*) > \tau \frac{1-\mu}{1-\tau\mu}$$

- Increasing the tax rate:
  - dcreases activity on formal lines when $\mu < 1$ (standard discouragement effect)
  - increases evasion (MB of evasion ↑)

Basri et al (2020): Welfare

- Social welfare is

$$W = \underbrace{\int_{l^*}^{L} \left(y_l^p - c\left(y_l^p\right)\right) dl - \tau z}_{\text{firm post-rax profits from taxed lines}} + \underbrace{\int_0^{l^*} y_l^e\left(\alpha\right) - c\left(y_l^e\left(\alpha\right)\right) - \alpha b\left(y_l^e\left(\alpha\right)\right) h\left(l\right) dl}_{\text{firm post-tax profits from evaded lines}}$$
$$+ \underbrace{v\left(\tau z - a\left(\alpha\right)\right)}_{\text{social value of public funds}}$$

- How does marginal change in enforcement α affect welfare? Using envelope theorem

$$W_\alpha = -\frac{d\gamma}{d\alpha} + v\left(\tau\frac{dz}{d\alpha} - \frac{da}{d\alpha}\right)$$

where $\gamma \equiv \int_0^{l^*} \alpha b\left(y_l^e\left(\alpha\right)\right) h\left(l\right) dl$ is private compliance cost.

- Similarly

$$W_\tau = -z + v\left(z + \tau\frac{dz}{d\tau}\right) = -z + vz\left(1 - \frac{\tau}{1-\tau}\varepsilon_{1-\tau}\right)$$

Basri et al (2020): Welfare

- We want to compare these welfare effects. Consider a thought experiment in which we a) increase enforcement by $d\alpha$, and b) reduce tax rates by exactly the right amount $\frac{d\tau}{d\alpha}\big|_R$ to keep revenue $R = \tau z - a(\alpha)$ the same. Does this improve welfare?
- The revenue neutral reform is:

$$\left.\frac{d\tau}{d\alpha}\right|_R = -\frac{dR/d\alpha}{dR/d\tau} = -\frac{\tau\frac{dz}{d\alpha} - \frac{da}{d\alpha}}{z\left(1 - \frac{\tau}{1-\tau}\varepsilon_{1-\tau}\right)}$$

- And the welfare effect is

$$\begin{aligned} dW &= W_\tau \left.\frac{d\tau}{d\alpha}\right|_R + W_\alpha \\ &= \left(\tau\frac{dz}{d\alpha} - \frac{da}{d\alpha}\right)\frac{1}{1 - \frac{\tau}{1-\tau}\varepsilon_{1-\tau}} - \frac{d\gamma}{d\alpha} \end{aligned}$$

Basri et al (2020): Size-Dependent Enforcement

- Suppose level of enforcement depends on firm size? Then evasion cost could be written as

$$\alpha m\left(z\right) b'\left(y\right) h\left(l\right)$$

with $m' > 0$

- Now firms evade up until

$$\underbrace{y_l^e\left(\alpha\right) - c\left(y_l^e\left(\alpha\right)\right) - \alpha m\left(z\right) b\left(y_l^e\left(\alpha\right)\right) h\left(l^*\right)}_{\text{profit from evading on marginal line}} = \underbrace{\left(1-\tau\right) y^p - \left(1-\tau\mu\right) c\left(y^p\right)}_{\text{profit from not evading on marginal line}}$$

$$\underbrace{- m'\left(z\right)\left(y^p - \mu c\left(y^p\right)\right) \int_0^{l^*} \alpha b\left(y_l^e\left(\alpha\right)\right) h\left(l\right) dl}_{\text{loss from higher evasion costs on evaded lines}}$$

Basri et al (2020): Effects of enforcement

- Study effect on firms of being put into the MTO in 2007
- Empirical strategy is a matched difference in differences. Use entropy balancing (Hainmueller 2012) to find weights for control firms that pre-treatment characteristics match the treatment firms.
- Match on 2005 gross income and taxes paid.
- Reduced form:

$$Y_{it} = \alpha + \beta^{RF} \left(M_{iFC} \times 1_{t>2005} \right) + \delta_t + \delta_i + \epsilon_{it}$$

where M_{iFC} is a dummy for being in the first wave of MTO, δ_t, δ_i are year, firm FEs.

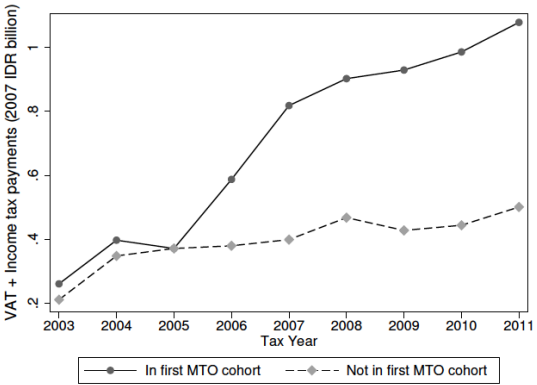
- Several firms assigned to MTO in 2009 so also estimate IV:

$$Y_{it} = \alpha + \beta^{IV} M_{it} + \delta_t + \delta_i + \epsilon_{it}$$

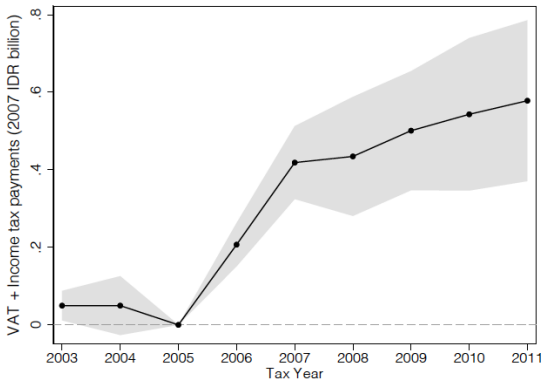
where instrument for actual MTO status M_{it} with $M_{iFC} \times 1_{t>2005}$

Basri et al (2020): Enforcement Effects

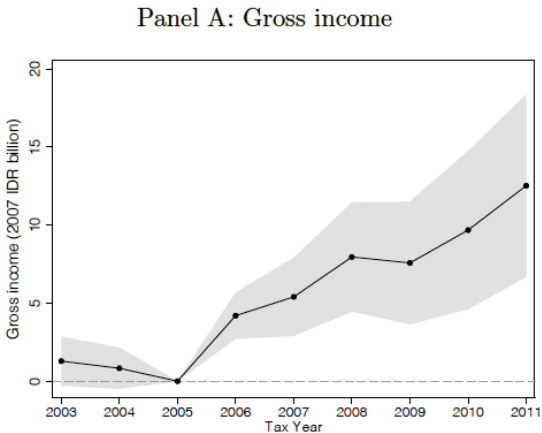
Panel A: MTO vs. non-MTO weighted annual averages

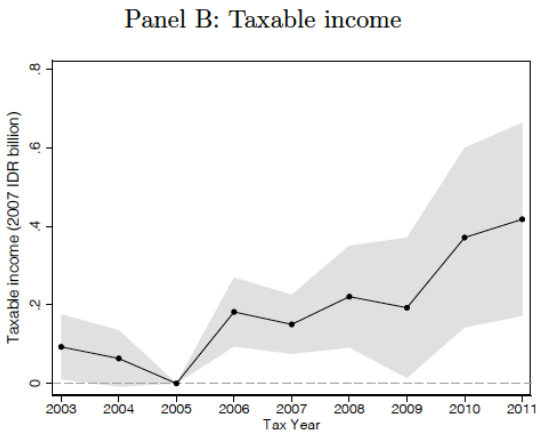


Panel B: Year-by-year estimates

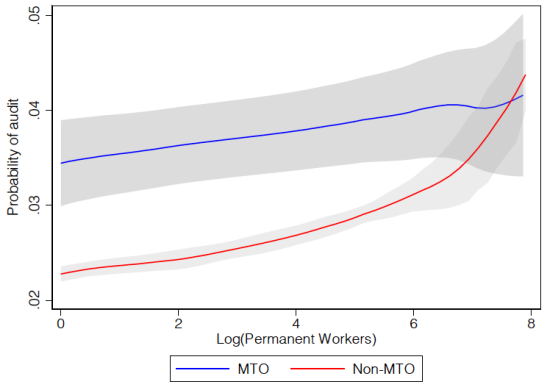


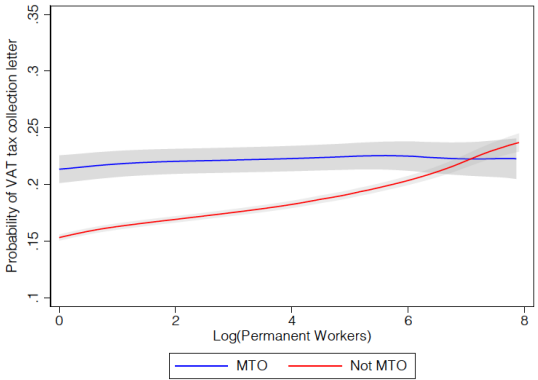
Basri et al (2020): Enforcement Effects





Basri et al (2020): Enforcement Effects





Basri et al (2020): Tax Reform

- Follow simulated instrument approach as in Gruber & Saez (2002), Gruber & Rauh (2007).

$$\ln\left(\frac{z_{it+1}}{z_{it}}\right) = \alpha + \varepsilon \ln\left(\frac{1-\tau_{it+1}}{1-\tau_{it}}\right) + \psi_1 \ln z_{it} + \psi_2 \ln g_{it} + \delta_t + \delta_i + \nu_{it}$$

  where z_{it} is (reported) taxable income, g_{it} is reported gross income, τ_{it} is statutory marginal tax rate
- Instrument for $\ln\left(\left(1-\tau_{it+1}\right)/\left(1-\tau_{it}\right)\right)$ by computing pre-(t) and post-(t+1) tax rates using 2008 values of g_{i2008} and z_{i2008} to create $\ln\left(\left(1-\tau^C_{it+1}\right)/\left(1-\tau^C_{it}\right)\right)$. First stage is

$$\ln\left(\frac{1-\tau_{it+1}}{1-\tau_{it}}\right) = \alpha + \omega \ln\left(\frac{1-\tau^C_{it+1}}{1-\tau^C_{it}}\right) + \theta_1 \ln z_{it} + \theta_2 \ln g_{it} + \delta_t + \delta_i + \nu_{it}$$

- Use the same sample and balancing weights as for MTO for comparability of results.

Basri et al (2020): Tax Reform Results

	Instrument: Reform-induced change in marginal tax rate		
		Separate by MTO status	
	All taxpayers	MTO	Not MTO
	(1)	(2)	(3)
Panel A: First Stage			
Endogenous:	0.980	0.981	0.982
Δ Ln(Net-of-tax rate)	(0.010)	(0.018)	(0.010)
F-statistic	3,629.32	1,112.23	3,250.73
N	16,021	1,050	14,971
Panel B: IV (ETI estimates)			
Outcome:	0.590	0.348	0.779
Δ Ln(Taxable Income)	(0.198)	(0.379)	(0.216)
P-value of difference		0.322	
Taxpayer FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes

Basri et al (2020): Comparison of Enforcement and Rates

- Modify the welfare effect of the revenue neutral reform to reflect the fact that the tax rate reform applies to the top tax bracket only

$$dW = \left(\tau \frac{dz}{d\alpha} - \frac{da}{d\alpha}\right) \frac{1}{1 - \frac{\tau}{1-\tau}\rho\varepsilon_{1-\tau}} - \frac{d\gamma}{d\alpha}$$

- Taxable income elasticity implies $1/\left(1 - \frac{\tau}{1-\tau}\rho\hat{\varepsilon}_{1-\tau}\right) = 1.51$
- net revenue effect $\tau\frac{dz}{d\alpha} - \frac{da}{d\alpha}$ is 2 orders of magniture larger than $da/d\alpha$.
- Suggests $d\gamma/d\alpha$ would need to be massive for $dW < 0$. Surveys suggest $d\gamma/d\alpha$ may well have been negative.

Outline